



The Geology of Yemen: An Annotated Bibliography of Yemen's Geology, Geography and Earth Science.

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 A bibliography on Yemen prepared by the Army Geospatial Center (AGC) to assist the US government in understanding the geological and hydrological problems of this country, by identifying citations on geography, topography, transportation, water, medical concerns, and security.

15. SUBJECT TERMS: Yemen. Climate. Earth Sciences. Geology. Geography. Groundwater. Hydrology. Maps. Meteorology. Mining. Soils. Surface-water. Transportation. Water. Yemen.

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Preface

Special thanks and recognition are given to the people outside of the Army Geospatial Center who have helped or assisted in this project.

Ms. Veronica T. Calvo of the National Science Foundation (NSF) kindly helped with the editing and the proofing of the text.

Mr. Issam Saliba, Senior Foreign Law Specialist of the Global Legal Research Center of the Law Library of Congress was especially helpful in providing information and insight to the water laws of Yemen.

Thanks also to the public services staff of the Defense Technical Information Center (DTIC) who responded so quickly to our requests, and who bent over backwards to make their information available online to the public (<http://www.dtic.mil>).

Special thanks are also given to the Reference Staff of the Geography and Map Division, The Library of Congress (<http://www.loc.gov/rr/geogmap/>) and also to the African & Middle Eastern Reading Room (<http://www.loc.gov/rr/amed/>).

The Reference Staff of the US Geological Survey Library replied promptly to our requests and made their services so accessible (<http://library.usgs.gov/>).

Finally, special thanks are also given to RefWorks for the use of their services in putting together and updating the bibliography of citations, abstracts and maps from so many different electronic and printed resources so quickly (www.RefWorks.com).

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Similar earth science bibliographies of countries have been produced by Geospatial Information Library (GIL) of the US Army Geospatial Center previously. They are:

Afghanistan:

Hadden, Robert Lee. 2005. "Adits, Caves, Karizi-Qanats, and Tunnels in Afghanistan: An Annotated Bibliography." Alexandria, VA. US Army Corps of Engineers. Topographic Engineering Center (now the US Army Geospatial Center). Defense Technical Information Center (DTIC) Number: ADA444101. URL: <http://handle.dtic.mil/100.2/ADA444101>.

Burma:

Hadden, Robert Lee. 2008. The Geology of Burma (Myanmar): An Annotated Bibliography of Burma's Geology, Geography and Earth Science. GEOSPATIAL INFORMATION LIBRARY (GIL), Topographic Engineering Center, Engineer Research and Development Center (ERDC), US Army Corps of Engineers, ALEXANDRIA VA. A bibliography on Burma prepared by the Topographic Engineering Center (TEC) to assist with humanitarian efforts offered by the US Government after the devastating Cyclone Nargis hit Burma on May 2, 2008. As such, this bibliography covers items of interest to disaster engineers and emergency planners, including citations on topography, transportation, water, medical concerns, and security. See the site at: <http://handle.dtic.mil/100.2/ADA487552>

Guadalcanal:

Hadden, Robert Lee. 2009. "The Geology of Guadalcanal: a Selected Bibliography of the Geology, Natural History, and the History of Guadalcanal." Alexandria, VA: Topographic Engineering Center. This bibliography on the geographical, water and geological information of Guadalcanal was begun to fill a request for current information needed for the forensics recovery of the bodies of the US Marines of the Lt Col. Frank B. Goettge Reconnaissance patrol that was ambushed in August 1942.

Part I of this report is a bibliography of the geology, geography and natural history of the island.

Part II is a bibliography on the history of the island, including accounts of the Battle of Guadalcanal. This bibliography brings together selected citations from a variety of different cartographic, geographical, geological and hydrological resources and a number of specialized library collections. Most of the citations have location information on where these items can be located and either used on site, or borrowed through inter-library loan, or where copies of the items can be purchased from the originating source, or through commercial document delivery services. See: <http://handle.dtic.mil/100.2/ADA472656>

Haiti:

Hadden, Robert Lee and Minson, Steven G. "The Geology of Haiti: An Annotated Bibliography of Haiti's Geology, Geography and Earth Science." US Army Corps of Engineers, Army Geospatial Center, 7701 Telegraph Road, Alexandria, VA 22315. A bibliography on Haiti prepared by the Army Geospatial Center (AGC) to assist with humanitarian efforts offered by the US Government and the Corps of Engineers after the devastating earthquake hit Haiti on January, 2010. As such, this bibliography covers items of interest to disaster engineers and emergency planners, including citations on geology and geography, topography, transportation, water, medical concerns, and security. URL: <http://handle.dtic.mil/100.2/ADA528274>

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Liberia:

Hadden, Robert Lee. 2006. "The Geology of Liberia: a Selected Bibliography of Liberian Geology, Geography and Earth Science" Originally prepared by the US Geological Survey Library staff as part of an US Department of State project to restore the Geological Library of Liberia, 1998-1999. Revised and Updated through 2006. Defense Technical Information Center. See: <http://handle.dtic.mil/100.2/ADA451649>.

Somalia:

Hadden, Robert Lee. 2006. "The Geology of Somalia: A Selected Bibliography of Somalian Geology, Geography and Earth Science." Engineer Research and Development Laboratories, Topographic Engineering Center, Alexandria, VA. DTIC Report # ADA 464006 found at: <http://handle.dtic.mil/100.2/ADA464006>

Syria:

Hadden, Robert Lee. 2005. "Syria: A Selected Bibliography of Earth Science and Hydrologic References." Abstract: This bibliography on the water and geological information of Syria was begun in 2002. It brings together selected citations from a variety of different cartographic, geological and hydrological resources and specialized library collections. Resources cover publications, reports and maps in English, Arabic, French, German, Hebrew, Russian and other languages taken from a variety of government or private library and geological information centers. Most of the citations have location information describing where these items can be located and either borrowed through inter-library loan or purchased through commercial document delivery services. Distribution authorized to U.S. Gov't. agencies only; Administrative/Operational Use; 11 JUL 2005. Other requests shall be referred to U.S. Army Corps of Engineers, Topographic Engineering Center, Attn: CEERD-TO-I, 7701 Telegraph Rd., Alexandria, VA 22315-3864.

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Bibliography and Sources of Citations

This bibliography on the geology, geography and earth sciences of Yemen was gathered from a variety of different abstracting, bibliographical and cartographical resources. They include numerous citations from agriculture, botany, engineering, geology, geography, medical, military science, soils, transportation and other subject resources. These citation resources are provided by a number of scientific societies, such as the American Geographical Society; from government resources, such as the Defense Technical Information Center (DTIC); non-governmental organizations such as the United Nation's Food and Agricultural Organization (FAO) Library in Rome; and from such commercial databanks such as GeoRef, WorldCat and GeoBase. Many unique citations were collected from the catalogs and resources of major research libraries, such as the Library of Congress and the US Geological Survey Library.

Within this bibliography, the article retrieval information is given as much as possible. These include specific ISSN, ISBN, OCLC and Library of Congress numbers that allow the electronic borrowing or copying of these items through library networks. Alternately, the citations also include information on acquiring these items through document delivery companies and commercial services. Very often, scientific publications in less developed countries are not published in large numbers, and it is very difficult to retrieve reports or maps more than even a few years old. This bibliography is intended to be a resource for those scientific citations on Yemen that can still be retrieved.

Within these citations are many variations in spelling and place names. Many scientific and cartographic investigations were done in various local languages, and the languages of neighboring countries. Thus, the same name may be spelled differently according to the language(s) used. Variations on single and doubled consonants (geminated consonants) and single and doubled vowels (diphthongs) are common.

Many cities and geographic place names have variations on their spelling in western alphabets. So any search for authors, place names and locations in this bibliography should take into account differences in spelling variations.

Abbreviations and links to resources used:

(All links and URLs in this bibliography are current as of December 2011)

AGI: American Geological Institute, Alexandria, VA. See: www.agiweb.org. The AGI also has a document delivery service. They say, "When you see a document or map cited in the GeoRef database you can simply order a copy from the GeoRef Document Delivery Service. We provide copies of earth-science documents available in the U.S. Geological Survey Library in Reston, VA, the Library of Congress, the AGI Library, and through an international network of exchange partners including organizations in Germany, China, and the Russian Federation." Their document delivery service is found at: <http://www.agiweb.org/georef/dds/index.html>.

AGS: American Geographical Society Library, University of Wisconsin, Milwaukee Campus. See: <http://www.amergeog.org>

AS&T: Applied Science & Technology from H.W. Wilson is a bibliographic database that indexes articles of at least one column in length. English-language periodicals published in the United States and elsewhere are covered; non-English language articles are included if English abstracts are provided. Periodical coverage includes trade and industrial publications, journals issued by professional and technical societies, and specialized subject periodicals, as well as special issues such as buyers' guides, directories, and conference proceedings. See: <http://www.hwwilson.com/Databases/applieds.htm#Abstracts>

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ASFA: Aquatic Sciences and Fisheries Abstracts Input to ASFA is provided by a growing international network of information centers monitoring more than 5,000 serial publications, books, reports, conference proceedings, translations, and limited distribution literature. ASFA is a component of the Aquatic Sciences and Fisheries Information System (ASFIS), formed by four United Nations agency sponsors of ASFA and a network of international and national partners. Aquatic Sciences and Fisheries Abstracts are produced by CSA under contract to FAO. See: <http://www.csa.com/>

British Library: The British Library Document Supply Service can supply many of the article citations and reports given in this bibliography, especially those maps and other materials owned by the British Library. See: <http://www.bl.uk/services/document/dsc.html>

CISTI: Canada Institute of Scientific and Technical Information. This is a Canadian document supply service for scientific and technical literature. "Through Global Service, CISTI can obtain any document for you, from anywhere in the world. Most documents are supplied within four weeks. You can specify the level of service you prefer at the time of ordering by choosing the appropriate line from the drop down menu on any of the CISTI order forms." See: <http://cisti-icist.nrc-cnrc.gc.ca/>

CSA Technology Research Database: This comprehensive database provides a single mega-file of all the unique records available through its 3 components: the CSA Materials Research Database with METADEX, CSA High Technology Research Database with Aerospace, and the CSA Engineering Research Database. The database content represents the most comprehensive and current coverage of the relevant serial and non-serial literature available. Sources covered include over 4,000 periodicals, conference proceedings, technical reports, trade journal/newsletter items, patents, books, and press releases. See: <http://www.csa.com/>

DTIC: Defense Technical Information Center, Alexandria, VA. See: www.dtic.mil

ESPM: The *CSA Environmental Sciences and Pollution Management* database offers access to the international literature in the environmental sciences. Abstracts and citations are drawn from over 6000 serials including scientific journals, conference proceedings, reports, monographs, books and government publications. See: <http://www.csa.com/>

FAO: Food and Agriculture Organization Library, United Nations, Rome, Italy. See: www.fao.org.

GeoBase: GEOBASE is a unique multidisciplinary database supplying bibliographic information and abstracts for development studies, the Earth sciences, ecology, geomechanics, human geography, and oceanography. The database provides current coverage of almost 2,000 international journals, including both peer-reviewed titles and trade publications, and provides archival coverage of several thousand additional journal titles and books. GEOBASE is unequalled in its coverage of international literature of the core scientific and technical periodicals. Papers are selected, read, and classified using a unique classification scheme that is versatile and updated annually to adapt coverage to current research trends. The material covered includes refereed scientific papers; trade journal and magazine articles, product reviews, directories and any other relevant material. GEOBASE has a unique coverage of non-English language and less readily available publications including books, conference proceedings and reports, making this the best resource available for multidisciplinary searches of international literature. The content crosses over subject, language, and cultural boundaries, providing a unique research tool to users. All material in *GEOBASE* is also available as print in the following Elsevier/Geo Abstracts journals: *Geographical Abstracts*, *Physical Geography*, *Human*

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Geography, Geological Abstracts, Ecological Abstracts, International Development Abstracts and Oceanographic Literature Review, Geomechanics Abstracts. See: www.elsevier.com

GeoRef: see: American Geological Institute, Alexandria, VA, listed above. The American Geological Institute not only identified materials for the abstracting database, GeoRef, but also locates and supplies materials as a document delivery service. See: www.agiweb.org

ISBN: International Standard Book Number. This unique number can be used to identify and locate bookstore inventories for sale or library holdings of a particular book or report title. See: <http://www.isbn.org/standards/home/index.asp>

ISSN: International Standard Serial Number. This unique number can be used to locate libraries which have subscriptions to this journal, magazine or serial. See: <http://www.issn.org/>

Library of Congress Control Number – LCCN: This is a unique number applied by the Library of Congress to identify individual publications. This number can be used to identify copies of this item in libraries held in the US and abroad. See: http://www.loc.gov/marc/lccn_structure.html

LC or LOC: Library of Congress, Geography and Map Division, Washington, DC. The Geography and Map Division has the largest collection in the world, with 5.4 million maps, 75,000 atlases, 500 globes, 3,000 three-dimensional objects and thousands of digital files. Recently, the Library of Congress has digitally scanned and mounted its 10,000th map online. See: <http://www.loc.gov/rr/geogmap/>

Linda Hall Library: “Our Document Delivery Services Department allows students, researchers, and businesses to request copies of journal articles, conference proceedings, historical documents, or many other documents housed at the Linda Hall Library. We are committed to filling every in-scope, properly cited request within 24-48 hours. Requests are processed during the local working hours of 8 am – 5 pm, U. S. Central Time, Monday through Friday. Our fee is a cost recovery fee intended to support a strong collection and dedicated services.” See: http://www.lhl.lib.mo.us/services/document_delivery/index.shtml

Northwestern University Transportation Library: The Transportation Library was founded in 1958 to support the curricula and research programs of the Transportation Center and the Center for Public Safety of Northwestern University, including the School of Police Staff and Command. Containing over 400,000 items, the Transportation Library of Northwestern University is one of the largest transportation information centers in the world, encompassing information on all transportation modalities, including: air, rail, highway, pipeline, water, urban transport and logistics. Its collection of environmental impact statements is one of the most complete in the world. See: <http://www.library.northwestern.edu/transportation/>

NTIS: National Technical Information Service, Alexandria, VA. See: www.ntis.gov

OCLC: Founded in 1967, OCLC Online Computer Library Center is a nonprofit, membership, computer library service and research organization dedicated to the public purposes of furthering access to the world’s information and reducing information costs. More than 41,555 libraries in 112 countries and territories around the world use OCLC services to locate, acquire, catalog, lend and preserve library materials. Researchers, students, faculty, scholars, professional librarians and other information seekers use OCLC services to obtain bibliographic, abstract and full-text information when and where they need it. See: <http://www.oclc.org/> or their free service at: www.worldcat.org

SWRA: Selected Water Resources Abstracts (1967-94). *SWRA* provides more than 271,138 abstracts compiled by the Water Resources Scientific Information Center (WRSIC) of the USGS. *SWRA* provides thorough coverage of worldwide technical literature across the life,

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physical, and social-science aspects of water resources as well as U.S. Government documents produced by the USGS's many research facilities. Records are drawn from journals, monographs, conference proceedings, reports, court cases, and other federal and state publications. *SWRA*, and now *Water Resources Abstracts*, are your best sources for issues pertaining to groundwater, water quality, water planning, and water law and rights.

TRIS: TRIS is a bibliographic database funded by sponsors of the Transportation Research Board (TRB), primarily the state departments of transportation and selected federal transportation agencies. TRIS Online is hosted by the National Transportation Library under a cooperative agreement between the Bureau of Transportation Statistics and TRB. See: <http://ntlsearch.bts.gov/tris/index.do>

UN: United Nations Library, New York, NY. See: www.un.org

USGS: US Geological Survey Library, Reston, VA. See: www.usgs.gov/library

University of Texas at Austin. Perry-Castañeda Library Map Collection: "Many of these maps have been scanned and are available for downloading and other uses." See: <http://www.lib.utexas.edu/maps/>

WorldCat: Among other things, this a free database from OCLC showing local library holdings of desired publications. See: <http://www.worldcat.org/>

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Geology, Topology and Terrain¹

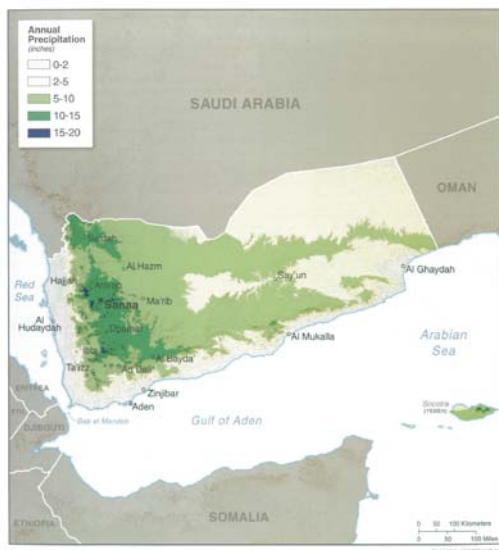
Situated on the southern tip of the Arabian Peninsula, Yemen is a country with a diverse landscape of mountains, plains, and deserts. It covers 203,849 square miles (527,970 square kilometers) including 112 islands, and it is an area approximately the size of California and Kentucky combined, or about twice the size of Wyoming. It has 0 square kilometers of open water. (Central Intelligence Agency. *Yemen- A MapFolio. 2011*)



It also shares borders with Saudi Arabia (1,458 km of borderlines) and Oman (288 km of borderlines). Yemen has 1,906 km of coastline. Yemen also claims 12 nautical miles of territorial seas, and an exclusive economic zone of 200 nautical miles. This country includes the Red Sea Islands; the Socotra Archipelago islands of Socotra, Abd al Kuri, Samhah and Darsa; the former Yemen Arab Republic (YAR or North Yemen), and the former People's Democratic Republic of Yemen (PDRY or South Yemen).

Climate

The climate varies with elevation. The coast is hot and humid throughout the year. The central highlands, with villages at 10,000 feet (3,048 meters), experience an average annual high temperature of 70°F (21°C). Average Daily Temperatures in January: 13.9°C/57°F; in July: 21.7°C/71°F.



The climate in Yemen is mostly desert. Although it is hot and humid along the coastal sections, Yemen has an extraordinarily hot, dry and harsh desert in the east. Yemen is temperate in the western mountains which are affected by seasonal monsoons. Monsoon rains may occur from April to August and from November to January. Rainfall is scarce in the coastal desert regions, but runoff from higher elevations and a series of small dams and channels help support some crops. Mountainsides in the arable highlands are terraced to increase the area suitable for cultivation. Forests once covered the highlands, but overgrazing and logging have almost eliminated them. Excluding its coastal waters, Yemen has no permanent body of open water.² (Central Intelligence Agency. *Yemen- a MapFolio. 2011*)

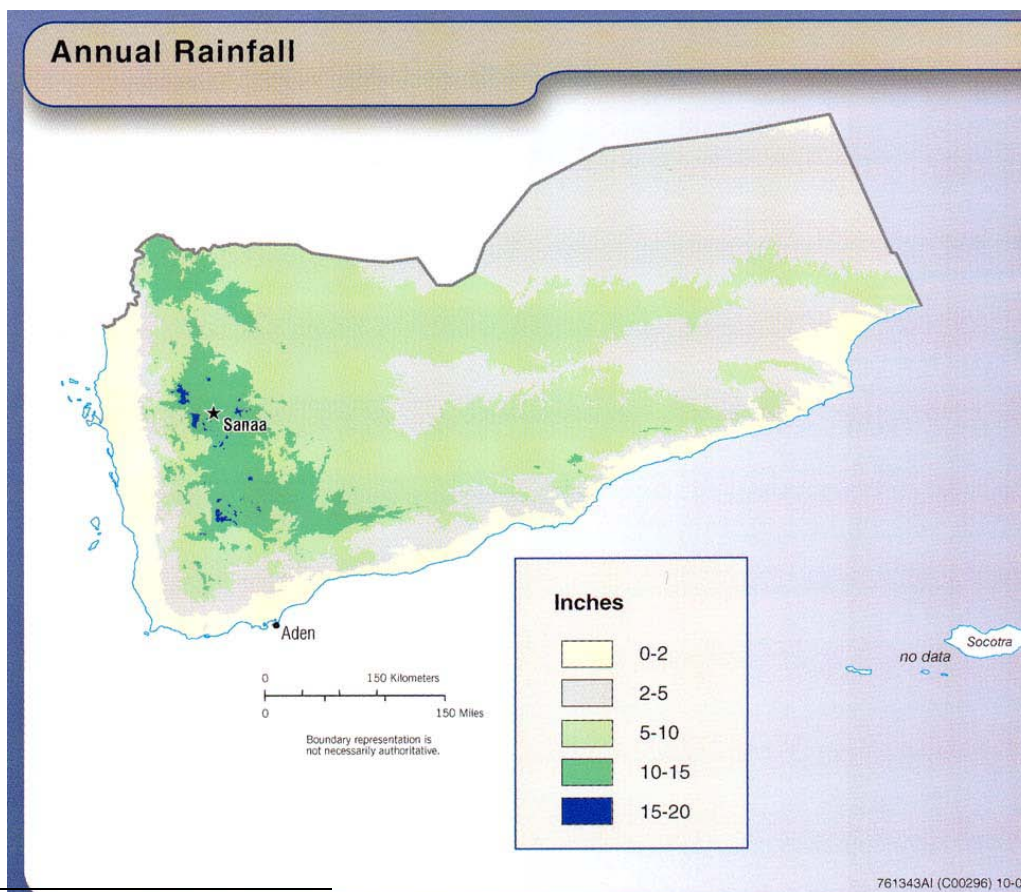
¹ The data in this introductory section are collected from a number of open literature and common knowledge publications and resources, such as various almanacs, AGI's "Glossary of Geology", geographical dictionaries and gazetteers; encyclopedias such as the World Survey of Climatology, the Encyclopedia Britannica, Encarta, Water Encyclopedia; Google Books Online and other standard print and online references and resources. Those items otherwise quoted from particular resources are footnoted.

² "Yemen." *CultureGrams Online Edition*. ProQuest, 2011. Web. 31 Aug 2011.

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The average annual rainfall in Yemen is 508mm/20". "Precipitation in Yemen is strongly influenced by relief and consequently varies considerably from place to place. Meteorological observations were made by J. E. Hasen, engineer, and Dr. Carlo Toffolon, then personal physician to the Imam, at Sana'a and Ta'izz, from 1942 to 1944. According to their observations at Ta'izz, the number of rains ranges from 90 to 160 per year, and annual precipitation ranges from 450 to 700 millimeters. Rainfall may exceed 50mm in a single torrential shower. Two rainy periods are distinguished at Ta'izz: (1) the most important period, in which precipitation may exceed 600mm, extends from April to May, or in some years, to June, and (2) a shorter period in which rain falls mostly during August and September. West winds predominate during the rainy seasons. At Sana'a annual precipitation ranges from 200 to 500 mm (60 to 90 showers) and also falls largely within two periods: (1) April to May and (2), the most important, from the later part of July through the first half of August. Clouds generally gather on the west slopes of the main massifs and cause very heavy rainfall which accounts for the erosive actions of the wadis, and the number of local springs."³

"The greatest rainfall occurs in the south, central and western highlands and feeds innumerable wadis which, like the terraced mountainsides, are heavily cultivated. A short monsoon in April and May alternates with a heavier monsoon in July and August, but the remainder of the years features sunny days."⁴



Annual Rainfall. 2002. CIA Map. See:

³ Geukens, F. 1966. "Geology of the Arabian Peninsula - Yemen." Professional Paper. Volume 560-B. Pages B2-B3.

⁴ Cities of the World. 1981. Detroit: Gale Research Company. Volume 4: Asia, the Pacific and the Asiatic Middle East. Page 360.

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http://www.lib.utexas.edu/maps/middle_east_and_asia/yemen_rainfall_2002.jpg

Yemen is covered with rocks whose ages date back to an era prior to the Cambrian era, about 3 billion years ago. Geologically speaking, Yemen composes part of the Arabian Shield within the larger framework of the Arabian-Nubian Shield.

The basement rocks of Yemen are some of the oldest structures dating back to about 3 billion years. Magmata rocks, gneiss and schist rocks represent such structures. These structures appear as belts extending for tens to hundreds of kilometers as ancient areas separating the small sheets which joined together and formed the Arab-African Shield. These rocks spread basically in two areas: the northern-southern area (that is, Sa'adah governorate) and the western-eastern plateau (that is, Ma'reb-Al-Baidha) along with the makashef فش الكشم in the south of Tai'zz and east of Al-mukalla.

“The basement rocks of Yemen represent the southern extension of the Arabian Shield, is [sic] of Paleoproterozoic to Neoproterozoic age. Yemen has identified five terranes, which can be correlated with the eastern margin of the Arabian Shield in Saudi Arabia and with northern Somalia. These include Pleoproterozoic to Neoproterozoic gneissic terranes and Pan-African island arc terranes and suture zones. These are the Afif, Abas and Mahfid terranes (gneiss terranes) and Al-Bayda' and Mukalla terranes (arc terranes). The Basement of Yemen provides the link between the arc collage of the Arabian Shield and the gneissic Mozambique belt of east Africa.

In the Upper Neoproterozoic constitution of the shape of the Arabian plate has commenced, so that in Yemen a transitional stage between the basement and platform was development and evidenced by the deposition of folded sediments of the Ghabar Group (Infracambrian). Similar subsurface Infracambrian deposits are known from Qina-1 well (southern flank of the Rub' Al-Khali basin), which are defined formally as Qina Group.”⁵

“The Precambrian basement rocks in Yemen comprise metavolcanic, metasedimentary, gneiss and migmatite belts produced in arc environments intruded by post tectonic granites and granodiorites. These are found throughout western Yemen from the northwest (Sa'dah - Al Jawf) and southwest areas (Marib-Al-Bayda), in addition to small outcrops in south of Tai'zz and west of al Mukalla. The oldest known rocks in Yemen occur in the Al Bayda terrane which contains late Archaean aged (Sm-Nd: 2700-2900 Ma) gneisses, amphibolite dykes and granites”⁶

Sedimentary Rocks: The oldest rocks of Yemen's sedimentary structures go back to the prime Proterozoic Eon. Such rocks are represented by Ghaba'er and Gunab groups which have sandstones and limestones. Also the types of the sedimentary rocks—the sandstones, limestones and the mudstones—cover big areas forming the surfaces and basins in Yemen. Most of these rocks are of the second and third geological eras. An exception is the sandstones of Wajid and the mudstones of A'kberah, located at the western-northern area of Yemen (that is, Sa'adah); these rocks were formed in the first geological era.

⁵ PEPA. 2011. “Geological & Stratigraphic Settings of Yemen.” See: <http://www.pepa.com.ye/Geological%20framework/Geological%20&%20Stratigraphic%20Settings%20of%20Yemen.htm>

⁶ Commission for the Geological Map of the World/Commission for the Geological Maps of the Middle East (CGM/CGMME). 2010. “Yemen.” See: <http://www.cgmme.com/Article.aspx?CId=Yemen&Txt=1>

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Sedimentary Rocks in Yemen comprise the following:

- Paleozoic Sediments:
 - Ghabar Group (Infra-Cambrian-Earliest Paleozoic): Sandstone limestone, silt, gypsum.,
 - Qinab Group (Infra Cambrian-Lowest Cambrian): Volcano-sedimentary succession consisting of dolerite, sandstone, silty shale and tuff.
 - Wajid Formation (Cambrian - Carboniferous): Quartz sandstone.
 - Akbarah formation (Late Carboniferous-Permian): Tillite (pebbles & boulders of basement rocks), shales, mudstones, sandstones and siltstones.
- Mesozoic Sediments:
 - Kuhlan Formation (Lower-Middle Jurassic): Sandstones, thin claystone and siltstone interbeds.
 - Amran Group (Middle Jurassic-Lower Cretaceous): Carbonate marl/shale with evaporitic succession.
 - Tawilah Group (Cretaceous): Sandstone with siltstone, marl, and shale, often interbedded with sandstone and also forming distinct marl or shale intervals and with generally persistent limestone-marl clasts.
 - Mahra Group (Cretaceous): Limestone, marl, and shale, often interbedded with sandstone.
- Cenozoic Sediments:
 - Hadramawt Group (Paleocene-Middle Eocene): Dolomite, shale, limestone with chalk and dolomite, marl, papery shale, bedded gypsum, and alternating sand stone and claystone.
 - Majzir Formation (Paleocene-Lower Eocene): A shallow marine-littoral sandstone succession.
 - Shihr Group (Oligocene-Pliocene): Conglomerate, sandstone, silt, lime tone and gypsum⁷

Volcanic Rocks: The formation of the Red Sea's basin in the third eon was associated with the process of regional uplifting of the western areas of Yemen in the early Eocene Epoch. This was through interval volcanic activities; the highest of which was in the Oligocene and Miocene epochs. Volcanic eruption reoccurred at the beginning of fourth era. Such volcanic operations resulted in the formation of Yemeni volcanics: acid rocks such as rhyolite, Ignimbrite; volcanic glass; and middle and basic rocks like the basalt and andalusite. During the volcanic activities and in the middle of the third eon, there was the formation of overlapped granite structures, injected in different types of rocks; most of which include A'mran group, Altaweelah rock group, the rocks of Yemen's volcanics and basement rocks.

“Volcanic and Intrusive Rocks: The was a time of Regional uplift occurred in western Yemen in the Paleocene/Eocene as evidenced by intermittent volcanic activity commencing in the Early Eocene which culminated in Oligocene-Miocene times with extensive extrusive and plateau flood basalt eruptions forming the Yemen Volcanic Group. This comprises an older trap series and younger Volcanic Series. These series include the whole spectrum of basaltic lithologies to silicic ignimbrites and tuffs. Sedimentary units, generally occurring as lenses of limited extent and thickness, occur in many parts of the volcanic sequence between flows

⁷ Commission for the Geological Map of the World/Commission for the Geological Maps of the Middle East (CGM/CGMME). 2010. “Yemen.” See: <http://www.cgmme.com/Article.aspx?CId=Yemen&Txt=1>

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(Geukens, 1960, 1966). These are generally composed of lacustrine deposits consisting of calcareous sandstone, mudstone and reworked volcanic clasts. Also observed in inter-trap sedimentary units are fluvio-aeolian sands and palaeo-soils, generally lateritic, often developing along plane surfaces but at times locally cutting across different beds. The Yemen Volcanic Group is intruded by granitoid rocks along much of the edge of the High Plateau of Yemen, which forms the great eastern escarpment of the Red Sea. Intrusions also occur in the Sana'a and Taiz districts.”⁸

“The Yemen Volcanic Group includes all the Cenozoic volcanic rocks, which is divided into the Yemen Trap Series (31.6 - 15 Ma) that consists of thick series of mainly flood volcanic rocks and Yemen Volcanic Series (10 - 0 Ma) that represents thinner series of mainly peralkaline intraplate basaltic volcanic rocks (Mattash and Balog, 1994). The Yemen Volcanic Series is divided into older volcanic rocks intruded west of Aden (10 - 5 Ma) and younger volcanic rocks east of Aden (5 - 0 Ma).”⁹

⁸ Commission for the Geological Map of the World/Commission for the Geological Maps of the Middle East (CGM/CGMME). 2010. “Yemen.” See: <http://www.cgmme.com/Article.aspx?Cid=Yemen&Txt=1>

⁹ PEPA. 2011. “Geological & Stratigraphic Settings of Yemen.” See: <http://www.pepa.com.ye/Geological%20framework/Geological%20&%20Stratigraphic%20Settings%20of%20Yemen.htm>

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Terrain

There are five main regions in Yemen. The Tihama Coastal Plains; the Yemen Mountain Massif; the Eastern Plateau Region; the Desert, and the Islands. There are also four major drainage basins, regrouping numerous smaller wadis: the Red Sea basin; the Gulf of Aden basin; the Arabian Sea basin and the Rub Al Khali interior basin.

The Tihama Coast Plains

Yemen has a narrow coastal plain backed by flat topped hills and rugged mountains, called “The Tihama” or the “Tihamah” (Arabic: تهامة *Tihāmah*) is a narrow coastal region of Arabia on the Red Sea. The Tihamah (which means “hot lands” or “hot earth”) form a very arid and flat coastal plain along Yemen’s entire Red Sea coastline. Despite the aridity, the presence of many lagoons makes this region very marshy and a suitable breeding ground for malaria mosquitoes. There are extensive crescent-shaped sand dunes. The evaporation in the Tihamah is so great that streams from the highlands never reach the sea, but they do contribute to extensive groundwater reserves. Today, these are heavily exploited for agricultural use. Near the village of Madar about 48 km (30 mi) north of Sana’a, dinosaur footprints were found, indicating that the area was once a muddy flat.

“This 30 to 60 km wide region ranges in elevation from sea level on the coast to about 200 meters in the foothills. Annual rainfall for the Tihama range between 50 and 300mm, and falls quite erratically. Average temperatures are quite high year round. Humidity is usually between 50% and 70%. High winds often come in from the sea, causing sandstorms and soil erosion. Dryland farming can only be practiced under semi-desert conditions in years of exceptional rainfall, but about 70,000ha are cultivated under spate irrigation, and another 25,000ha under well irrigation.”¹⁰

The Coastal Plains are located in the west and south-west and are flat to slightly sloping with maximum elevations of only a few hundred meters above sea level. They have a hot climate with generally low to very low rainfall (< 50 mm/year). Nevertheless, the Plains contain important agricultural zones, due to the numerous wadis that drain the adjoining mountainous and hilly hinterland.¹¹

It is currently divided between Saudi Arabia and Yemen. In a broad sense, Tihamah refers to the entire coastline from the Gulf of Aqaba to the Bab el Mandeb Strait but it more often refers only to its southern half, starting just south of Jeddah and running parallel to Asir and Yemen. Unlike the inland regions, it is made up of sand dunes and plains and is largely arid except for a few oases. Important urban centers of the region include Al Hudaydah, Mocha, and Zabid in Yemen and Jizan, Al-Qunfudhah, and Al Lith in Saudi Arabia. Most of the Tihama coastline is hazardous to approaching vessels, and harbors are therefore few and far between, especially in the northern half.

“The Tihamah Group (Upper Oligocene/recent) represents the syn- and post-rift Cenozoic sediments in the Tihamah basin on- and offshore of the Red Sea along the Yemeni coast and includes the Zaydiyah Formation (Lower Miocene), Maqna Formation (Lower/Middle Miocene), Salif Formation (Middle/Upper Miocene) and Abbas Formation (Pliocene/Pleistocene), which represent the top unit of the Tihamah Group (As-Saruri, 1999; and As-Saruri and Beydoun, 1998). However, the development of the Red Sea- Gulf of Aden rifts in Oligocene/Recent time, which resulted in massive uplift along the rift boundaries, where huge

¹⁰ Speece, Mark. 1982. *Draft environmental report on Yemen (Yemen Arab Republic)*. Pages 4-5.

¹¹ Water Profile of Yemen. 2008. See: http://www.eoearth.org/article/Water_profile_of_Yemen

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bimodal volcanic rocks and their associated Neogene intrusions (granite, syenite, diorite, gabbro) formed the high plateau of the western Yemen province.”¹²

The temperatures in Tihamah are probably some of the hottest and most uncomfortable on earth. A normal summer day in Al Hudaydah can be 43° Celsius (110° Fahrenheit) with the humidity of around 40-60% at noon, causing the heat index to be dangerously high. Only the inhabitants can normally withstand the heat, and highland Yemenis often find it very difficult to stay in the Tihamah area.

“The country’s main water divide lies at a distance of about 120km from the Red Sea coast, running north-south for over 400km before it bifurcates just south of the city of Dhamar. Areas west, east and south of this divide are called the western, eastern and southern escarpments respectively. The western escarpment comprises the Tihama Basin-plain and catchment areas. The boundary between the plain and the catchment areas is commonly drawn at 200m contour line limit; the catchments are divided into lower (plain), middle (foothills) and upper (mountains). The Tihama stretches some 400km along the Red Sea, from the Asir region in the north to Bab-al-Mandeb near the southern border. It ranges in width from 20 to 50km, with its widest part stretching between the two largest wadis (Mawr and Zabid). The plain is characterized by flat to slightly undulating topography with a very gentle slope towards the sea; the only significant land forms on the plain are associated with the seven major and several minor wadis, the courses of which generally disappear beneath the high sand dunes near the coast.”¹³

The Yemen Mountain Massif

This massif constitutes a high zone of very irregular and dissected topography, with elevations ranging from a few hundred meters to 3,760 m above sea level. Accordingly, the climate varies from hot at lower elevations to cool at the highest altitudes. The western and southern slopes are the steepest and enjoy moderate to rather high rainfall, on average 300-500 mm/year, but in some places even more than 1,000 mm/year. The eastern slopes show a comparatively smoother topography and average rainfall decreases rapidly from west to east.¹⁴

“In the desert areas of the east there was once extensive agriculture based on runoff from the mountains, and it was here the great kingdoms were based in pre-Islamic times. But throughout the Islamic period, Ma’rib and the area around it have been parched and poor. In the Tihamah, the lowland coastal plain at the west of the country, runoff from the mountains was also used for farming, and still is nowadays; but the Tihamah never matched the power and prosperity of the ancient east. The dominant area of Yemeni history for the last millennium and more has been the rain fed plateaus and mountain country running north to south.”¹⁵

The central highlands are an extensive high plateau over 2,000 metres (6,562 ft) in elevation. This area is drier than the western highlands because of rain-shadow influences but still receives sufficient rain in wet years for extensive cropping. Diurnal temperature ranges are among the highest in the world: ranges from 30 °C (86 °F) in the day to 0 °C (32 °F) at night are normal. Water storage allows for irrigation and the growing of wheat and barley. Sana’a is

¹² PEPA. 2011. “Geological & Stratigraphic Settings of Yemen.” See: <http://www.pepa.com.ye/Geological%20framework/Geological%20&%20Stratigraphic%20Settings%20of%20Yemen.htm>

¹³ Smith, G.V.; Al-Mooji, Y.A. 1987. Groundwater Development in the Tihama Coastal Plain. Page 151.

¹⁴ Water Profile of Yemen. 2008. See: http://www.eoearth.org/article/Water_profile_of_Yemen

¹⁵ Dresch, Paul. 1993. Tribes, Government and History in Yemen. Oxford: Clarendon Press. Page 8.

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located in this region. The highest point in Yemen is Jabal an Nabi Shu'ayb, at 3,666 metres (12,028 ft).

The “Central Highlands” or the “Interior Highlands”, “...climbs from the area of the western foothill (200 to 1,500m) to peaks exceeding 3,000m in the center of the highlands. Seven major wadis run out of the highlands into the Red Sea, three run to the east and two major ones flow southwards. Most of these are perennial in the upper reaches, but rarely reach the sea except at high flood times. Rainfall varies considerably in the interior. Generally it becomes wetter from north to south and from lower to higher elevation. Lower levels of the Western foothills may get 250-300mm annually. Annual averages in the northernmost areas of the highlands may be as low as 100mm, while the figure for Ta'izz provinces is over 600mm. Ibb recorded an average for 1970-73 of 1,100mm. Temperature in the highlands are quite comfortable, with average summer highs of ca 21°C and lows in the winter of around 4°C. The interior is traditionally the major agricultural area of the Yemen Arab Republic. Most cultivation must be practiced on terraced land, and most is rain fed rather than irrigated.”¹⁶

“The Central Highlands comprise the upper parts of the central mountain range with altitudes varying between 2,000 and 3,000 meters and peaks often exceeding 3,500 meters. Yemen's highest mountain, Nabi Shu'ayb, rises to a height of 3,760 meters. This area is much less indented than the western slopes; the eastern slopes of the central highlands are gentle and terminate in the high tablelands. Rainfall in the highlands is less abundant than on the western slopes.”¹⁷

The Eastern Plateau Region

This region covers the eastern half of the country. Elevations decrease from 1,200-1,800 m at the major watershed lines to 900 m on the northern desert border and to sea level on the coast. The climate in general is hot and dry, with average annual rainfall below 100 mm, except in the higher parts. Nevertheless, floods following rare rainfall may be devastating.¹⁸

Hadramawt, Hadhramaut, Hadhramout, Hadramawt or Ḥaḍramūt (Arabic: حضرموت



Flag of Hadramawt with three forts representing the principal cities Al Mukalla, Shibam and Ash Shihr

Ḥaḍramawt) is a historical region of the south Arabian Peninsula along the Gulf of Aden in the Arabian Sea, extending eastwards from Yemen (proper) to the borders of the Dhofar region of Oman. The name of the region is currently retained in the smaller Hadhramaut Governorate of the Republic of Yemen. The people of Hadhramaut are called Hadhramis and speak Hadhrami Arabic.

Narrowly, Hadhramaut refers to the historical Qu'aiti and Kathiri sultanates, which were in the Aden Protectorate overseen by the British Resident at Aden until their abolition upon the independence of South Yemen in 1967. The current governorate of Hadhramaut roughly incorporates the former territory of the two sultanates. It consists of a narrow, arid coastal plain bounded by the steep escarpment of a broad plateau (*al-Jol*, averaging 1,370 m (4,490 ft)), with a very sparse network of deeply sunk wadis (seasonal watercourses). The undefined northern edge of Hadhramaut slopes down to the desert Empty Quarter.

¹⁶ Speece, Mark. 1982. *Draft environmental report on Yemen (Yemen Arab Republic)*. Page 5.

¹⁷ United Nations. 1982. “Yemen.” In: *Ground Water in the Eastern Mediterranean and Western Asia*. New York. Department of Technical Co-operation for Development. Natural Resources Water Series Number 9. Page 207.

¹⁸ Water Profile of Yemen. 2008. See: http://www.eoearth.org/article/Water_profile_of_Yemen

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In a wider sense, Hadhramaut includes the territory of Mahra to the east all the way to the contemporary border with Oman. This encompasses the current governorates of Hadramaut and Mahra in their entirety as well as parts of the Shabwah Governorate.

Hadhramout Governorate now, is what was of the former Sultanates of *Al Qa'ety* and *Al Kathiri*. Both of which were British Protectorates, indirectly governed by the British representatives in Aden until Southern Yemen's independence in 1967; *Aden* was the largest city in the then Southern Yemen and became its capital after independence. Historically, Hadhramout's capital was in Shabwa and extended from *Shabwa* in the East, all the way to *Mahra* and the border of Oman in the West.

Hadhramout was long ago referred to as the *Land of Al'Ahqaf*. Legend has it that *Hadhramout* was named so, after *Amar Bin Qahtan*, who is said to have invaded *Al'Ahqaf*; after the disappearance of the *A'ad* people who are mentioned in the Noble Quran. Folklore has it that, whenever *Amar Bin Qahtan* entered a battle, many people died. And thus, the *Land of Al'Ahqaf* was called *Hadhr* (meaning in Arabic: 'has come' or 'was present') and *mout* (meaning 'death' in Arabic). While Biblical dictionaries, seem to indicate that the name *Hadhramout*, is what is referred to as *Hazarmaveth* in The Bible - Genesis 10:26 and Chronicles 1:20. *Hazarmaveth* is also said to have been derived from the Greek word *hydreumata*; meaning enclosed or fortified 'watering stations' found in valleys.¹⁹

The Hadhramis live in densely built towns centered on traditional watering stations along the wadis. Hadhramis harvest crops of wheat and millet, tend date palm and coconut groves, and grow some coffee. On the plateau, Bedouins tend sheep and goats. Society is still highly tribal, with the old Seyyid aristocracy, descended from the Prophet Muhammad, traditionally educated and strict in their Islamic observance and highly respected in religious and secular affairs.

The Qu'aiti sultans ruled the vast majority of Hadramaut, under a loose British protectorate, the Aden Protectorate, from 1882 to 1967, when the Hadhramaut was annexed by South Yemen. In 1967, the former British Colony of Aden and the former Aden Protectorate including Hadramaut became an independent Communist state, the People's Republic of South Yemen, later the People's Democratic Republic of Yemen. South Yemen, along with Hadramaut, was united with North Yemen in 1990 as the Republic of Yemen.

The capital and largest city of Hadhramaut is the port Al Mukalla. The population of Yemen is crowding into its Hadramaut cities: Al Mukalla had a 1994 population of 122,400 and a 2003 population of 174,700, while the port city of Ash Shihr has grown from 48,600 to 69,400 in the same time. One of the more historically important cities in the region is Tarim. An important locus of Islamic learning, it is estimated to contain the highest concentration of descendants of the Muhammad anywhere in the world.

"The Hadhramaut region in the south east of Yemen is well known for its mud brick architecture. Throughout the centuries, the population has developed very sophisticated building techniques and created a unique architectural environment. Spectacular structures such as ten-story mud brick tower houses rise up from the valley's floor. In interviews throughout the documentary, the masons describe their working techniques and the challenges they face with the introduction of new, imported building materials. *The Architecture of Mud* documents the vernacular architecture, the building craft and the society they belong to."²⁰

¹⁹ See: <http://knol.google.com/k/hadhramout-or-hadhramaut-or-hadhramawt-h%C3%A4-dhr%C3%A4-m%C3%B4t-arabic-%D8%AD%D8%B6%D8%B1%D9%85%D9%88%D8%AA-ha-dhra-maut#>

²⁰ "Architecture of Mud". 1999. Documentary Educational Resources (DER). See the site accessed October 5, 2011: <http://www.der.org/films/architecture-of-mud.html>.

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“Wadi Hadramawt, the biggest wadi in the Arabian Peninsula, is one of the major attractions of southern Yemen. This famous valley runs for 160km, west to east, amidst most arid, stony desert plateaus about 160km from the coast. At the western end is the sandy desert of Ramlat as-Sab’atayn. Downstream the wadi joins with the dry and inhospitable Wadi Masila, which connects the system to the sea. Wadi Hadramawt with its numerous tributaries, however, is very fertile, making it possible for a population of 200,000 to live in agriculture and goat herding. Formed by erosion of the sandstone bedrock over millions of years, the main wadi is today some 300 meters deep and two km wide on average, with the wadi bottom at an altitude of 700 meters. Ground water is available throughout the year; the rainy season brings floods to replenish it, creating this most unexpectedly green land between the desolate tablelands... In the eastern part of the country, the huge Wadi Hadramawt gathers the scanty rains that fall on the rocky area between the Arabian Sea and the central deserts of the Arabian Peninsula. This wadi, though sufficiently fertile to allow a sizable population to derive a living from agriculture, never yields its waters anywhere near the sea. Date palm is the most notably cultivated tree here; the Hadramis grow enough dates for export to other countries.”²¹

The Desert

Dissected upland desert plains in the center of the country slope into the desert interior of the Arabian Peninsula. The Eastern Slopes is “...approximately 80,000 sq km region that slopes gently eastward into the Rub al-Khali. Very little climatic data is available on the area beyond the general observation that it may be classed as varying from desert to semi-desert. Little agriculture is practiced here; rather it is primarily an area of nomadic herding.”²²



Yemen’s portion of the Rub al Khali desert in the east is much lower, generally below 1,000 meters (3,281 ft), and receives almost no rain. It is populated only by Bedouin herders of camels.

(This German language “Rub al-Chali/Empty Quarter” map is based on a 2006 map, last modified in 2011)

“To the east and north, the rains become scattered and less frequent, ceasing altogether in the north central parts of the country, where the stony semi-deserts gradually turn into sandy deserts. Here, only a few shrubs and grasses survive. In the past, large wadis carried enough water from the eastern mountains to the desert to sustain entire civilizations. The famous kingdom of Saba owed its prosperity to a dam that collected water from the vast Wadi-al-Sudd flowing in the north-eastern direction.”²³

Between the Yemen Mountain Massif and the Eastern Plateau lies the Ramlat as Sabatayn, a sand desert. Rainfall and vegetation are nearly absent, except along its margins where rivers bring water from adjacent mountain and upland zones. In the north lies the Rub Al

²¹ Härmäläinen, Pertti. 1991. Yemen: A Travel Survival Kit. Berkeley, CA: Lonely Planet. 2nd edition. Page 28, 202.

²² Speece, Mark. 1982. *Draft environmental report on Yemen (Yemen Arab Republic)*. Page 5.

²³ Härmäläinen, Pertti. 1991. Yemen: A Travel Survival Kit. Berkeley, CA: Lonely Planet. 2nd edition. Page 28.

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Khali desert, which extends far into Saudi Arabia and is approximately 500,000 km² in area. This sand desert is one of the most desolate parts of the world.²⁴

“The eastern mountain slopes rise gently towards the eastern desert and end at an altitude of 1,000 meters in the Empty Quarter (Rub al Khali), one of the most desolate parts of the world. The rainfall, though minimal, renders agricultural activities possible, but only in a couple of very broad wadis draining the high tablelands... Eastern Mountain Slopes: 1,200 to 1,500 meters in altitude; Subtropical; Maximum Average Temperature: 22.0°C; Precipitation: 100-250 mm/yr. Eastern Desert: 800-1,200 meters in altitude; Desert subtropical; Maximum average temperature: 24.0°C; Precipitation: 80-100mm/yr.”²⁵

Islands

A number of Red Sea islands, including the Hanish Islands, Kamaran, and Perim, as well as Socotra in the Arabian Sea, belong to Yemen. Many of the islands are volcanic; for example Jabal al-Tair had a volcanic eruption in 2007 and before that in 1883.

The **Hanish Islands** (Arabic: جزر حنيش) are an island group in the Red Sea. Most of them are a part of Yemen, but before 1998–1999 they were claimed by Eritrea as well. After a long trial with an international court under the guidance of Dr. Abdul Karim Aleryani, Yemen was granted full ownership of the larger islands while Eritrea was awarded the peripheral islands to the southwest.

Kamaran Island (Arabic: كمران *Kamarān*) is the largest Yemen-controlled island in the Red Sea. The 108-km² (42-sq. mile) island is 18 km (11 miles) long and 7 km (4.5 miles) wide and is strategically located at the southern end of the Red Sea. It is a “shelf island” located in the shallow waters of the Arabian peninsula’s continental shelf with coral reefs surrounding three sides of the island. The population numbers 2,200. Kamaran is generally flat, with a few hills in the south. Its highest point is Jabal Yaman (24 meters high), situated about three kilometers from Ra’s al Yaman, the southeastern cape of the island.

Jabal al-Tair Island (Jebel Teir, Jabal al-Tayr, Tair Island, Al-Tair Island, Jazirat at-Tair; Arabic: جزيرة جبل الطير *Jazīrat Jabal at-Ṭayr*, literally, “Bird Mountain Island”) is a roughly oval volcanic island northwest of the constricted Bab al-Mandab passage at the mouth of the Red Sea, about half way between Yemen and Eritrea. From 1996 until it erupted in 2007 Yemen maintained two watchtowers and a small military base on the island. After 124 years of dormancy, the volcano that created the island erupted on 30 September 2007. The island is roughly oval, about 3 kilometres (1.9 mi) long, and 3.9 square kilometres (1.5 sq mi) in area. It lies nearly half way between Yemen 115 kilometres (71 mi) to the east and Eritrea about 150 km (93 mi) south west. It is about 82 kilometres (51 mi) from the Yemeni Kamaran Island; the Saudi Arabian Farasan Islands lie to the north east. The island lies close to the divergent boundary between the African Plate and the Arabian Plate.

The island comprises the basaltic strato-volcano **Jabal al-Tair** (Tair Mountain; Arabic: جبل الطير *Jabal at-Ṭayr*, literally, “Bird Mountain”) rising from seabed some 1,200 metres (3,940 ft) below the surface of the Red Sea, continuing for 244 m (801 feet) above the surface up to the summit of the crater. The volcano was considered “recently extinct” as of 1982. It was the northernmost known Holocene volcano in the Red Sea, with one central vent, Jebel Duchan. It

²⁴ Water Profile of Yemen. 2008. See: http://www.eoearth.org/article/Water_profile_of_Yemen

²⁵ United Nations. 1982. “Yemen.” In: Ground Water in the Eastern Mediterranean and Western Asia. New York. Department of Technical Co-operation for Development. Natural Resources Water Series Number 9. Page 208.

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lies in the volcanic and geologically active region of the Red Sea Rift, the divergent boundary between the African Plate and the Arabian Plate. In 1900 the British Admiralty described the island as having no natural water supply, and having a high conical peak rising above a basalt bluff some 300 feet (90 m) above a gradual littoral. The prominent profile made it an ideal landmark for Red Sea shipping, and the steep drop-off below sea level meant that it might be safely run for.^[4] The island has no settled population, but some parts of the island have allowed for the seasonal presence of fishermen.²⁶

Perim (Arabic: بریم [*Barīm*]) is a volcanic island strategically located in the Strait of Mandeb at the southern entrance into the Red Sea, off the southwestern coast of Yemen. It has a surface area of 13 square kilometers and rises to an altitude of 65 meters. The island has a natural harbor on its southwestern coast, but there is only scarce vegetation. The absence of fresh water on the island has always been one of the major difficulties impeding permanent settlement. Sometimes in the geological past, its eruptions have blocked the Bab el Mandeb and thus the Red Sea evaporated to an empty hot dry salt-floored sink. A bridge linking Yemen and Djibouti via Perim Island has been proposed in 2008 by a Dubai-based company, Al Noor Holding Investments. At around 28.5 km, it would be one of the longest bridges in the world.

Socotra (Arabic: سُقُطْرَى *Suqūṭra*), also spelt *Soqatra*, is a small archipelago of four islands in the Indian Ocean. The largest island, also called Socotra, is about 95% of the landmass of the archipelago. It lies some 240 kilometres (150 mi) east of the Horn of Africa and 380 kilometres (240 mi) south of the Arabian Peninsula. The island is very isolated and through the process of speciation, a third of its plant life is found nowhere else on the planet. It has been described as the most alien-looking place on Earth.

Socotra is one of the most isolated landforms on Earth of continental origin (i.e. not of volcanic origin). The archipelago was once part of the supercontinent of Gondwana and detached during the Miocene, in the same set of rifting events that opened the Gulf of Aden to its northwest.

The archipelago consists of the main island of Socotra (3,625 km² (1,400 sq mi)), the three smaller islands of Abd al Kuri, Samhah and Darsa and small rock outcrops like Ka'l Fir'awn and Sābūnīyah that are uninhabitable by humans but important for seabirds.

The main island has three geographical terrains: the narrow coastal plains, a limestone plateau permeated with karstic caves, and the Haghier Mountains. The mountains rise to 5,000 feet (1,500 m). The island is a little over 80 miles (130 km) long east to west and typically 18–22 miles (29–35 km) north to south.

The climate of Socotra is classified in the Köppen climate classification as BWh and BSh, meaning a tropical desert climate and semi-desert climate with a mean annual temperature over 18°C (64°F). Yearly rainfall is light, but is fairly spread throughout the year. Generally the higher inland areas receive more rain than the coastal lowlands, due to orographic lift provided by the interior mountains. The monsoon season brings strong winds and high seas.

Public transport on Socotra is limited to infrequent minibuses to Qulansiyah and to the villages on northeastern coast, car hire usually means hiring a 4WD car with driver. Ships connect the only Socotra port- 5 km (3 mi) east of Hadibu- with the Yemeni coastal city of Al Mukalla. According to information from the ports, the journey takes 2–3 days and the service is used mostly for cargo.

²⁶ "Jebel at Tair." 2011. Global Volcanism Program, Smithsonian Institution. See the site accessed September 13, 2011: <http://www.volcano.si.edu/world/volcano.cfm?vnum=0201-01>

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Yemenia and Felix Airways fly from Socotra Airport to Sana'a and Aden via Al Mukalla (RIY- Rihan Airport). The Sana'a service operates daily, while Aden flights are on Mondays, as of December 2009.

Surface and Ground Water Resources

The country's biggest natural resource problem is its falling water table. Rainfall, though heavy in some areas of the country, is insufficient to meet Yemen's agricultural needs. Consequently, Yemen extracts more groundwater than is recharged, causing the water table to drop by an average of 2 meters annually. Population growth is also placing greater pressure on limited water resources, particularly in urban areas. In particular, the population of Sana'a is growing at around 7% a year and, as a result, the capital's water table is dropping rapidly.²⁷

Excluding its coastal waters, Yemen has no permanent body of water. There are limited natural freshwater resources, and inadequate supplies of potable water. The freshwater withdrawal for domestic use, industrial purposes and agriculture is about 6.63 cubic kilometers per year, based on 1997 estimates. This comes to about 316 cubic meters of freshwater per person per year (based on 2000 estimates). There are only 4.2 cubic meters of renewable freshwater resources (based on 1997 estimates) in the country.

"Agriculture takes the lion's share of Yemen's water resources, sucking up almost 90 percent. Until the early 1970s, traditional practices ensured a balance between supply and demand. Then the introduction of deep tube wells led to a drastic expansion of land under cultivation. In the period from 1970 to 2004, the irrigated area increased tenfold, from 37,000 to 407,000 hectares, 40 percent of which was supplied by deep groundwater aquifers. The thousands of Yemenis working abroad often invested their remittances in irrigation. Other incentives to expand farmland came in the form of agricultural and fuel subsidies. Farmers began growing less of the local, drought-resistant varieties of wheat and more water-intensive cash crops such as citrus and bananas."²⁸



The renovated Jadaan Cistern is built of natural stone that protects the water supply. A USAID environmental health program helped the community in the mountain village of Thula renovate a 700-year-old cistern using natural materials and traditional methods.

(Photo: USAID. See: http://www.usaid.gov/stories/yemen/ss_ye_cistern.html)

The Hadramaut Basin covers almost 40% of the total surface area of Yemen. The aquifer material consists of sand and gravel mixed with clay and sandy clay. Because of the poor quality of water in some of its parts, the productivity of the Hadramaut Basin is rather limited. The basin recharge is claimed to be about $257 \times 10^6 \text{ m}^3\text{y}^{-1}$

About 62% of the population of Yemen has access to improved water resources. About 38% have only unimproved resources. Only 52% of the population has access to

²⁷ Economist Intelligence Unit: Yemen. http://find.galegroup.com/gtx/infomark.do?&contentSet=IAC- Documents&type=retrieve&tabID=T001&prodId=AONE&docId=A180876880&source=gale&srcprod=AONE&userGroupName=loc_main&version=1.0.

²⁸ Lichtenthaler, Gerhard. 2010. "Water Conflict and Cooperation in Yemen." Middle East Research and Information Project. See the site, accessed on September 13, 2011: <http://www.merip.org/mer/mer254/water-conflict-cooperation-yemen>

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improved sanitary facilities. Food or waterborne diseases are high, with bacterial diarrhea, hepatitis A and typhoid fever as leading illnesses. Schistosomiasis, a water contact disease, is also prevalent. Polio and malaria are common to Yemen. Polio is present in some Red Sea coastal towns and malaria is also present in low-lying areas along the Red Sea. There have been reports of a dengue fever outbreak in the Arabian Gulf coast and in the western coastal towns of al-Hodeidah and Mokha and the hill area of al-Dali'. The most recent outbreak occurred in Tai'zz, in southern Yemen.

Today, there are between 45,000 and 70,000 wells in Yemen, the majority of which are under private control. No one can be certain of the exact number, as almost all were drilled without license.²⁹

There are about 6,800 square kilometers of irrigated land in Yemen, based on 2008 estimates. Overgrazing of pastureland is endemic. Soil erosion and desertification is also a hazard.

“Surface water quality in the Tihama is generally considered to be fairly good, with medium salinity, low sodium, and slight alkalinity in some cases. Test analysis in wadis Rima and Zabid showed total dissolved solids (TDS) around 290 mg/l and 500 mg/l respectively. Electrical conductivity was 455 and 740 micromhos (at 25°C) respectively. These values are probably representative for the Tihama, but no data is readily available for the highlands areas. Groundwater quality in the Tihama is quite variable. It can be fairly good, as in wadis Rima and Zabid, but more commonly Tihama groundwater tends toward high salinity. Often this is attributed to the existence of salt deposits underlying the aquifer in many area.”³⁰

“Along the coast between Al Mukallā and Aden a number of fishing villages are supplied by water within a half mile of the shore. The water levels are a few feet above mean sea level and probably represent wedges of freshwater floating on sea water (Ghyben-Herzberg Principle). The fresh water has probably originated from the higher ground behind the coastal plains by slow seaward movement, and partly from natural precipitation.”³¹

The minister for water and the environment, Dr Abdulrahman al-Eryani, is an agricultural engineer - and he is a worried man. “The Sana'a basin is using water 10 times faster than Nature is replenishing it,” he told me. “And before long there won't even be enough to drink. I am not an optimist. I think many of the city's people will simply have to move away. “The solution I am proposing is a very clear policy - a voluntary one - of reallocating people from here down to the Red Sea coast. We could use renewable energy there to desalinate sea water. And it would be cheaper than trying to provide enough water to Sana'a. “This is not the first time that Yemenis have had to move to avoid disaster. It's happened many times in the last few thousand years, when Nature allowed the population to increase rapidly. This time, though, there are political frontiers in the way of an exodus.”³²

²⁹ Lichtenthaler, Gerhard. 2010. “Water Conflict and Cooperation in Yemen.” Middle East Research and Information Project. See the site, accessed on September 13, 2011: <http://www.merip.org/mer/mer254/water-conflict-cooperation-yemen>

³⁰ Speece, Mark. 1982. *Draft environmental report on Yemen (Yemen Arab Republic)*. Pages 29-30.

³¹ Greenwood, J.E.G.W. and D. Bleackley. 1967. “Geology of the Arabian Peninsula- Aden Protectorate.” USGS Professional Paper 560-C. Page C85.

³² Kirby, Alex. 2007. “Yemen's khat habit soaks up water.” BBC News, Sana'a. See the site, accessed August 31, 2011: http://news.bbc.co.uk/2/hi/programmes/from_our_own_correspondent/6530453.stm

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“Towards the north, the rains gradually diminish. In the central highlands, the summer is dry, with only a couple of showers a month. Most of the rain occurs in this region in two distinct rainy seasons, the lighter in March and April, and the heavier around August. In Sana’a, April may bring a rainfall of about 100mm and August usually sees almost 200mm of rain.”³³

“While Yemen is a Muslim country and Islamic law is a part of its legal heritage, its present legal system is codified and follows the civil law system. There are two laws that are relevant to your request. The first is the Water Law No. 33 of 2002, an Arabic copy of which is available on the Yemeni Public Prosecutor’s website, at [http://www.agoye.com/userimages/Image/book/2/2/1\(28\).pdf](http://www.agoye.com/userimages/Image/book/2/2/1(28).pdf), and the second is the Environment Law No. 26 of 1995, an Arabic copy of which is also available on the same website, at [http://www.agoye.com/userimages/Image/book/2/2/1\(23\).pdf](http://www.agoye.com/userimages/Image/book/2/2/1(23).pdf).”³⁴

“Historically, management of water resources in the Republic of Yemen has been inadequate, with some of the key problems being:

- water and property rights are not clearly defined,
- the problems of groundwater mining have led to abstraction rates that exceed recharge by about 80% on average, and in some places abstraction exceeds recharge by 400%,
- charges for water use are low, or non-existent,
- water usage is distributed 93% for irrigation purposes, 5% for domestic use, and 2% for industry, and
- political and economic upheaval over the past decade has resulted in limited institutional capacity, particularly to bring water demand in line with availability.

As a major step forward in the process of securing improved water resources management, the Government of the Republic of Yemen (GOY) have prepared a Water Law, which was ratified by the House of Representatives in July 2002.”³⁵

Geography

There are about 24,133,000 citizens of Yemen (2010 estimate). The median age is 18.1 years old, and the population growth is 2.647%, with 33.49 births per 1,000, and a death rate of 7.02% per 1,000 (2011 estimates). The life expectancy at birth is 63.74 years old.

About 32% of the total population is urbanized. The governorates of Yemen are divided into 333 districts (muderiah). The districts are subdivided into 2,210 sub-districts, and then into 38,284 villages (as of 2001).

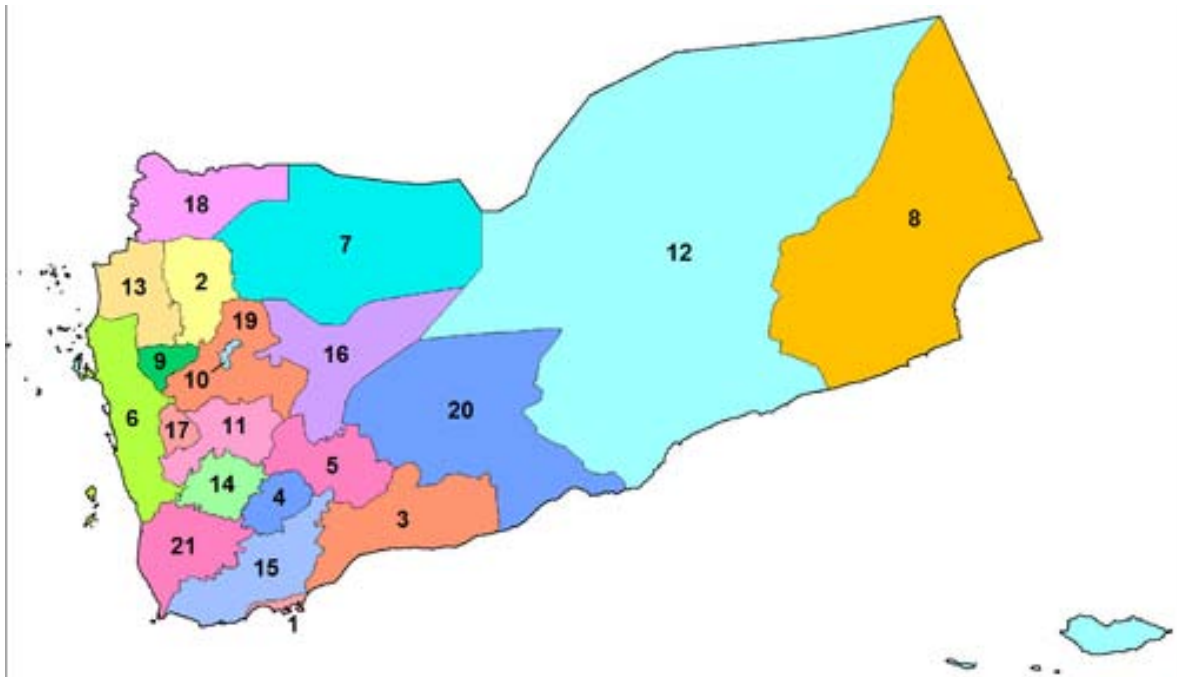
³³ Hämmäläinen, Pertti. 1991. Yemen: A Travel Survival Kit. Berkeley, CA: Lonely Planet. 2nd edition. Page 27.

³⁴ Saliba, Issam. 2012. Private communication. Issam Saliba is a foreign law specialist with the Law Library of Congress.

³⁵ Richards, Tony. 2002. “Assessment of Yemen Water Law: Final Report.” Prepared for: Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ) GmbH. Page 1. URL: <http://www.tc-wateryemen.org/documents/downloads/AssessmentofYemenWaterLawFinalReport.pdf>

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Provinces and Governorates of Yemen



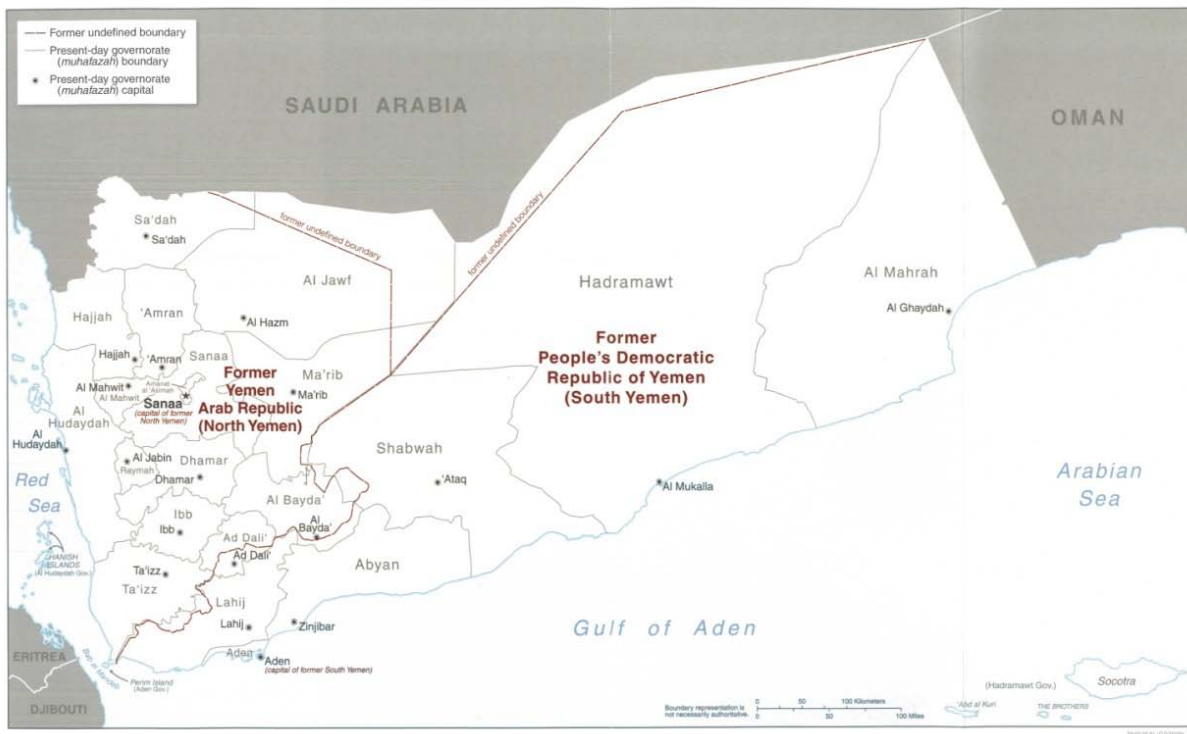
Former North Yemen (Yemen Arab Republic), until 1990

Division	Arabic Name	Capital City	Area km ²	Pop (2004)	Key to Map
'Amran		'Amran	9,013	877,786	2
Ad Dali'	علاضلا	Ad Dali'	4,448	470,564	4
Al Bayda'		Al Bayda	10,487	577,369	5
Al Hudaydah	قديدل	Al Hudaydah	15,407	2,157,552	6
Al Jawf	فوجل	Al Jawf	46,170	443,797	7
Al Mahwit		Al Mahwit	2,452	494,557	9
Amanat Al Asimah		San'a'	126	1,747,834	10
Dhamar		Dhamar	8,705	1,330,108	11
Hajjah		Hajjah	9,376	1,479,568	13
Ibb	بإ	Ibb	6,031	2,131,861	14
Ma'rib	برأم	Ma'rib	19,529	238,522	16
Raymah		Raymah	2,239	394,448	17
Sa'dah	قدهص	Sa'dah	14,364	695,033	18
Sana'a	عاعنص	San'a'	13,730	919,215	19
Ta'izz	زعت	Ta'izz	11,573	2,393,425	21

Former South Yemen (People's Democratic Republic of Yemen), until 1990

Division	Arabic Name	Capital City	Area km ²	Pop (2004)	Key to Map
'Adan	ندع	Aden	825	589,419	1
Abyan	نابأ	Zinjibar	20,380	433,819	3
Al Mahrah	قرملا	Al Ghaydah	78,073	88,594	8
Hadramaut	تومرضح	Al Mukalla	195,626	1,028,556	12
Lahij	جحل	Lahij	14,003	722,694	15
Shabwah	قوبش	Ataq	45,519	470,440	20

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(Central Intelligence Agency. Yemen- A Map Folio. 2011)

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Cities and Towns

Aden (*AH-den*, Arabic: عدن *Adan*) is a seaport city in Yemen, located by the eastern approach to the Red Sea (the Gulf of Aden), some 170 kilometres east of Bab-el-Mandeb.

The ancient port of Aden was well known to the Romans as the trading port of “Eudæmon” (Greek for “Happy Spirits”), and it was a transfer point on shipping between Rome and India, and partly the origin of the famous “Incense Route” and the “Spice Route” that saw the transportation and trade of aromatic trees (*de arboris aromaticis*) such as myrrh, pepper, cinnamon, cardamom and cassia; of aromatic herbs (*de herbis aromaticis*), such as nard, saffron, cardamom, that came through the trade routes, others that were also available in Europe, such as thyme, aloes, rose, violet, lily, gentian, wormwood, fennel and others. The decline of the incense trade later saw Yemen take to the export of coffee via the Red Sea port of *al-Mocha*.



Aden Region. See:

http://www.mapshop.com/Travel_Maps/Africa/African-Country-maps/Yemen9781553414629.jpg

a former oasis area; Al-Mansura, a town planned by the British; and Madinat ash-Sha'b (formerly Madinat al-Itihad), the site designated as the capital of the South Arabian Federation and now home to a large power/desalination facility and additional faculties of Aden University. Aden encloses the eastern side of a vast, natural harbor that comprises the modern port. The volcanic peninsula of Little Aden forms a near-mirror image, enclosing the harbor and port on the western side. Little Aden became the site of the oil refinery and tanker port. Both were established and operated by British Petroleum until they were turned over to Yemeni government ownership and control in 1977.

Aden is one of the largest towns, with an estimated population in 2010 of 692,900. “The port of Aden is undergoing large scale redevelopment, under a 20 year management contract with the Port of Singapore Authority, which holds 60 per cent equity. The port should capture significant Europe-Asia container traffic, as it avoids the detour into the Persian Gulf.”³⁶

³⁶ Australian Government Department of Foreign Affairs and Trade. 2000. “Accessing Middle East Growth. September 2000. ISBN: 0 642 47659 4. See the site, accessed August 31, 2011: <http://www.dfat.gov.au/publications/megrowth/index.html>.

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Dhamar Town and Dhamar Province. Dhamar is a major agricultural region, being located midway between two of Yemen's three largest cities (Sana'a and Ta'izz). It produces to some degree almost all the crops grown in the Yemeni highlands. Dhamar town itself is notable as the only town in the former Yemen Arab Republic not to be walled: rather it is merely a town on open plains. Dhamar is the most consistently elevated governorate in Yemen, with most of the land lying at over 2,500 metres (8,200 ft). The climate, though, remains hot during the day, with typical maxima of between 25 and 30 °C (77 and 86 °F), but frosts are very common at night during the winter months. During January 1986, temperatures are believed to have fallen as low as -12 °C (10 °F). Although no reliable rain gauge exists within the governorate, it is estimated that annual rainfall would range between 400 and 500 millimetres (16 and 20 in) concentrated exclusively in the summer months, especially in July and August but also in March and April. Occasionally, floods can prove disastrous though causing extensive erosion, notably in early April 2006. Adrah Dam: Adrah village is famous for its large number of dams. Adrah Dam is 10 kilometers to the east of Dhamar city. This dam dates back to the Hymiarate civilization but its ancient monuments are still there. The Dam is a water barrier built between two mountains. It is 67 meters long, 47 meters height, and approximately 20 meters width.

Hodeida (al-Hudaydah) is an industrial city and the seaport for Sana'a on the Red Sea. There is a main road between Sana'a and the port of Hodeida, about 40km long. Its chief exports are coffee and dates. After a disastrous fire in January 1961 destroyed much of the city, it was rebuilt, particularly the port facilities, with Soviet aid. A 360° photograph of the Port of Al Hudaydah with typical ships in the African style can be seen at the site, accessed on September 13, 2011: <http://www.360cities.net/image/port-of-al-hudaydah-with-ships-yemen/#484.47,16.95,70.0>

A highway to Sana, the capital, was completed in 1961. Hudaydah was the site of a Soviet naval base in the 1970s and 1980s. The city has a large number of historical places, particularly in Zabid, which is regarded as one of the most important Islamic towns in the world. The city is not large but it has more than 100 old mosques. Furthermore, the city used to have an old university which is as old as al-Azhar.

Al Hudaydah (Arabic: الحديدة *Al Hudaidā*) is also a governorate of Yemen, and its capital is Al Hudaydah. This governorate borders the Red Sea and is part of the narrow Tihamah region. Hodeida "...is the second largest city and the principal seaport in Yemen. It depends, for its domestic water, on the Town Water Supply with sources of water from four drilled wells in Baydah, about 11 kilometers northeast of the city. Water from these wells has nitrates, chloride, salt, calcium and magnesium far beyond acceptable levels for human consumption as defined by WHO." The average temperature in Hodeida (1974) was a low of 19°C, high 38.8°C, and often climbing above 54°. ³⁷

Huth. "Huth, the next town along the main asphalt road and thus roughly on the major watershed, is a little lower. The landscape and the housing are quite similar to those near Khamir. The track westward, however, from Huth to Shahārah, drops steeply from the plateau across a crumbling, weathered strata that give an impression of the world decayed; and at the bottom, in the lowlands of al-Batanah, one is in a quite different landscape. The temperature and humidity are higher than on the plateau, agriculture is far richer (exploiting spates from the mountains), and the insect life in summer makes the fizzling crackle of a broken insulator on some massive power cable. The dense fields of sorghum are interspersed with houses that are often little more than shanties. A few watch towers stand out on rock elevations. It is here that al-

³⁷ Speece, Mark. 1982. *Draft environmental report on Yemen (Yemen Arab Republic)*. Pages 5, 30.

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'Usaymat and 'Idhar are found. On the western side of al-Batanah is the rugged, terraced mountain massif, about 2,500 meters high, where Shaharah stands and where al-Ahnum have their territory."³⁸

Ibb (or **Abb**) (Arabic: إب) is a city in Yemen, the capital of Ibb Governorate, situated on a mountain ridge, surrounded by fertile land and is known as "The Green City". It is located about 73 miles (117 km) north-east of Mocha. Ibb was governed by a semi-autonomous emir until 1944, when the emirate was abolished. The population is 160,000 (2005). Ibb is bordered by several provinces, from the north with Dhamar, south with Ta'izz and Ad Dali, east with Al Bayda', and west with Al Hudaydah. Ibb has a cool continental climate, varied in the mountainous highlands and mild in the central plains, while it's warm in the southern and western regions. It rains over most parts of the province. A summer seasonal rainfall in most districts reach to 800–1200 mm.

The city has its source of water from three wells drilled in Queensland near Ibb. The quality of water is in excess of the maximum permissible limits in calcium, chloride and nitrates.³⁹

"Rainfall is highest on the western slopes of the western mountains and the southern part of the mountain area, where the province of Ibb is called "the fertile province." Around Ibb, it rains every month of the year- only a few mm in January but, in July and August (when there may be daily rain), a monthly rainfall of 500mm is common."⁴⁰

Al Mokha. Mocha or Mokha (Arabic: المخا [al-Mukhā]) is a port city on the Red Sea coast of Yemen. Until it was eclipsed in the 19th century by Aden and Hodeida, Mocha was the principal port for Yemen's capital Sana'a. At present, Mocha is no longer utilized as a major trade route and the current local economy is largely based upon fishing and small amounts of tourism. The village of Mocha was officially relocated 3 kilometers west along the Red Sea shore to accommodate the building and demolition of several coastal highways. This seaport town depends on two drilled wells for its water supply. The water has chlorides, sulphates, nitrates and salt content above the maximum permissible levels for human consumption.⁴¹

Saada (Arabic: صعدة *Ṣa'da*) is a governorate located in the north of Yemen on the border with Saudi Arabia. As of February 2004, the province had a population of 695,033 inhabitants, around 3.67% of the total population of Yemen and have an area of 11,375 square kilometers. It is one of the most inaccessible areas of Yemen and ranks among the poorest in the country. The provincial capital is Sa'dah, the largest city in the province. Saada is one of the few regions of Yemen inhabited by a large majority of Zaydis, a Muslim religious minority close to Shi'a Islam (from which they separated at the end of the 8th century after a dispute about the identity of the fifth Shi'a Imam). It is currently the center of an insurgency pitting Zaydi rebels against the government.

Sana'a is the largest town with a population of about 2.339 million (2009 estimate). "The geology around the city mixes volcanic with sedimentary rocks, and the reflected light in the morning and afternoon can create striking patterns on the brown and black mountains. This relieves the general barrenness of the city's environs, where the decline in the water table in the last few years has seriously impeded agriculture in the valley. Wadis flowing down into the

³⁸ Dresch, Paul. 1993. *Tribes, Government and History in Yemen*. Oxford: Clarendon Press. Page 27.

³⁹ Speece, Mark. 1982. *Draft environmental report on Yemen (Yemen Arab Republic)*. Page 31.

⁴⁰ Hämmäläinen, Pertti. 1991. *Yemen: A Travel Survival Kit*. Berkeley, CA: Lonely Planet. 2nd edition. Page 27.

⁴¹ Speece, Mark. 1982. *Draft environmental report on Yemen (Yemen Arab Republic)*. Page 30.

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valley, however, remain verdant channels of cultivation. Terracing, a short distance from the capital on the western slopes of the escarpment, allows the desolate hills to turn green during the year's two growing seasons."⁴²

The capital of Yemen, Sana'a, is one of the oldest cities in the world. It is a walled city with eight gates and numerous mosques. "If you want local colour, then go to Sana'a. The entire old city is a UNESCO World Heritage Site, complete with tall stuccoed houses whose perforated walls use the winds for natural ventilation. There is the small square which covers the site of the 6th-Century Christian cathedral, though nothing now remains of its ebony and ivory pulpit or its crosses of silver and gold. In the narrow lanes of the market you are pressed to buy a bag of dull golden crystals and your senses succumb to the smell of burning incense. To the Romans, Yemen was, after all, Arabia Felix, the home of frankincense and myrrh. They still make novel souvenirs. Venture further, beyond the Old City's 30-foot-high (9-metre-high) clay walls, and there are plenty more reminders that Sana'a is one of a kind. There is the Military Museum, an eclectic assembly of old weapons (including a camel-mounted cannon), old motor cars, and relics of the British colony in Aden. A chillingly topical touch is an illustration from the 1950s of an execution, the bloodied scimitar still in the swordsman's hand as the convict expires. Perhaps that explains why the museum is run by part of the interior ministry - the moral guidance department. Sana'a is at least 2,500 years old. It claims to be the world's oldest inhabited city, though Damascus disputes that."⁴³



Ancient houses of Old Sana'a, dating back hundreds of years, are kept in excellent condition in part thanks to U.S.-funded drainage and infrastructure projects near the old city. See: http://www.usaid.gov/our_work/features/yemen/

A small Vietnamese-speaking community is found in the capital city of Sana'a, originating from Yemeni immigrants expatriated from Vietnam after the Vietnam War in the 1970s. A small yet rising number of ethnic Chinese in Sana'a brought the Chinese language to the country, a byproduct of historic Chinese immigration. Also there are South Asian Languages spoken by the small but present South Asian community, most notably Hindi, Urdu and Marathi languages.

Sana'a is "...the capital city and depends upon deep wells dug to a maximum depth of 200 meters. The wells are dug in a cretaceous sandstone aquifer northeast and northwest of the city. Shallow wells are dug into the alluvium which overlie layers of basalt rock. Although this is probably the best water in Yemen, it is considered below acceptable standards for human consumption."⁴⁴

"One third of the 125 wells operated by the state-owned Sana'a Local Corporation for Water Supply and Sanitation for supply of the capital have been drilled down to 2,600 to 3,900

⁴² Cities of the World. 1981. Detroit: Gale Research Company. Volume 4: Asia, the Pacific and the Asiatic Middle East. Pages 363-364.

⁴³ Kirby, Alex. 2007. "Yemen's Khat Habit Soaks Up Water." BBC News, Sana'a. See the site, accessed August 31, 2011: http://news.bbc.co.uk/2/hi/programmes/from_our_own_correspondent/6530453.stm

⁴⁴ Speece, Mark. 1982. *Draft environmental report on Yemen (Yemen Arab Republic)*. Page 31.

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feet. The combined output of all these wells barely meets 35 percent of the growing city's need. The rest is supplied either by small, privately owned networks or by hundreds of mobile tankers. In recent years, as water quality has deteriorated, privately owned kiosks that use reverse osmosis -- a water filtration method -- to purify poor-quality groundwater supplies have mushroomed in Sana'a and other towns. Future supply options include pumping desalinated water from the Red Sea over a distance of 155 miles, over 9,000-foot mountains into the capital, itself located at an altitude of 7,226 feet. The enormous pumping cost would push the price of water up to \$10 per cubic meter (roughly 35 cubic feet). Yemen may be willing to pay this price for household demand. For agricultural water, however, the elevated cost is out of the question since the quantity required per capita is at least one hundred times greater. Other options to supply Sana'a from adjacent regions are fraught due to perceived water rights. Islam teaches that water is a gift from God and cannot be owned. Land, however, can. When a person digs or drills a well on his own land, he obtains the right to extract and use as much water as he can draw. The increasing awareness of the country's water scarcity has resulted in a race to the bottom -- every man for himself. Well owners are trying to capture what remains of this valuable resource before the neighbors do."⁴⁵

Ta'izz (Arabic: *تاعة Ta'izz*), or **Taiz**, is a city in the Yemeni Highlands, near the famous Mocha port on the Red Sea, lying at an elevation of about 1,400 metres above sea level. It is the capital of Ta'izz Governorate. The city is the third largest city in Yemen following the capital Sana'a and the southern port of Aden. Ta'izz has a dramatic setting where the roads run up and down the mountain sides. Above the city rises the 3,006 metres high Sabir Mountain. The weather in Taizz is fair and beautiful most of the time. The average daily temperature high during August is 30°C. Annual rainfall of Ta'izz may reach 760 mm to over 1,000 on Jabal Sabir per year. Ta'izz is one of the largest cities, and a government center in the highlands, with an estimated population in 2010 of 556,480 people.

"This city [Ta'izz] has its domestic water supply from the Town Water Supply and from natural springs in Jabal Sabar and Salah. The Town Water Supply has six wells in the Haugla area drilled by USAID during the sixties. (Sample analyses of these waters are listed in Appendix VI). Their nitrate content is extremely high and range from 50 to 200 parts per million as compared to 45 parts per million, considered the maximum permitted level for drinking purposes. Similarly, the salt content is 2,000 PPM as compared to the maximum permissible level of 1,500 PPM. Water from Jabal Salah is relatively acceptable although it has 16 PPM of nitrates and high levels of fluoride respectively. Yet there is considerable demand for this water although the supply fails to meet the demand. Therefore, over 90% of population depends upon the less desirable Town Water Supply for drinking and domestic use."⁴⁶

For such a small area, the Ta'izz governorate has an extraordinarily diverse geography. The western half of the governorate is part of the Tihamah coastal plain and has an exceedingly hot, humid and arid climate. The eastern half, however, is very mountainous, with the major peak being 3,070-metre-high Jebel Saber, near Ta'izz city. These mountains trap the moisture created by an upper-level wind reversal between April and October, so that in the eastern half of the governorate annual rainfall increases from 200 millimetres (8 inches) in the foothills to probably more than 1,000 millimetres (40 inches) near Jebel Saber. Temperatures in the highlands remain

⁴⁵ Lichtenthaler, Gerhard. 2010. "Water Conflict and Cooperation in Yemen." Middle East Research and Information Project. See the site, accessed on September 13, 2011: <http://www.merip.org/mer/mer254/water-conflict-cooperation-yemen>

⁴⁶ Speece, Mark. 1982. *Draft environmental report on Yemen (Yemen Arab Republic)*. Page 31.

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high during the daytime, but at the highest elevations they can fall dramatically to -5°C (23°F) overnight.

Ethnic Groups

The ethnic groups in Yemen are mostly Arab, but there are also populations of Afro-Arabs, South Asians and Europeans living in the country. About 70% of the men are literate; only about 30% of the women are.

There are also refugees from the region's problems. Some of these refugees are treated well, others not. "Since 2008 more than 100,000 mainly Somali and Ethiopian asylum seekers and migrants have arrived on Yemen's shores by boat. Many suffer horribly along the way. The smugglers who carry them cram their passengers into overcrowded boats and savagely beat those who try to move. Smugglers have murdered passengers and have often forced them to disembark in deep water and swim to shore, leading to many deaths from drowning. More than 1,000 people have died making the crossing in the past two years. After arriving in Yemen the exhausted travelers face one of two very different receptions, depending not on why they have come but on where they come from. Those from Somalia are welcomed as refugees without exception. But the majority of those from Ethiopia are treated like criminals to be hunted down and deported, even if they came to Yemen in search of asylum..."⁴⁷

Religions

Shaf'i (Sunni) The majority of the Sunni (63% of the total population of Yemen) are of the Shafi'i sect, but also include the Salafi and some other sects. "The southern mountains and the Tihamah have been predominately Shafi'i (Sunni) for almost as long, being ruled by a succession of more or less powerful states and sometimes raided or dominated by the northerners. The Shafi'is have much more tolerance for such practices as venerating saints, since they recognize less close an association than did Zaydis between religious doctrine and temporal power. The Imamate was the major difference between the two schools. Apart from this, the doctrinal differences between Zaydis and Shafi'is are not very marked, and it is only at a few points in their history that either group has tried to suppress practices approved by learned men of the other. But the northerners, without the Imams' encouragement, often dominated or even occupied Lower Yemen. At several periods the Imamate controlled both ends of the country, and southerners today show a marked distrust of northern tribesmen."⁴⁸

Zaydi or Zaidi or Sayyids (Shia): The majority of the Yemeni Shia (about 35% of the total population) are of the Zaydi sect, but also include the Isma'ili sect.

The origins of the sayyids were summarized by Dr. Paul Dresch in his book, *A History of Modern Yemen*. "The areas around Sana'a and northwards for centuries were dominated by Zaidi (Shi'ite) Imams. The crux of Zaidism was that legitimate rule descends through the Prophet's line, of his daughter Fatimah and son-in-law Ali Bin Abi Talib. Such descendants of the Prophet are usually called sayyids (also sometimes sharifs; or sadah⁴⁹ or 'Alawis, after Ali

⁴⁷ Human Rights Watch (Organization). 2009. *Hostile Shores Abuse and Refoulement of Asylum Seekers and Refugees in Yemen*. December 20, 2009. URL: <http://www.hrw.org/node/87224/section/1>.

⁴⁸ Dresch, Paul. 1993. *Tribes, Government and History in Yemen*. Oxford: Clarendon Press. Page 11.

⁴⁹ Mohammed Al-Kibsi told the Observer that he once heard his grandfather, who was a judge in Hajjah, telling this story: "My grandfather said that when Imam Al-Hadi first came to Yemen, he saw that most of the tribes people were illiterate shepherds. He instructed his cousins not to marry illiterate or ignorant people. He then kept marrying sharifat (plural of sharifa, female sayyids) to sadah," said Al-Kibsi. "All sadah do the same thing, and never allow non-family members to marry their daughters."

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Bin Abu Talib). Their venture in the northern part of Yemen was launched in AD 896 around Saada by the first Imam, Al-Hadi, and on occasion they had ruled enormous areas, Imams being of the sword as well as of the book and righteousness: the Qasimis in the seventeenth century had briefly held most of Yemen (even Hadhramout for some years), and certain earlier Imams less enamored of state forms had also been conquerors. The sayyids were important further south too, especially in Hadhramout. There the sayyid presence was established in AD 952 by a migrant from Iraq named Ahmad Isa, but the venture he began was very different from that in the far north and the Shafi'i (Sunni) style of Islam, unlike the Zaidi, launched no great bids for power: Sayyid influence was local, often built around mediation and sacred tombs, although family connections and connections of learning reached beyond particular towns or tribes."

Dhamar Governorate is the important seat for the Zaydi religious sect which has long had a major influence in Yemen. The pre-Islamic kingdoms of Saba' (Sheba), Qataban and Himyar had their capitals within the present area of Dhamar, and the Himyarite kingdom with its capital at Yarim set up the numerous terraces that allow for highly intensive agriculture throughout the region.

"The northern tribes have been much where they are now are throughout the period, and from the end of the ninth century AD to 1962 were associated with a succession of Zaydi (Shi'ite) Imams drawn from descendents from the Prophet. Zaydism developed early in Islamic history and has little in common with later developments of Shi'ite ideas in such countries as Iran. Zaydi scholars were usually hostile to undisciplined ecstasy, the veneration of saints, or millenarian longings, and they promoted instead a rather sober religious style which is still that of most tribesmen today. The Imam was ideally both a scholar and warrior who could order what is right and forbid what is reprehensible. The Imamate's political fortunes varied greatly, but association of Zayidism with the tribes is of long standing."⁵⁰

Jews are the oldest non-Muslim religious minority. Nearly all of the country's once-sizeable Jewish population have emigrated to Israel. Fewer than 400 Jews remain in the northern part of the country, primarily in Amran Governorate.

"A small but important Jewish minority existed in the country through the first 14 Islamic centuries. During the years 1948 to 1950, the newly established state of Israel organized operation "Magic Carpet", a major airlift from Aden through which some 50,000 Yemeni Jews emigrated to Israel, leaving only a few hundred behind."⁵¹ These Jewish families which remained in their homes in Yemen experienced increasing levels of harassment and danger from their neighbors.

Since January 2007, the historic Saada governorate community of 45 Jews have lived in Sana'a, under the protection and care of the Yemen Government, after abandoning their homes in the face of threats from al-Houthi rebels. The community has also abandoned its synagogues in Saada. There is at least one functioning synagogue in the Amran Governorate. Jewish residents of Rayda and Bait Harrash in Amran Governorate reportedly experienced increased harassment by a small group of their Muslim neighbors. Government officials reportedly could not intervene because of a lack of witnesses to the harassment. In one case a bullet was fired into a water tank on the roof of one of the community's homes while a member of the family was on the roof. Government authorities investigated the case and arrested the perpetrator, who remained incarcerated at the end of the reporting period. The displaced Saada Jewish community continued to reside in Sana'a, under government protection and care, after being threatened by

⁵⁰ Dresch, Paul. 1993. *Tribes, Government and History in Yemen*. Oxford: Clarendon Press. Page 11.

⁵¹ Hämmäläinen, Pertti. 1991. *Yemen: A Travel Survival Kit*. Berkeley, CA: Lonely Planet. 2nd edition. Page 41.

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al-Houthi rebels in January 2007. In April 2008 a large group of men entered, ransacked, and destroyed two homes in the Saada Governorate belonging to a member of the Jewish community now living in Sana'a. The attack was reportedly believed to have been the work of some of the al-Houthi rebels.⁵²

“At this time 65 Jews from Al Salim live in the Tourist City in San'a, and 270 Jews live in Raida and Kharif, in 'Amran governorate, where they live under the protection of the local tribe. We urge you to instruct Jibrán Abu Shawarib, the leader of the Hashid tribe in that area, and the governor of 'Amran province, Kuhlan Abu Shawarib, Jibrán's brother, to afford the Jewish communities in Raida and Kharif all necessary protection, and to work towards the safe return of the Jews now in Tourist City to their homes in Al Salim.”⁵³

Christian- In 2008, there were 3,000 Christians throughout the country, most of whom are refugees or temporary foreign residents. There are four churches in Aden, three Roman Catholic and one Anglican. Christian missionaries and nongovernmental organizations (NGOs) affiliated with missionary groups operate in the country; most restrict their activities to the provision of medical services; others were employed in teaching and social services. Invited by the Government, the Sisters of Charity run homes for the poor and persons with disabilities in Sana'a, Taiz, Hodeida, and Aden. A Swedish mission organization runs a technical school for the disabled and poor in Taiz. There was also a medical mission in Saada, but in January 2007, the mission reportedly fled to escape the fighting. It is believed that they remained in the region to provide medical assistance to victims of the violence. Another mission operated two charitable clinics in Aden.⁵⁴

Hindu- in 2008 there were 40 Hindus living in Aden who trace their origins to India. Aden also has one Hindu temple.⁵⁵

Tribes

Yemenis consider *Allah*, family, and tribe to be the most important aspects of their traditional society. The objective in life is to be devoted to *Allah* so that in death one's spirit will be with *Allah*. The Yemenis are extremely proud of their historical dedication to Islam.

People are concerned with the perceptions of others and will not do something that might be regarded as disrespectful to *Allah* or family. Likewise, individuals yield their wishes and rights to the well-being of the tribe or family. Concepts of personal space are not common. Ancestry helps determine who has power, who holds public office, and who is considered especially devout. Personal relations are also important. Yemenis prefer to establish trust and confidence before proceeding with business. Increasing Western influence has benefited Sana'a but has also created strains between more secular areas and conservative villages.

⁵² “Yemen” 2008. US Department of State. International Religious Freedom Report. See: <http://www.state.gov/g/drl/rls/irf/2008/108496.htm>.

⁵³ Human Rights Watch. January 9, 2009. “Letter to Yemen's President Saleh urging him to protect Yemen's Jewish community.” URL: <http://www.hrw.org/news/2009/01/09/letter-yemens-president-saleh-urging-him-protect-yemens-jewish-community>.

⁵⁴ “Yemen” 2008. US Department of State. International Religious Freedom Report. See: <http://www.state.gov/g/drl/rls/irf/2008/108496.htm>.

⁵⁵ “Yemen” 2008. US Department of State. International Religious Freedom Report. See: <http://www.state.gov/g/drl/rls/irf/2008/108496.htm>.

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“Yemen is a tribal society; therefore, people are mostly seen based on which tribe and or city they come from. Depending on the organization, where you come from may have a significant influence on where you go within the organizational structure. Ethnic differences also



(Central Intelligence Agency. *Yemen- A MapFolio*. 2011)

effect where one may go within the organizational structure with a “pure” Yemeni, a Yemeni whose both parents are from Yemen, being favoured over the “Muwalad” Yemeni who has a parent from a different country... A local superior or manager is usually respected for their experience and leadership. However, one must keep in mind that Yemen is a tribal structured country and therefore the city or tribe the manager belongs too can also play a role in defining the structure of the relationship with the superior or manager.”⁵⁶

It is above all the clan system that influences social interrelationships in Yemen. There is a complex hierarchy of tribes, each exerting different degrees of power.

“A tribe in Shabwa province permitted its men to kidnap their cousins for the purpose of marriage. Yemeni Bedouins divorced their wives

immediately if they were asked to do so or else they were considered of a lesser grade than normal men. Some tribes of Yemen shake hands and touch each other with their noses when they say hello to each other. While the tribesmen in a region in Saada province still adorn themselves and take better care of their hair than women.”⁵⁷

The current military aid and counterterrorism efforts will do little if anything to stabilize Yemen, which faces a host of grave environmental and economic challenges. Most of these challenges, from water shortages to a rapidly increasing population, are not easily dealt with and all require long-term strategies and solutions. The tribal nature of Yemeni society has existed for hundreds, if not thousands, of years and will remain long after the Salih regime has ended. This tribal structure is both an asset and an impediment to stability. It is an asset in that it often produces a functioning governmental structure that is responsive to local needs. The myriad tribes, their customs, laws and government have endured and in some cases offer viable and desirable alternatives to a regime that is beset with corruption and cronyism. However, it must also be noted that feuds between and within tribes are common and blood-feuds remain a scourge in parts of Yemen. The intertribal feuds, which will likely increase as the Salih regime’s patronage network breaks down, are one of the primary impediments to stability in Yemen. From practical and ideological perspectives, AQAP has little to offer to Yemen’s tribes and it is unlikely that the organization would be able to act as any kind of unifying force. However, if real development is not pursued, groups like AQAP will continue to find shelter and recruits among Yemen’s overwhelmingly impoverished residents. It is clear that AQAP understands the

⁵⁶ Centre for Intercultural Learning. 2011. Cultural Information- Yemen. See the site, accessed August 31, 2011: <http://www.intercultures.ca/cil-cai/ci-ic-eng.asp?iso=ye#cn-6>

⁵⁷ Yahya Al-Olfi. 2009. “Yemeni fading bizarre traditions.” *Yemen Times*. December 8, 2009. See the site, accessed August 22, 2011: http://www.yementimes.com/defaultdet.aspx?SUB_ID=17749.

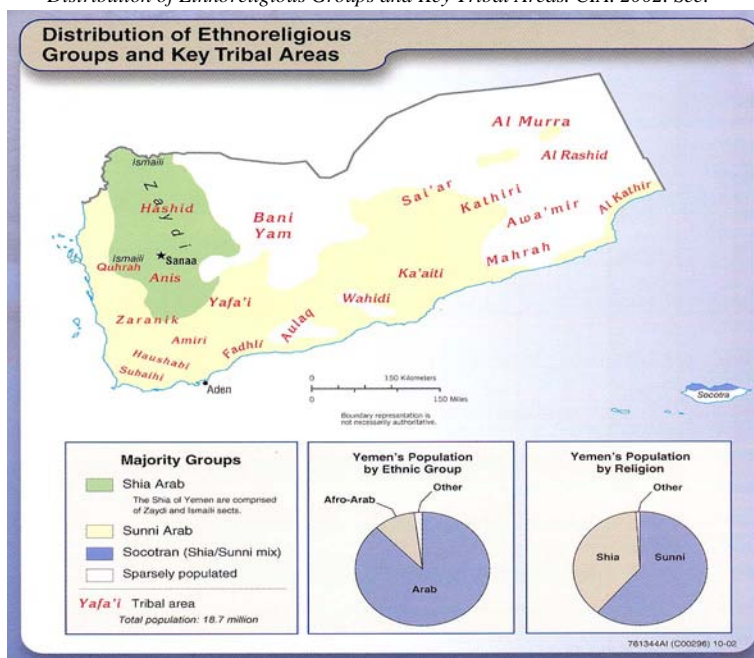
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importance of Yemen's tribes and that it is attempting to incorporate this understanding into its own efforts to recruit and expand in Yemen.⁵⁸

"Many of Yemen's northern tribes belong to one of two tribal confederations: the Bakil and the Hashid. The Bakil is Yemen's largest tribal confederation, but it is historically not as well organized as the smaller but far more politically active Hashid confederation. The Hashid, traditionally led by members of the al-Ahmar family, is an influential actor in Yemeni politics. President Salih's Sanhan tribe belongs to the Hashid confederation. This and Salih's reliance on tribal politics to consolidate and increase his political reach have ensured the continued prominence of the Hashid in all aspects of Yemeni society, especially in northern Yemen. Both the Hashid and the Bakil have rejected al-Qaeda efforts to recruit their members (Saudi Gazette, January 6, 2010)."⁵⁹

"Banu", the plural of "ibn", is used to designate a tribe or clan in Yemen.

Distribution of Ethnoreligious Groups and Key Tribal Areas. CIA. 2002. See:



http://www.lib.utexas.edu/maps/middle_east_and_asia/yemen_ethno_2002.jpg

"Certain tribal terms, not always corresponding to modern frontiers, are Yemeni, applied to certain tribes near Aden: Jebeli, various mountain tribes; Mushreqi or 'eastern', applied to an ill-defined district east of the Yemen. Other terms used in south Arabia, but much farther east, are Hinawi and Ghafari, two political factions to one or other of which every tribe in the south-east owes allegiance. Superficially these seem to date from an eighteenth century split over the succession in 'Omān, but their origin is really much deeper and may be racial. The Hinawi all

⁵⁸ Horton, Michael. 2011. "The Tribes of Yemen: An Asset or Impediment to Stability?" Terrorism Monitor. Volume 9 (3), January 20, 2011. See: http://www.jamestown.org/programs/gta/single/?tx_ttnews%5Btt_news%5D=37388&tx_ttnews%5BbackPid%5D=26&cHash=c435b1a3f7

⁵⁹ Horton, Michael. 2011. "The Tribes of Yemen: An Asset or Impediment to Stability?" Terrorism Monitor. Volume 9 (1), January 6, 2011. See: http://www.jamestown.org/programs/gta/single/?tx_ttnews%5Btt_news%5D=37330&tx_ttnews%5BbackPid%5D=26&cHash=0879e192ac

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claim descent from Qahtān, while the Ghafari are non-Qahtānic stock, mainly Ma'adi or Nizari. The Sei'ar are reckoned as the westernmost Ghafari, while the Al-Kathir are Hinawi. Regional terms for the country westwards and eastwards of Dhufār are, respectively, Ma'arab and Mishgas; thus the Sei'ar and all tribes to the west are Ma'arab, although some are Ghafari and others Hinawi.”⁶⁰

“...the Southern Arabs entered the Islamic period with a sense of ethnic distinction between themselves and all other Arabs to explain the differences in language, custom and physiognomy. Popular belief held and still holds that although the Arabs are descended from a common ancestor, Sham ibn Nuh (Shem, son of Noah), the “pure” or southern Arab (Qahtani) is descended from Qahtan ibn Amir (Joktan ben Eber), or Hud, as he is often called, whereas the northern Arab (Adani) is descended from Ismail (Ishmael) through Adnan. Other Arab nationals, particularly those of tribal societies, know or think they know to which group they belong but are little concerned about it, but this split is a matter of importance to Yemenis, and many twentieth century feuds can be traced back to it. The Imans of Yemen claimed Qahtani descent as a



consequence of their alleged descent from the Himyar, although they were in fact, Adanis if, as they also claimed, to be descendents of the Prophet Mohammed through his grandson Hassan. Author Manfred Wenner points out that both claims are possible as a result of intermarriage.”⁶¹

Tribal map of Yemen. Original source unknown. See the site, accessed August 22, 2011, at: http://www.google.com/imgres?imgurl=http://turcopolier.typepad.com/sic_sempet_tyrannis/files/tribal_map.jpg&imgrefurl=http://forums.islamicawakening.com/f18/anwar-al-awlaki-31538/&h=3508&w=2550&sz=1205&tbnid=IeCMZv2brs7_0M:&tbnh=150&tbnw=109&prev=/search%3Fq%3DYemen%2BTribal%2Bmap%26tbn%3Dsch%26tbo%3Du&zoom=1&q=yemen+tribal+map&hl=en&usq=Htr44gEh-8xTa6OBkbzfHwRhiRo-&sa=X&ei=KpSTsTwKZKugQfWtWTBw&ved=0CCUQ9QEwBw

Arab tradition maintains that a semi-legendary ancestral figure named *Qahtan* and his 24 sons are the progenitors of the southern inhabitants of the Arabian peninsula known as Qahtani. Early Islamic historians identified Qahtan with the Yoqtan (Joktan) son of Eber of the Hebrew Bible (Gen. 10:25-29). Among the sons of Qahtan are noteworthy figures like

A'zaal (believed by Arabs to have been the original name of Sana'a, although its current name has been attested since the Iron Age) and Hadhramaut. Another son is Ya'rub, and his son Yashjub is the father of 'Abd Shams, who is also called Saba. All Yemeni tribes trace their ancestry back to this “Saba”, either through Himyar or Kahlan, his two sons. The Qahtani people are divided into the two sub-groups of Himyar and Kahlan, who represent the settled Arabs of

⁶⁰ Naval Intelligence Division. 1946? “Western Arabia and the Red Sea.” Geographical Handbook Series. Pages 402-403.

⁶¹ Nyrop, Richard F. et al. 1986. The Yemens: Country Studies. DA Pamphlet 550-183. Pages 13-14.

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the south and their nomadic kinsmen (nomads). The Kahlan division of Qahtan consists of 4 subgroups: the Ta' or Tayy, the Azd group which invaded Oman, the 'Amila-Judham group of Palestine, and the Hamdan-Madhhij group who mostly remain in Yemen. The Kahlan branch includes the following tribes: Aus and Khazraj, Ghassan, Azd, Hamdan, Khath'am, Bajflah, Madhhij, Murad, Zubaid and Nakh', Ash'ar, Lakhm and Kindah.

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Qat (Khat)

The primary recreation in Yemen is chewing *qat* while visiting friends. Soccer, the most popular sport, is played mainly by school-aged boys. Women do not participate in sports, but they enjoy dancing. Music is an important part of festive occasions and *qat* chews.

Most Yemeni men visit friends and relatives every afternoon to talk, gossip, and chew *qat* (an addictive stimulant leaf that grows on a bush). The “chew” is usually held in a room with cushions and pillows on the floor. Visitors purchase their own *qat* at the *suq* (open-air market). When swallowed, juice from the leaves has a caffeine-like effect on the body but does not significantly alter behavior. Cola, juice, or water is also served. Guests also smoke a *mada'a* (water pipe filled with tobacco) and cigarettes. The visit ends by 6:30 p.m. Often business or political decisions are made and disputes are resolved during the chew. If women chew *qat*, they do so in a separate room or household. More Westernized or educated people may avoid *qat* because of its negative impact on society: *qat* inhibits a healthy appetite, the poor often substitute it for food, and *qat* fields are displacing cash and food crops.

Male guests do not see the females in the host family. If they need something, the host calls for the women to bring the desired item, which is placed where a male family member can retrieve it. Women do not necessarily visit the same homes as their husbands. In rural areas or the north, women only visit close neighbors; they do not walk on roads or go into town. Young children generally stay with their mothers when they visit, or they stay home with an older sister or grandparent.

Housing styles vary from region to region, but most homes feature a sitting room, in which the male host and his guests sit on cushions as they chew *qat*. Rural Yemenis generally live in stone or mud-brick houses with two or three storeys. Multi-storey apartment buildings are common in cities, though some families build small freestanding houses on urban outskirts, where land is cheaper. Examples of ancient building methods—such as stones fitted together without mortar—are still evident in many parts of the country, though cinder blocks are rapidly replacing traditional techniques. Running water is available in many parts of the country, but most villages remain without it. Women in remote areas typically draw water from the nearest well twice a day, sometimes walking up to two hours each way. They may carry the water in pots on their heads or load them onto donkeys.⁶²

The preferred social activity among Yemenites is the khat session. The khat is a green plant that produces a light stimulant effect. According to the World Health Organization it is a mild narcotic, although Yemenites are convinced that it is not a drug. Its freshly cut leaves are chewed and held between the teeth and the cheek. The more skillful manage to form a tennis ball sized mass in their mouths! Khat sessions take place every day. Someone will invite friends to their home, or a gathering will occur in a public place or on the street. Sessions begin early in the afternoon and may last until late in the evening. It is said that khat loosens the tongue and keeps one awake. As a result, khat sessions are an opportunity for long conversations among men. It

⁶² "Yemen." *CultureGrams Online Edition*. ProQuest, 2011. Web. 31 Aug 2011.

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would appear that a number of important decisions are made during khat sessions, which are always timed to coincide with formal and official meetings. On the other hand, it is generally thought very poorly of for women to indulge in this activity.⁶³

“The country imports most of its food, largely because it has too little water to feed itself. Yemenis have about one-fiftieth as much water per head as the world average. And, to confound confusion, insupportably large amounts of water go on a non-essential crop - khat. Khat in today’s Yemen is what smoking was in Britain a generation ago. Everywhere you go you find men with cheeks bulging bizarrely as they get their fix. It is a shrub whose leaves, when you chew them, can induce mild euphoria, excitement, hallucinations and even constipation. It is increasingly popular in Yemen. While a few years ago men would spend a couple of hours a day on their habit, many now chew happily away for seven or eight hours. Within the last five years or so khat use has become much more accepted among women. One young professional woman told me she chewed it perhaps once every three months, as a way of socialising. More often, she said, would be too much. She blames the drug for what she says is Yemenis’ failure to better themselves. Moralising apart, khat is having a baleful effect on Yemen. Of the country’s scarce water, 40% goes on irrigating khat - and khat cultivation is increasing by 10% to 15% a year. You cannot blame the farmers. As one says, growing khat earns him 20 times as much as growing potatoes. You probably should not blame the chewers either. In a country where almost half the people live on less than US\$2 (£1) a day, you find your fun where you can.”⁶⁴

Infrastructure

Yemen’s infrastructure is poor. It has no railway and relies on a dilapidated road network to transport people and goods around the country.

Roads

The British government has a clear warning for their military and civilian employees, or British tourists, about using the roads in Yemen: “In the event of a breakdown of law and order access routes in and out of major cities may be blocked. If you wish to drive outside Sana’a you will need prior permission from the Yemen Tourist Police. Travel permits may take at least 24 hours to be issued and are easiest to obtain through a travel agent. Travel without such permission is likely to result in detention and possible deportation. You should be aware that the consular assistance we can offer outside Sana’a is limited due to restrictions on travel. There have been disturbances in Aden, Lahij and al-Dhali’, which have resulted in closures of the Aden-Sana’a road. These have been short-lived but if you intend to travel by road you should check that the road is open before starting your journey. You can drive in Yemen on an International Driving Permit. Driving standards are poor and mountain roads hazardous. You should avoid all road travel outside the main cities at night. Care should also be taken to avoid minefields left over from Yemen’s civil wars. Travelling off well-used tracks without an experienced guide could be extremely hazardous, particularly in parts of the south and the central highlands.”⁶⁵

⁶³ Centre for Intercultural Learning. 2011. Cultural Information- Yemen. See the site, accessed August 31, 2011: <http://www.intercultures.ca/cil-cai/ci-ic-eng.asp?iso=ye#cn-6>

⁶⁴ Kirby, Alex. 2007. “Yemen's khat habit soaks up water.” BBC News, Sana’a. See the site, accessed August 31, 2011: http://news.bbc.co.uk/2/hi/programmes/from_our_own_correspondent/6530453.stm

⁶⁵ Foreign and Commonwealth Office. Travel and Living Abroad: Yemen. See the site, accessed on August 31, 2011: <http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/middle-east-north-africa/yemen>

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Given the size of the country, the road transport system in Yemen is relatively limited. In 2004 there were around 10,500 km of asphalt roads and 13,500 km of graded roads. By comparison, neighboring Oman, with a total land area of around two-thirds the size of Yemen (and a considerably smaller population), has about 14,700 km of asphalt roads and more than 25,000 km of graded roads. Maintenance poses another problem for Yemen: in many areas of the south the road system is in a state of disrepair. The poor road system hinders economic development, and one of the demands frequently made by tribes in the north in exchange for hostages is provision of roads to villages. Aware of the inadequacies of Yemen's road system, the government is making efforts to upgrade the country's main arterial routes. Plans for a highway linking Aden in the south and Amran in the north are well advanced, although funding remains a hurdle. Once completed, the road will halve the current journey time between the southern coast and the northern border with Saudi Arabia.⁶⁶

"...what is dust during the dry season becomes mud when it rains. You may find that small dirt roads along the wadis- plenty of them around here! - are untraversable, even with a 4WD vehicle, so you had best stick to the main roads."⁶⁷

Yemen's transportation system is relatively extensive; the most remote mountain villages are accessible by some form of transportation. Two-lane paved roads run between major cities. Smaller communities are connected by dirt roads or dry riverbeds. Private cars are rare outside of major cities. Most urban people travel by bus or in converted six-passenger minivans. Shared taxis are fast and convenient but crowded, with 10 people in a station wagon or as many as 20 in a larger vehicle. Buses are slower but more comfortable. Outside of large cities, women rarely travel, and then only if accompanied by a male relative. Yemen has an airline but no railways. Major seaports are located in Aden, al-Hudaydah, al-Mukalla, and Mocha.

"Foreigners who use public transportation complain about fleas and lice."⁶⁸

Ports

The main ports of Yemen are: Hodeida (Al Hudaydah), Aden, Mukalla (Al Mukalla) and Mocha. In addition, Ras Isa serves as a loading point for oil exports, and a small amount of cargo passes through Nastoon port. Hodeida, built by the Soviets in the 1960s, is the main point of entry for imports to the populous northern highlands. Mukalla serves the Hadramawt hinterland for imports of goods and exports of oil. An active trade in live animals with Ethiopia is conducted through Mocha. Another port is under construction at Belhaf, on the southern coast, from where the country will commence liquefied natural gas (LNG) exports in 2009.⁶⁹

Yemen's primary port is in Aden, which has a natural physical advantage over other container ports in the region: it is just a few kilometres off the main shipping routes between Europe and Asia and is one of the world's best natural deepwater harbours. Facilities at Aden consist of Maalla port and the Aden Container Terminal (ACT), which opened in March 1999.

⁶⁶ Economist Intelligence Unit: Country Profile: Yemen. See: http://find.galegroup.com/gtx/infomark.do?&contentSet=IAC-Documents&type=retrieve&tabID=T001&prodId=AONE&docId=A180876881&source=gale&srcprod=AONE&userGroupName=loc_main&version=1.0.

⁶⁷ Hämmäläinen, Pertti. 1991. Yemen: A Travel Survival Kit. Berkeley, CA: Lonely Planet. 2nd edition. Page 64.

⁶⁸ Cities of the World. 1981. Detroit: Gale Research Company. Volume 4: Asia, the Pacific and the Asiatic Middle East. Page 363.

⁶⁹ Economist Intelligence Unit: Country Profile: Yemen. See: http://find.galegroup.com/gtx/infomark.do?&contentSet=IAC-Documents&type=retrieve&tabID=T001&prodId=AONE&docId=A180876881&source=gale&srcprod=AONE&userGroupName=loc_main&version=1.0.

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After the collapse in business at the port in late 2002 after the bombing of a French tanker, the Limburg, monthly throughput dropped from over 42,000 TEUs in September to just 8,000 TEUs. However, activity has since recovered, and in 2007 the ACT handled its highest throughput ever. In November 2007 a Memorandum of Understanding (MoU) was signed with Dubai Ports World (DP World) to operate and develop the ACT.⁷⁰

Sea Transport

The International Maritime Bureau reports offshore waters in the Gulf of Aden are high risk for piracy; numerous vessels, including commercial shipping and pleasure craft, have been attacked and hijacked both at anchor and while underway; crew, passengers, and cargo are held for ransom; the presence of several naval task forces in the Gulf of Aden and additional anti-piracy measures on the part of ship operators reduced the incidence of piracy in that body of water by more than half in 2010.

The Yemen Coast Guard was established in 2002. According to the US Coast Guard website, they helped the Yemen Coast Guard with their patrol boats: “US Coast Guard Awards Contract to Build Two 87-foot Protector-class Coastal Patrol Boats for the Yemen Coast Guard. September 11, 2009. The Coast Guard awarded a \$28.2 million contract to Bollinger Shipyards, Inc., in Lockport, La., on September 11, 2009, to build two 87-foot Protector-class Coastal Patrol Boats for the Yemen Coast Guard. The Office of International Acquisition (CG-922) at the U.S. Coast Guard (USCG) received a request from the Navy International Programs Office (IPO) to procure these boats on May 13, 2009. The USCG anticipates the delivery to Yemen in August 2011. This procurement is the latest in a series of projects, which further strengthen the longstanding relationship between the US Coast Guard and the Yemen Coast Guard. Since 2003, the USCG has delivered eight 44-foot Motor Life Boats, twelve 25-foot Defender Response Boats, and four 42-foot Fast Response Boats (SPC-NLB) to the Yemen Coast Guard. The USCG has also provided 26 mobile training team visits and 54 resident training slots in USCG schools to the Yemen Coast Guard.”⁷¹



Yemen also has some lighthouses that are maintained for sea navigation by the Yemen Ports Authority, an extension of the “Port of Aden.” A list of the lighthouses, photographs and descriptions of their flashing can be seen (accessed on January 6, 2012) at: <http://www.unc.edu/~rowlett/lighthouse/yem.htm>.

Air transport

Yemen has five major airports: Sana’a, Aden, Rayyan (near Mukalla), Taiz and Hodeida. Following renovation work at Aden airport, which was damaged during the 1994 civil war, the government had ambitious hopes to turn the facility into a regional cargo hub, with an “air cargo village” to be created alongside the long-planned free zone. The project subsequently collapsed amid allegations of corruption, although some US\$250m of the funds raised at the London donor conference in 2006 is to be used to revive the project. Another 12 airports have paved runways.

⁷⁰ Economist Intelligence Unit: Country Profile: Yemen. See: http://find.galegroup.com/gtx/infomark.do?&contentSet=IAC-Documents&type=retrieve&tabID=T001&prodId=AONE&docId=A180876881&source=gale&srcprod=AONE&userGroupName=loc_main&version=1.0.

⁷¹ Url: <http://www.uscg.mil/acquisition/newsroom/updates/fms091109.asp>

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Yemen also has another 38 airports with unpaved runways, most of them under 1,500 meters long.

Yemenia is the national airline. In 1996 it absorbed Al Yemda, the former carrier of South Yemen. Plans to privatise Yemenia, 51% of which is owned by the government of Yemen and 49% by the government of Saudi Arabia, have seemingly been abandoned. The company suffers from overstaffing and ageing aircraft. Yemenia partly resolved the latter issue by leasing three new Boeing 737s for eight years, effective from April 2002. However, with the fleet's remaining nine aircraft rapidly becoming worn out, Yemenia announced in March 2006 that it would acquire six Airbus A350 long-haul aircraft, with options for four more. Deliveries are scheduled to begin in 2012.

Energy

According to the World Bank, Yemen has the lowest level of electricity connection in the Middle East, with only 40% of the population having access to electricity. Rural areas are particularly badly affected. Industrial concerns, hospitals and hotels have their own back-up generators. To address these shortages, a 340-mw gas-fired power plant is currently under construction--and close to completion--at Marib. Further expansion to the facility, which will add an additional 400 mw of output, is already planned. Yemen has received considerable support for the development of its power generation network in recent years, with contributions coming from Saudi Arabia, France, the US, as well as multilateral donors such as the World Bank. Consequently, a National Rural Electrification Program is now in place and the construction of three substations, along with the necessary transmission lines, is currently under way. Yemen is also looking into the development of wind power, although plans for the construction of a nuclear power generating facility have been shelved.⁷² Electrical production is 5.665 billion kWh (2007 estimate). Electrical consumption is about 4.133 billion kWh.

Telecommunications

Landline telephone systems have become much more reliable in recent years, and cellular phone use is now widespread. Internet cafés are available in major cities.

Yemen's television stations are government-owned. Newscasts are in Arabic (with two English news bulletins per day). Local radio stations broadcast in Arabic. The Ministry of Information administers all broadcasting through the Public Corporation for Radio and Television. It controls most printing presses and funds some newspapers.

The press writes openly about social life and politics. Sana'a has several Arabic daily newspapers and two English weekly papers. TV and radio are vital news sources, given that illiteracy is widespread. State-run Yemeni Radio and Television Corporation (YRTC) operates national networks. Private satellite TV stations operate from bases outside Yemen.⁷³

Republic of Yemen Radio (<http://yemenrt.com/en/english.htm>) is state run, and operates the General Program from Sana'a, and the Second Program from Aden.

General assessment: since unification in 1990, efforts have been made to create a national telecommunications network

⁷² Economist Intelligence Unit: Country Profile: Yemen. See: http://find.galegroup.com/gtx/infomark.do?&contentSet=IAC-Documents&type=retrieve&tabID=T001&prodId=AONE&docId=A180876881&source=gale&srcprod=AONE&userGroupName=loc_main&version=1.0.

⁷³ "Yemen." *CultureGrams Online Edition*. ProQuest, 2011. Web. 14 Sep 2011.

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Domestic: the national network consists of microwave radio relay, cable, tropospheric scatter, GSM and CDMA mobile-cellular telephone systems; fixed-line and mobile-cellular teledensity remains low by regional standards

International: country telephone code - 967; landing point for the international submarine cable Fiber-Optic Link Around the Globe (FLAG); satellite earth stations - 3 Intelsat (2 Indian Ocean and 1 Atlantic Ocean), 1 Intersputnik (Atlantic Ocean region), and 2 Arabsat; microwave radio relay to Saudi Arabia and Djibouti.

The Internet country code for Yemen is .ye. In 2010 there were 255 Internet hosts in the country. About 2.349 million Yemenis have access to the Internet (2009 estimate). Internet use is growing, albeit from a very low base. According to the ITU, in September 2009 there were 370,000 users, or 1.6 per cent of the population. OpenNet Initiative, which monitors internet censorship, says filtering is “relatively broad in scope”. Rebel groups are increasingly making use of the internet to air their views.

Teledensity in Yemen is low, with only 4.5 landlines per 100 people in 2007, according to the International Telecommunication Union (ITU). This is the lowest penetration rate in the region (with the exception of Sudan) and compares unfavorably with international norms. Mobile-phone density in Yemen is also low by regional and global standards, at just 13.6 subscribers per 100 people in 2007, according to the ITU, although it is increasing rapidly. TeleYemen is the exclusive provider of international telecoms services for the country--including fixed-line, telex and Internet services--and is also one of the mobile-phone operators. In December 2003 a five-year tender for the management of TeleYemen was awarded to France Telecom. An initial public offering of some 45% of TeleYemen’s mobile subsidiary, Yemen Mobile, was launched in July 2006, with shares traded through the banks. Two private companies, Sabafon and Spacotel Yemen, launched mobile-phone services in early 2001, after winning 15-year licences at a cost of US\$10m each in mid-2000. Growth of the companies’ services has been rapid, but the precarious security environment, ponderous legal system and poor consumer payment record have acted as barriers. In August 2006 a licence for a fourth mobile-phone provider was awarded to Unitel, a joint venture between China Mobile and a group of Yemeni investors. Yemen’s usage of the Internet also remains low in comparison with that of neighboring countries--a result of the prohibitively high costs of computer equipment and connections relative to average wages, as well as the restricted bandwidth available on the country’s outdated telephone network.⁷⁴

74 Economist Intelligence Unit: Country Profile: Yemen. See: http://find.galegroup.com/gtx/infomark.do?&contentSet=IAC-Documents&type=retrieve&tabID=T001&prodId=AONE&docId=A180876881&source=gale&srcprod=AONE&userGroupName=loc_main&version=1.0

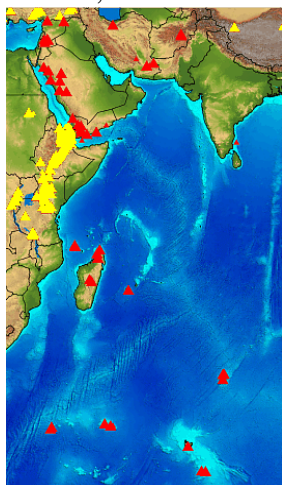
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Natural Hazards

Earthquakes in Yemen: January 1, 1941 in Yemen. Latitude: 16.400; Longitude: 43.500 Magnitude: 5.9; Deaths: 1200.

December 13, 1982 “North Yemen Earthquake” Latitude: 14.675; Longitude: 44.223; Magnitude: 6.2MW; Depth: 7km; Deaths: 2,800. “In 1982, [US Air Force] Military Airlift Command airlifted 87 tons of supplies -- tents, blankets, medical supplies, and generators -- to earthquake victims in the Yemen Arab Republic.”⁷⁵

November 22, 1991. Latitude: 13.887; Longitude: 44.068; Depth: 10km; Magnitude: 4.7mb; Deaths: 11.



Sandstorms and dust storms occur in summer months.

Volcanism: Yemen experiences limited volcanic activity; Jebel at Tair (Jabal al-Tair, Jebel Teir, Jabal al-Tayr, Jazirat at-Tair) (elev. 244 m), which forms an island in the Red Sea, erupted in 2007 after awakening from dormancy.

*Large red triangles show volcanoes with known or inferred Holocene eruptions; small red triangles mark volcanoes with possible, but uncertain Holocene eruptions or Pleistocene volcanoes with major thermal activity. Yellow triangles distinguish volcanoes of other regions.*⁷⁶

Other historically active volcanoes include Harra of Arhab, Harras of Dhamar, Harra es-Sawad, and Jebel Zubair, although many of these have not erupted in over a century.

Volcanoes of Yemen⁷⁷:

Name	Meters	Feet	Coordinates	Last Eruption
Bir Borhut ⁷⁸			15°33N/50°38E	905
Hanish	422	1,384	13°43N/42°44E	Holocene
Harra es-Sawad ⁷⁹	1,737	5,699	13°35N 46°07E	1253
Harra of Arhab ⁸⁰	3,100	10,170	15°38N 44°05E	500

⁷⁵ “Humanitarian Relief.” URL: <http://www.af.mil/information/heritage/spotlight.asp?id=123009451>.

⁷⁶ Siebert L, and Simkin T (2002-). [Volcanoes of the World: an Illustrated Catalog of Holocene Volcanoes and their Eruptions. Smithsonian Institution, Global Volcanism Program Digital Information Series, GVP-3, \(http://www.volcano.si.edu/world/\).](http://www.volcano.si.edu/world/)

⁷⁷ Siebert L, and Simkin T (2002-). [Volcanoes of the World: an Illustrated Catalog of Holocene Volcanoes and their Eruptions. Smithsonian Institution, Global Volcanism Program Digital Information Series, GVP-3, \(http://www.volcano.si.edu/world/\).](http://www.volcano.si.edu/world/)

⁷⁸ Arabic reports exist of an active volcano in eastern Hadramaut that erupted in the 10th century and was reported to be still smoking in 1813. Geologic maps of the Arabian Peninsula show Quaternary mafic volcanic rocks in this area, which lies south and west of the Wadi al Masilah river valley.

⁷⁹ The Harra es-Sawâd (or Shuqra) volcanic field in southern Yemen extends for nearly 100 km along the Gulf of Aden, east of the city of Shuqra (Shaqra). The volcanic field is oriented WSW-ENE and contains about a hundred cones that have produced a 40 x 95 km lava field that blankets faulted basement limestones. Most of the volcanic field is Holocene in age, and in many cases the flows and cones are essentially uneroded. Although eruptions may have occurred in historical time, the only recorded event was a major, but poorly documented eruption in 1253 AD.

⁸⁰ The Quaternary Harra of Arhab lava field in Yemen, north of the capital city of Sana'a, consists of a 1500 sq km basaltic plateau capped by a few small stratovolcanoes and about 60 scoria cones, two of which have erupted in historical time. Cones in the volcanic field (also known as the Sana'a or the Sana'a-Amran volcanic field) are

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Harra of Bal Haf ⁸¹	233	764	14°03N 48°20E	Holocene
Harras of Dhamar ⁸²	3,500	11,483	14°34N 44°40E	1937
Jabal el-Marha ⁸³	2,650	8,694	15°17N 44°13E	Holocene
Jabal Hamman Demt	1,500	4,921	14°03N 44°45E	
Jabal Haylan ⁸⁴	1,550	5,085	15°26N 44°47E	1200 BC
Jebel Tair	244	801	15°42N 41°44E	1332
Jebel at Tair	244	801	15°33N 41°49E	2007
Jebel Zubair	191	627	15°03N 42°11E	1824
Unnamed ⁸⁵	Unknown	Unknown	12° 15N 45°00E	
Zukur	624	2,047	14°01N 42°45E	Holocene

Economy

Yemen is a low income country that is highly dependent on declining oil resources for revenue. Petroleum accounts for roughly 25% of GDP and 70% of government revenue. Yemen has tried to counter the effects of its declining oil resources by diversifying its economy through an economic reform program initiated in 2006 that is designed to bolster non-oil sectors of the economy and foreign investment. In October 2009, Yemen exported its first liquefied natural gas as part of this diversification effort. In January 2010, the international community established the Friends of Yemen group that aims to support Yemen's efforts towards economic and political reform, and in August 2010 the IMF approved a three-year \$370 million program to further this effort. Despite these ambitious endeavors, Yemen continues to

commonly aligned along a north-NW trend above a 100-250-m-thick volcanic plateau. Pliocene-to-Holocene volcanic rocks have a dominantly basaltic-to-hawaiitic composition and overlie the northern end of an area of extensive Oligocene-Miocene basaltic-to-rhyolitic rocks that extends to the SW tip of the Arabian Peninsula. The latest eruption at Harra of Arhab took place in pre-Islamic time between about 400 and 600 AD and produced a lava flow that traveled 9 km.

⁸¹ The Harra of Bal Haf is a small volcanic field along the Gulf of Aden in southern Yemen that contains tuff cones and large aa lava fields. The volcanic field lies along the coast about 100 km SW of the city of Al Mukalla. Lava flows erupted from cinder cones blanket much of the volcanic field and produce an irregular shoreline. One fresh-looking basaltic flow may be of historical age. At-Tabâb tuff cone along the coast rises from the sea to 233 m and has a 1.5-km-wide crater partially filled by a cinder cone and associated lava flows. An adjacent tuff cone to the east is lake filled.

⁸² The lava fields surrounding the town of Dhamar are part of a volcanic field extending 80 km to the east that includes several stratovolcanoes and many youthful volcanic cones. Basaltic lava flows overlie older rhyolitic flows. Harras of Dhamar was the source of the only 20th-century eruption in the Arabian Peninsula, where possible explosive activity occurred in 1937.

⁸³ Jabal el-Marha is an isolated ca. 2500-m-high, crescent-shaped tuff cone about 11 km south of the center of Sana'a, the capital city of Yemen. A very fresh-looking basaltic aa lava flow was erupted from this little-known volcano (Catalog of Active Volcanoes of the World), although the age of the flow is not known. The flow traveled 1.8 km east from the cone over alluvial deposits on a broad plain that is partly covered with bombs and lapilli from the eruption.

⁸⁴ The Jabal Haylan area contains a 75-km-long chain of tuff cones and associated olivine basaltic lava flows in eastern Yemen. The chain crosses a NW-SE-trending fault extending between the highlands and desert lowlands to the east. One of the lava flows covers alluvial terraces that accumulated behind man-made dams dating back to about 800-1200 BC (Catalog of Active Volcanoes of the World).

⁸⁵ A submarine volcano in the Gulf of Aden between Yemen and Somalia was listed by Rudolph (1887), von Wolff (1914), and Sapper (1917) with no mention of the date of its activity (Neumann van Padang, 1963). The validity of these reports is uncertain.

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face difficult long term challenges, including declining water resources and a high population growth rate.

Most people are employed in agriculture and herding; services, construction, industry, and commerce account for less than one-fourth of the labor force. The unemployment rate in 2003 was 35%. Almost 42% of the population is below the poverty line.

Agricultural products are: grain, fruits, vegetables, pulses, qat, coffee, cotton; dairy products, livestock (sheep, goats, cattle, camels), poultry; fish

Main industries are: crude oil production and petroleum refining; small-scale production of cotton textiles and leather goods; food processing; handicrafts; small aluminum products factory; cement; commercial ship repair; natural gas production.

Oil production is about 288,400 bbl/day (2009 estimate). Natural gas production is 454,700 cubic meters (2009 estimate).

In Yemen, hierarchy is very important in the work setting, and there is a great deal of respect for authority. Traditionally, decisions are made at the top of the organizational chart. It is uncommon to make decisions by committee.

Yemenites have not been exposed to participatory management styles.

Nevertheless, when they are explained and put into effect, such techniques receive a positive response.

It is perfectly acceptable to seek feedback from one's supervisor. He will consider the initiative to be a mark of respect and loyalty.

Decisions are usually taken by certain superiors/managers and work their way down. Ideas are generated by senior staff and rarely come from the average employee. This also changes from organization to another. Private sector organizations involve employees in the decision making process more than any other organizations. However, in general decisions are made at the top of the hierarchy and work their way down.

It is acceptable to go your immediate supervisor for answers and feedback. However, you may not receive the amount of feedback you would expect here in Canada. Yemenis are generally conservative in feedback and may avoid constructive criticism through a face-to-face interaction.⁸⁶

Yemen has relatively few natural resources. It has limited--and dwindling--oil reserves, although the country has only just begun to fully exploit its gas potential. The commercial viability of other mineral deposits, such as those of gold and zinc, was believed to be limited. However, in early 2008 a UK company, ZincOx, announced its intention to develop a zinc mine in the country. Around the same time, the General Authority for Survey and Minerals published the results of a geological survey that it had recently carried out, which revealed larger quantities of gold deposits in the country than had previously been realised. The survey indicated that the area around Wadi Madan in the Harraz mountain massif contains about 678 tons of minerals, of which 15% is gold and 11% silver.⁸⁷

⁸⁶ Centre for Intercultural Learning. 2011. Cultural Information- Yemen. See the site, accessed August 31, 2011: <http://www.intercultures.ca/cil-cai/ci-ic-eng.asp?iso=ye#cn-6>

⁸⁷ Economist Intelligence Unit: Yemen. http://find.galegroup.com/gtx/infomark.do?&contentSet=IAC-Documents&type=retrieve&tabID=T001&prodId=AONE&docId=A180876880&source=gale&srcprod=AONE&userGroupName=loc_main&version=1.0

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“Surprisingly few occurrences of economic minerals have been discovered in the basement areas of the E.A.P. What has been discovered does not appear to be of commercial value, being mainly limited to occurrence of iron in dikes or mineralized veins in areas of difficult access or too far from seaports. Some scattered occurrences of other minerals, including traces of galena, some mica (here of no commercial value), and small garnets are of no economic significance. It must be pointed out, however, that no systematic mineral survey of the area has been made. Such a survey may yield some results, but they will probably be limited, to judge by the overall picture so far known.”⁸⁸

Education

In the past, only the *Qur'an* was taught at religious centers. After World War II, a modern school system was introduced; a primary level lasts six years, an intermediate level lasts three years, and a secondary level lasts three years. A university system established in 1970 now is joined by several small colleges and polytechnic institutes. In an effort to achieve self-reliance, Yemen is replacing foreign educators with native teachers. Students who do not finish school usually become laborers, farmers, factory workers, or shopkeepers.



“How long traditional building styles will survive is hard to tell. A trend not to be celebrated may, however, be emerging in the form of the worst examples of modern architecture: the schools of Yemen. Unvarying in style, these stone buildings dot the towns and countryside of the northern provinces in their hundreds as if destined to influence the buildings of the future by shaping the architectural vision of today’s young Yemenis.”⁸⁹

(In Marib Governorate of Yemen, Ali Benzaid Abdelhadi is chairman of the Parents Council at a school being expanded and refurbished by U.S. aid. His forehead shows the mark left from Muslim prayers. See: http://www.usaid.gov/our_work/features/yemen/)

⁸⁸ Beydoun, Z. 1966. Geology of the Arabian Peninsula: Eastern Aden Protectorate. USGS Professional Paper 560-H. Page H17.

⁸⁹ Hämäläinen, Pertti. 1991. Yemen: A Travel Survival Kit. Berkeley, CA: Lonely Planet. 2nd edition. Page 37.

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20th Century History of Yemen

“In pre-Islamic times, the area that encompasses the present-day Republic of Yemen was called Arabia Felix- happy or prosperous Arabia- and was ruled by a number of indigenous dynasties in several different kingdoms. The most important cultural, social, and political event in Yemen’s history was the coming of Islam around A.D. 630. Following the conversion of the Persian governor, many of the sheikhs and their tribes converted to Islam, and Yemen was ruled as part of Arab caliphates. The former North Yemen came under the control of imams of various dynasties, the most important of which were the Zaydis, whose dynasty lasted well into the twentieth century.”⁹⁰

Ottoman suzerainty was reestablished in northern Yemen in the late 19th century but its control was largely confined to cities, and the Zaidi imam’s rule over Upper Yemen was formally recognized. North Yemen became independent of the Ottoman Empire in 1918, and Imam Yahya Muhammad strengthened his control over northern Yemen creating the Mutawakkilite Kingdom of Yemen, that lasted from 1927-1962. *See flag of the “Mutawakkilite Kingdom of Yemen”*



Aden was ruled as part of British India until 1937, when the city of Aden became the Colony of Aden, a crown colony in its own right. The Aden hinterland and Hadhramaut to the east formed the remainder of what would become South Yemen and were not administered directly by Aden but were tied to Britain by treaties of protection.

Economic development was largely centered in Aden, and while the city



flourished partly due to the discovery of crude oil on the Arabian Peninsula in the 1930s, the states of the Aden Protectorate stagnated. *See flag of the Colony of Aden, 1937-1963.*

Yemen became a member of the Arab League in 1945 and a member of the United Nations in 1947.

1948 - Yahya is assassinated, but his son Ahmad beats off opponents of feudal rule and succeeds his father.

Photo: Imam Ahmad bin Yahya (1891- 18 September 1962), son of Yahya Muhammad, was the penultimate king of the Mutawakkilite Kingdom of Yemen from 1948 to 1962. He was considered to be a despot, and his main focus was on modernizing the military. URL:

<http://www.nationsonline.org/oneworld/History/Yemen-history.htm>

1960s

1962 - Imam Ahmad dies, and shortly after assuming power in 1962, Ahmad’s son, the Crown Prince Muhammad al-Badr was deposed by coup forces, who took control of Sana’a and created the Yemen Arab Republic (YAR). Egypt assisted the YAR with troops and supplies to combat forces loyal to the Kingdom. Saudi Arabia and Jordan supported Badr’s royalist forces to oppose the newly formed republic starting the North Yemen Civil War. Conflict continued periodically until 1967 when Egyptian troops were finally withdrawn.

Photo: 1962 - [1996] H.M. Al-Mansur Bi’llah Muhammad Al-Badr bin Al-Nasir-li-dinu’llah Ahmad, Imam and Commander of the Faithful, and King of the Mutawakkilite Kingdom of the Yemen. Born at Hajjah, 25th February 1926, eldest surviving son of H.M. Al-Nasir-li-dinu’llah Ahmad as-Shams bin Al-Mutawakkil ‘Ala Allah Yahya, Imam of the Yemen, by his first wife, Sayyida Safia bint Muhammad Al-Ezzi, educ. at Hajjah and Taizz Madrassas. Appointed as Heir Apparent with the title of Crown Prince, April 1955. Dep. Governor of Hudaidah 1949-1955, Dep. Prime Minister,



⁹⁰ URL: <http://www.marines.mil/news/publications/Documents/Yemen%20Profile.pdf>

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Minister for Defence and Foreign Affairs 1955-1962. Succeeded on the death of his father, 18th September 1962. Received the oath of allegiance, 19th September 1962. Deposed by a military coup d'etat at San'a, 26th September 1962, but continued a Royalist government in resistance in the countryside and from Saudi Arabia. Went into exile England after the final defeat of the Royalists in 1972. Rcvd: GC of the Order of Merit of the Republic of Italy (28.11.1957). He died from pneumonia at a London hospital, 6th August 1996. URL: <http://www.royalark.net/Yemen/yemen5.htm>.

“During the Yemen War of 1963 through 1967, Egypt evidently used mustard bombs in support of South Yemen against royalist troops in North Yemen. Nasser’s adventure in Yemen in 1963 on the side of a military coup began when the Egyptian army fought the Saudi Arabian backed royalist Yemeni tribes was the first time the Egyptian Army fights against Arabs since Ibrahim Pasha campaign against the Wahhabie rebels in Arabia in the 1820’s. The use of chemical weapons against the Yemeni tribesmen was the first use of chemical weapons in the Middle East. During the Yemeni civil war phosgene and mustard aerial bombs killed at least 1,400 people. Some reports claim that Egypt also used an organophosphate nerve agent against Yemeni Royalist forces.”⁹¹

During the 1960s, the British sought to incorporate all of the Aden Protectorate territories into the Federation of South Arabia. On 18 January 1963, the Colony of Aden was incorporated against the wishes of much of the city’s populace as the State of Aden and the Federation was renamed the Federation of South Arabia. Several more states subsequently joined the Federation and the remaining states that declined to join, mainly in Hadhramaut, formed the Protectorate of South Arabia.



In 1963 fighting between Egyptian forces and British-led Saudi-financed guerrillas in the Yemen Arab Republic spread to South Arabia with the formation of the National Liberation Front (NLF), who hoped to force the British out of South Arabia. Hostilities started with a grenade attack by the NLF against the British High Commissioner on 10 December 1963, killing one person and injuring fifty, and a state of emergency was declared, becoming known as the Aden Emergency.

The Radfan or the Radfan Hills is a region of the Republic of Yemen. In the 1960s, the area was part of a British protectorate of Dhala (a member of the Federation of South Arabia) and was the site of intense fighting during the Aden Emergency. In 1964, local Qutaibi tribes people attacked the British on the Aden to Mecca caravan route which passed through the nearby town Dhala (Ad Dali’). The tribal members had traditionally collected tolls from passing caravans, but the implementation of the customs union of the Federation of South Arabia in 1962 put a stop to this. The tribes resented the loss of this income.

A select bibliography was prepared on the British Armed Forces activities in the Radfan and Aden Emergency by the Joint Services Command and Staff College.⁹²

In January 1964, the British moved into the Radfan hills in the border region to confront the Egyptian-backed guerrillas, later reinforced by the NLF. By October they had largely been

⁹¹ “Weapons of Mass Destruction: Chemical Weapons Programs- Egypt.” 1999. Federation of American Scientists (FAS). <http://www.fas.org/nuke/guide/egypt/cw/>.

⁹² Hobson, Chris. 2009. “JSCSC Library Bibliography: Campaign & Battle Series: Aden and the Radfan Campaigns, 1963 – 1967.” Joint Services Command and Staff College: January 2009.

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suppressed, and the NLF switched to grenade attacks against off-duty military personnel and police officers elsewhere in the Aden Colony.

In 1964, the new British government under Harold Wilson announced their intention to hand over power to the Federation of South Arabia in 1968, but that the British military would remain. In 1964, there were around 280 guerrilla attacks and over 500 in 1965. In 1966 the British Government announced that all British forces would be withdrawn at independence. In response, the security situation deteriorated with the creation of the socialist Front for the Liberation of Occupied South Yemen (FLOSY) which started to attack the NLF in a bid for power, as well as attacking the British.

In January 1967, there were mass riots by NLF and FLOSY supporters in the old Arab quarter of Aden town, which continued until mid February, despite the intervention of British troops. During the period there were many attacks on the troops, and an Aden Airlines Douglas DC-3 plane was destroyed in the air with no survivors. At the same time, the members of FLOSY and the NLF were also killing each other in large numbers.

The temporary closure of the Suez Canal in 1967 effectively negated the last reason that British had kept hold of the colonies in Yemen, and, in the face of the uncontrollable violence, the British forces began to withdraw.

On 20 June 1967, there was a mutiny in the Federation of South Arabia Army, which also spread to the police. Order was restored by the British, mainly due to the efforts of the 1st Battalion Argyll and Sutherland Highlanders, under the command of Lt-Col. Colin Campbell Mitchell.

Nevertheless, deadly guerrilla attacks particularly by the NLF soon resumed against British forces once again, with the British being defeated and driven from Aden by the end of November 1967. This withdrawal was earlier than had been planned by British Prime Minister Harold Wilson, and was completed without an agreement on the succeeding governance. Their enemies, the NLF, managed to seize power, with Aden itself under NLF control. The Royal Marines, who had been the first British troops to occupy Aden in 1839, were the last ones to leave. The Federation of South Arabia collapsed and Southern Yemen became independent as the People's Republic of South Yemen. The NLF, with the support of the army, attained total control of the new state after defeating the FLOSY and the states of the former Federation in a drawn out campaign of terror.

The British, who had set up a protectorate area around the southern port of Aden in the 19th century, withdrew in 1967 from what became South Yemen. Three years later, the southern government adopted a Marxist orientation. The massive exodus of hundreds of thousands of Yemenis from the south to the north contributed to two decades of hostility between the states.

Most of the opposing leaders reconciled by 1968, in the aftermath of a final royalist siege of San'a'. In 1970, Saudi Arabia recognized the Yemen Arab Republic and a ceasefire was effected.

A radical (Marxist) wing of the NLF gained power in South Yemen in June, 1969.

1970s

The NLF changed the name of South Yemen on 1 December 1970 to the People's Democratic Republic of Yemen (PDRY). In the PDRY, all political parties were amalgamated into the Yemeni Socialist Party (YSP), which became the only legal party. The PDRY established close ties with the Soviet Union, the People's Republic of China, Cuba, and the

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radical Palestinians. The major communist powers also assisted in the building of the PDRY's armed forces. Strong military and financial support from Moscow resulted in Soviet naval forces gaining access to naval facilities in South Yemen. *Flag of the Democratic Republic of Yemen*



Unlike East and West Germany, the two Yemens remained relatively friendly, though relations were often strained. In 1972 it was declared unification would eventually occur.

However, in October 1972 fighting erupted between the North Yemen and the South Yemen; North Yemen was supplied by Saudi Arabia and South Yemen by the Soviet Union. Fighting was short-lived and the conflict led to the October 28, 1972, Cairo Agreement, which set forth a plan to unify the two countries.

Fighting broke out again a few years later in February and March 1979, with South Yemen allegedly supplying aid to rebels in the north through the National Democratic Front and crossing the borders. Southern forces made it as far as the city of Taizz before withdrawing. This conflict was also short-lived. The war was only stopped by an Arab League intervention. The goal of unity was reaffirmed by the northern and southern heads of state during a summit meeting in Kuwait in March 1979.

What the PDRY government failed to tell the YAR government was that it wished to be the dominant power in any unification, and left wing rebels in North Yemen began to receive extensive funding and arms from South Yemen.

1980s

In 1980, PDRY president Abdul Fattah Ismail resigned and went into exile. His successor, Ali Nasir Muhammad, took a less interventionist stance toward both North Yemen and neighboring Oman. On January 13, 1986, a violent struggle began in Aden between Ali Nasir's supporters and supporters of the returned Ismail, who wanted power back. Fighting lasted for more than a month and resulted in thousands of casualties, Ali Nasir's ouster, and Ismail's death. Some 60,000 people, including the deposed Ali Nasir, fled to the YAR.

Although the governments of the PDRY and the YAR declared that they approved a future union in 1972, little progress was made toward unification, and relations were often strained.

In May 1988, the YAR and PDRY governments came to an understanding that considerably reduced tensions including agreement to renew discussions concerning unification, to establish a joint oil exploration area along their undefined border, to demilitarize the border, and to allow Yemenis unrestricted border passage on the basis of only a national identification card.

In November 1989, the leaders of the YAR (Ali Abdullah Saleh) and the PDRY (Ali Salim al-Baidh) agreed on a draft unity constitution originally drawn up in 1981.

1990s

The Republic of Yemen (ROY) was declared on May 22, 1990, with Ali Abdallah Saleh becoming President and Ali Saleem al-Baidh becoming Vice President. For the first time in centuries, much of Greater Yemen was politically united. A 30-month transitional period for completing the unification of the two political and economic systems was set. A presidential council was jointly elected by the 26-member YAR advisory council and the 17-member PDRY presidium. The presidential council appointed a Prime Minister, who formed a Cabinet. There was also a 301-seat provisional unified parliament, consisting of 159 members from the north,

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111 members from the south, and 31 independent members appointed by the chairman of the council.

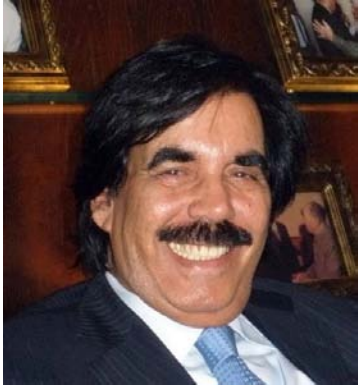


Photo: Ali Saleem al Baid, December 21, 2011. "Former President of South Yemen Ali Salem al-Baid is in Beirut to combat a media "blackout" on developments in "occupied" southern Yemeni and shore up support for his call that that nothing short of full independence will solve the crisis." URL: <http://english.al-akhbar.com/content/ali-salem-al-baid-reviving-south-yemeni-separatism>

A unity constitution was agreed upon in May 1990 and ratified a year later by the populace in May 1991. It affirmed Yemen's commitment to free elections, a multiparty political system, the right to own private property, equality under the law, and respect of basic human rights. Parliamentary elections were held on April 27, 1993. International groups assisted in the organization of the elections and observed the actual balloting. The resulting Parliament included 143 GPC, 69 YSP, 63 Islaah (Yemeni grouping for reform, a party composed of various tribal and religious groups), six Baathis, three Nasserists, two Al Haq, and 15 independents. The head of Islaah, Paramount Hashid Sheik Abdallah Bin Husayn Al-Ahmar, was the speaker of Parliament.

Islaah was invited into the ruling coalition, and the presidential council was altered to include one Islaah member. Conflicts within the coalition resulted in the self-imposed exile of Vice President Ali Salim Al-Bidh to Aden beginning in August 1993 and a deterioration in the general security situation as political rivals settled scores and tribal elements took advantage of the unsettled situation.

Haydar Abu Bakr Al-Attas, the former PDRY Prime Minister continued to serve as the ROY Prime Minister, but his government was ineffective due to political infighting. Continuous negotiations between northern and southern leaders resulted in the signing of the document of pledge and accord in Amman, Jordan, on February 20, 1994. Despite this pledge, clashes intensified until civil war broke out in early May 1994.

Almost all of the actual fighting in the 1994 civil war occurred in the southern part of the country despite air and missile attacks against cities and major installations in the north. Southerners sought support from neighboring states and received billions of dollars of equipment and financial assistance, mostly from Saudi Arabia, which felt threatened by a united Yemen. The United States also strongly supported Yemeni unity, but repeatedly called for a cease-fire and a return to the negotiating table. Various attempts, including by a UN special envoy, were unsuccessful to effect a cease-fire.

Southern leaders declared secession and the establishment of the Democratic Republic of Yemen (DRY) on 21 May 1994, but the DRY was not recognized by the international community. Ali Nasir Muhammad supporters greatly assisted military operations against the secessionists and Aden was captured on 7 July 1994. Other resistance quickly collapsed and thousands of southern leaders and military went into exile. Early during the fighting, President Ali Abdallah Salih announced a general amnesty which applied to everyone except a list of 16 persons. Most southerners returned to Yemen after a short exile.

An armed opposition was announced from Saudi Arabia, but no significant incidents within Yemen materialized. The government prepared legal cases against four southern leaders: Ali Salim al-Baidh; Haydar Abu Bakr Al-Attas; Abd Al-Rahman Ali Al-Jifri; and Salih Munassar Al-Siyali, for misappropriation of official funds. Others on the list of 16 were told informally they could return to take advantage of the amnesty, but most remained outside

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Yemen. Although many of Ali Nasir Muhammad's followers were appointed to senior governmental positions (including Vice President, Chief of Staff, and Governor of Aden), Ali Nasir Muhammad himself remained abroad in Syria.

In the aftermath of the civil war, YSP leaders within Yemen reorganized the party and elected a new politburo in July 1994. However, the party remained disheartened and without its former influence. Islaah held a party convention in September 1994. The GPC did the same in June 1995.

In 1994, amendments to the unity constitution eliminated the presidential council. President Ali Abdallah Saleh was elected by Parliament on 1 October 1994 to a 5-year term. The constitution provides that henceforth the President would be elected by popular vote from at least two candidates selected by the legislature. Yemen held its first direct presidential elections in September 1999, electing President Ali Abdallah Salih to a 5-year term in what were generally considered free and fair elections. Yemen held its second multiparty parliamentary elections in April 1997.

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Constitutional amendments adopted in the summer of 2000 extended the presidential term by two years, creating a 7-year presidential term. The constitution provides that henceforth the president would be elected by popular vote from at least two candidates selected by the Yemen legislature. The amendments also extended the parliamentary term of office to a 6-year term, with the next elections occurring in 2009. On February 20, 2001, a new constitutional amendment created a bi-cameral legislature consisting of a Shura Council of 111 seats; the members to be appointed by the president; and a House of Representatives of 301 seats; with the members elected by popular vote. In April 2003, the third multiparty parliamentary elections were held with improvements in voter registration for both men and women and in a generally free and fair atmosphere. Two women were elected. In September 2006, citizens re-elected President Saleh to a second term in a generally open and competitive election, although there were multiple problems with the voting process and use of state resources on behalf of the ruling party.

In the 2000s the government has been fighting rebel groups such as the one led by Hussein al-Houthi's Zaydi movement, the Shabab al-Mu'mineen, "The Young Believers".

The southern secessionist movement was revitalized in 2008 when a popular socio-economic protest movement initiated the prior year took on some political goals, including secession. Public rallies and anti-government protests in Sana'a against President Salih that were inspired by similar demonstrations in Tunisia and Egypt during "The Arab Spring", slowly built momentum starting in late January 2011, fueled by complaints over high unemployment, poor economic conditions, and governmental corruption.

By the following month, some of these anti-government protests had resulted in violence, and the political demonstrations had spread to other major cities in the country. By March the opposition had hardened its demands and was unifying behind calls for Salih's immediate resignation and ouster. Media reports indicated that as many as 100 protesters had been killed and many more injured amid the protests. Domestic and international efforts, including efforts from other Arab countries in the region, to mediate a resolution to the political crisis had not yielded a deal as of mid April 2011.

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Photo: Staff Sgt Jeffrey S. Ray, a Drill Instructor at MCRD Parris Island S.C., speaks to



a delegation of military officers from Yemen via translator, during their orientation of recruit training hosted by Marine Corps Forces Central Command. The visit outlined how the United States, a partner nation, conducts comprehensive training programs and demonstrates the Marine Corps' commitment to being a long-term partner in security cooperation.

The 2011 Yemeni protests followed the initial stages of the Tunisian Revolution and occurred simultaneously with the Egyptian Revolution and other mass protests in the Arab world in early 2011. The protests were initially against unemployment, economic conditions and corruption, as well as against the government's proposals to modify the constitution of Yemen. The protestors' demands then escalated to calls for President Ali Abdullah Saleh to resign.

A major demonstration of over 16,000 protestors took place in Sana'a on January 27, 2011. On February 2nd, President Saleh announced he would not run for reelection in 2013 and that he would not pass power to his son. On 3 February, 20,000 people protested against the government in Sana'a, others protested in Aden, in a "Day of Rage" called for by Tawakel Karman, while soldiers, armed members of the General People's Congress and many protestors held a pro-government rally in Sana'a. In a "Friday of Anger" on 18 February, tens of thousands of Yemenis took part in anti-government demonstrations in Taiz, Sana'a and Aden. On a "Friday of No Return" on 11 March, protestors called for the ousting of Saleh in Sana'a where three people were killed. More protests were held in other cities, including Al Mukalla, where one person was killed. On 18 March, protesters in Sana'a were fired upon resulting in over 40 deaths and ultimately culminating in mass defections and resignations.

On 23 April Saleh accepted a proposal to step down and shift control to his deputy after thirty days. The agreement included immunity for him and his family and further required the opposition to stop public protests and join a coalition with Saleh's ruling party. Reactions to Saleh's acceptance have been reserved, without the agreement formalized or accepted by both sides and with the possibility of the stand-off continuing.

On 22 May Saleh had agreed to the deal only to back away hours before the scheduled signing for the third time. On 23 May Sheikh Sadiq al-Ahmar, the head of the Hashid tribal federation, one of the most powerful tribes in the country, declared support for the opposition and his armed supporters came into conflict with loyalist security forces in the capital Sana'a. Heavy street fighting ensued, which included artillery and mortar shelling.

Photo: His Excellency Ali Abdullah Saleh, President of the Republic of Yemen (Yemen Embassy official photo).



President Saleh and several others were injured and at least five people were killed by a 3 June rocket attack on the presidential compound when ordnance struck a mosque used by high-level government officials for prayer services. The next day, Vice President Abd al-Rab Mansur al-Hadi took over as acting president while Saleh flew to Saudi

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Arabia to be treated. As Saleh flew to the Saudi capital of Riyadh for surgery on 4 June, a cease-fire was brokered by Saudi Arabia's King Abdullah.

In early July the government rejected the opposition's demands, including the formation of a transitional council with the goal of formally transferring power from the current administration to a caretaker government intended to oversee Yemen's first-ever democratic elections. In response, factions of the opposition announced the formation of their own 17-member transitional council on 16 July, though the Joint Meeting Parties that have functioned as an umbrella for many of the Yemeni opposition groups during the uprising said the council did not represent them and did not match their "plan" for the country.

The flag of Yemen, most recently adopted on 22 May 1990, features three horizontal stripes of equal widths: red, white, and black. These colors (along with green, the color of Islam) are described as the pan-Arab colors and are used in a number of national flags in the Middle East region. According to the official description, the red stands for the bloodshed of martyrs and unity; the white for a bright future; black for the dark past. The basic designs of the flags of North Yemen and South Yemen were similar as they both had red, white and black horizontal stripes, but each flag had its own symbol added to it. *See the image of the flag of Yemen.*



Bibliography

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Abdu Hassan, A. S. 2001. "Geomorphological Characteristics of Wadi Zabid Basin (Yemen)." *Trans. Inst. Indian Geogr.* Volume 23, Issue 1, Pages 127-137. Abstract: Since topography is one of the principal basin characteristics affecting stream flow, this paper aims to analyze the morphology of the Wadi Zabid basin using the Digital Elevation Model (DEM), which has been developed for the wadi basin. The creation of the DEM enables more understanding of the basin landscape. In addition, the study carried out morphometric analysis of drainage network in order to show the morphometric characteristics of the drainage basin of Wadi Zabid. Database: SCOPUS. ISSN: 0970-9851.

Abdul-Elah Ahmed H. Abu-Ghanem. *Soils of the South Western Part of the Yemen Arab Republic: Their Characteristics and Evaluation = Bodems Van Het Zuidwesten Van De Yementische Arabische Republiek: Hun Karakteristieken En Evaluatie.* 1984. ix, 95, 46 leaves: ill., maps; 29 cm. Bodems van het zuidwesten van de Yementische Arabische Republiek: hun karakteristieken en evaluatie. OCLC: 43270001.

Abdulbaki, Kadri and Schliephake, Konrad. 2000. *Das Wasserangebot im Suedlichen Jemen und Probleme der Nutzung Dargestellt an Beispielsgebieten (Deltas Tuban und Abian und Wadi Hadhramaut).* Translated title: "The water supply problems in southern Yemen, and use the example shown in regions (Delta Tuban and Wadi Hadhramaut and Abian)." Federal Republic of Germany Geographisches Institut der Universitaet Wuerzburg, Germany; Martin-Luther-Universitaet Halle-Wittenberg, Halle, Federal Republic of Germany. *Wuerzburger Geographische Manuskripte.* Volume: 52, Descriptors: Arabian Peninsula; Asia; climate; consumption; drainage basins; ground water; irrigation; landscapes; relief; supply policy; surface water; vegetation; water; Yemen. References: 3 p. illus. incl. 17 tables, 10 plates, geol. sketch maps. ISSN: 0931-8623. Database: GeoRef in Process. GeoRef Number: 367500-1.

Abdulbaki, K. 1986. "Physisch-Geographischer Ueberblick über die VDR Jemen. Physical-Geographic Overview of Yemen." *Wissenschaftliche Beitræge - Martin-Luther-Universitaet Halle-Wittenberg.* Martin Luther Universitaet Halle-Wittenberg, Halle, Federal Republic of Germany Federal Republic of Germany. Volume 19, Pages 33-55. Descriptors: Arabian Peninsula; Asia; atmospheric precipitation; basins; coastal plains; drainage patterns; evaporation; fluvial features; geography; geomorphology; ground water; intermontane basins; landform description; mountains; regional; relief; runoff; soils; Southern Yemen; temperature; vegetation; Yemen. References: 22; geol. sketch maps. Database: GeoRef. ISSN: 0440-1298.

Abdulbari, Shakib Abdulaziz. 1990. *Evaluation of the Water Allocation Plan and the Impact of Existing Water Rights in the Wadi Mawr Command, the Republic of Yemen.* Descriptors: Irrigation -- Yemen (Republic); Water rights -- Yemen (Republic); Thesis/dissertation; Manuscript. Notes: xi, 137 leaves: ill. 28 cm. Dissertation: Professional paper (M.S.)--Colorado State University, 1990. Note(s): Typescript (photocopy). Includes bibliographical references (p. [135]-137. Responsibility: submitted by Shakib Abdulaziz Abdulbari. OCLC Accession Number: 26685846.

Abdulla, Abdulkader Noaman. 2005. "Ecohydrological--Erosion Model for Semi-Arid Mountain Catchment using Gis Techniques: A Case Study--Wadi Surdud Catchment, Republic of Yemen." *Arabian Journal for Science & Engineering, Section C: Theme Issues.* *Arabian Journal for Science & Engineering: Jāmi'at al-Batrūl wa-al-Ma'ādin.* Volume 30, Issue 2, Pages 99-109. Descriptors: Soil erosion; Rainstorms; Water conservation projects; Sedimentation & deposition; Mountain watersheds; Geographic information systems; Sediments

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(Geology); Yemen (Republic); Civil Engineering; Ecohydrology; erosion modeling; GIS; wadi. Abstract: An ecohydrological-erosion model for semi-arid mountain catchment has been developed and integrated with rainfall-runoff model for estimating upland delivery rates of sediments resulted from individual storm at the outlet of Wadi Surdud catchment (2370 km²), Tihama, Yemen. The degradation of soil resources in the mountainous areas of Yemen is evident due to long-term and intensive human impacts on those vulnerable ecological environments of the indigenous terraces. If current trends continue, Yemen may permanently lose a significant portion of its productive land to soil erosion due to lack of preservation of indigenous soil and water conservation systems. This area has been degraded into nearly desert-like condition. Yet, geological and even historic data indicate that the natural ecological environments should be much better than it appears. To restore the ecological environment, we need to know its potentials. The erosion and sedimentation processes of the upland watersheds have to be assessed by means which do not rely on historical storm flow data. Methods that depend on available or measurable representative data were developed for a deterministic approach of the erosion process. This study takes advantage of physically based methods and Geographic Information Systems (GIS) and uses the Digital Elevation Model (DEM) and observed meteorological and hydrological data to model the runoff and sediment yield in an attempt to assess the potential natural ecological environments. Our results show that the effective Curve Number (CN) and soil detachability are the factors that determine the potential natural ecological environments. In this paper the study of runoff and sediment delivery is based on one stream gauging station and 10 rainfall gauging stations. Discharge was calculated for the period from July, 15, 1998 to October, 10, 1998 which resulted from 10 rainfall storms. A comparison of observed and predicted sediment yield shows a good agreement with a coefficient of determination of 0.85. ISSN: 0377-9211. OCLC: 4172796.

Abdulmagid Thabet, Hamid, Huebner, Bruno and Wissing, Peter. 1992. "Betriebswirtschaftliche Bewertung Von Bewaesserungsverfahren unter Ariden Bedingungen in Der Republik Jemen." Wissenschaftliche Zeitschrift - Martin-Luther-Universitaet, Halle-Wittenberg, Mathematisch-Naturwissenschaftliche Reihe. Martin Luther Universitaet Halle Wittenberg, Halle, Federal Republic of Germany Federal Republic of Germany; Halle-Wittenberg, Mathematisch-Naturwissenschaftliche Reihe. Volume 41, Issue 3, Pages 143-152. Descriptors: arid environment; cost; evaluation; ground water; irrigation; Northern Yemen; pumping; surface water; technology; terrestrial environment; underground channels; water resources; water supply; water wells; wells. References: 1; illus. incl. 7 tables. Database: GeoRef in Process. ISSN: 0138-1504.

Abdulrazzak, MJ. 1995. "Water Supplies Versus Demand in Countries of Arabian Peninsula." J. Water Resour. Plann. Manage. Volume 121, Issue 3, Pages 227-234. Descriptors: Article Subject Terms: arid lands; available water; economic development; ground water; groundwater; water conservation; water demand; water management; water supply; water use; Article Geographic Terms: Bahrain; Kuwait; Middle East; Oman; Qatar; Saudi Arabia; Yemen; Arabia, Arabian Peninsula; United Arab Emirates; arid lands; Freshwater. Abstract: Rapid economic development in the countries of the Arabian Peninsula has resulted in a substantial imbalance between the available water resources and demand. Demand has increased from 5.95 billion to 22.6 billion m³ in the ten year period 1980-1990. Ambitious agricultural programs and the absence of conservation measures have lead to significant overdraft of the existing water resources. If current practices continue, water demand may reach 35.4 billion m³ by the year 2010. Considerable volumes will have to be mined from nonrenewable ground-water reserves. In this paper, water supply and demand problems for each country of the Arabian Peninsula are examined. Projections for water supply and future demands are made. Suggestions for comprehensive water planning are made that emphasize conservation measures and optimum allocation both within and between countries. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0733-9496. URL: <http://link.aip.org/link/?QWR/121/227/1>.

Abdulrazzak, MJ, Jurdi, M. and Basma, S. 2002. "The Role of Desalination in Meeting Water Supply Demands in Western Asia." Water Int. Sep. Volume 27, Issue 3, Pages 395-406. Descriptors: Aquifers; Coastal zone; Conservation; Demineralization; Desalination;

Geology of Yemen

Deterioration; Economics; Financial management; Groundwater pollution; Mining; Potential resources; Production cost; Surface water; Urban areas; Water demand (see also Water consumption); Water management; Water pollution; Water resources; Water supplies; Water supply; commissions; councils; production costs; water demand; water quality; Article Geographic Terms: Asia, western; Bahrain; Asia; Bahrain; Iraq; Kuwait; Oman; Qatar; Saudi Arabia; United Arab Emirates; Yemen; Kuwait; MED, Egypt, Arab Rep. Lebanon; Oman; Palestine; Saudi Arabia; United Arab Emirates.. Abstract: The increasing gap between the supply and demand for water in the Economic and Social Commission of Western Asia (ESCWA) member countries: Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, United Arab Emirates, and Yemen) can be attributed to the limited availability of surface water, mining of fossil groundwater sources, and water pollution mainly of shallow aquifers, deficient institutional structure, poor management processes, and inapt allocation of financial resources. The non-sustainable use of natural water resources to meet the escalating water demand has also contributed to the depletion and deterioration of water quality and quantity. To meet water supply shortages in the domestic sector, water desalination has been entrenched as a viable option for the Gulf Cooperation Council (GCC), which includes the following countries: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates. The objective of the paper is to investigate the role of water desalination in meeting the water demands in the ESCWA member countries. The significant role of desalination is highlighted with emphasis in evaluating not only its production trends, processes, and costs, but also its capacity in the provision of water demands. Water desalination has become a major and staunch water source for a number of large urban centers. For such countries such as Bahrain, Kuwait, and Qatar and the coastal zone areas of Oman, United Arab Emirates (UAE), and Saudi Arabia, desalination represents one of the most feasible and strategic alternative options for their current and future domestic water supply requirement. Given the high consumption rate from this source and its high production cost, fundamental efforts must be integrated and invested in both research and development programs to implement comprehensive conservation measures that would lead to a reduction in the consumption rates. Parallel to these achievements, efforts should be directed within the context of integrated management of water resources, to identify alternative potential water resources, to meet future water challenges. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0250-8060.

Abou-Deeb, J. M. D. H. Tarling; A. L. Abdeldayem. 2002. "Preliminary palaeomagnetic stratigraphy of the Tertiary Yemen Volcanics." *Geofísica Internacional*. Volume 41 (1), pages 37-47. Keywords: Palaeomagnetism; Ar/Ar dating; volcanic stratigraphy; Tertiary; Yemen volcanic. Abstract: Mainly basaltic samples from 60 sites in the Yemen Volcanic Group show somewhat high degrees of between-site directional scatter, but enable normal, reversed and intermediate polarities to be identified during thermal demagnetisation. Individual chrons cannot be assigned directly from the available stratigraphic controls, but can be estimated using published $^{39}\text{Ar}/^{40}\text{Ar}$ determinations. The Yemen plateau basalts appear to have begun eruption during chron C11r.1r, some 29 Ma ago, and eruption persisted for some 3 to 4 Myr, probably terminating during chron C8, some 26 Ma ago. While such an initial assessment needs further substantiation, it demonstrates that the combination of radiometric and palaeomagnetic methods provides far greater reliability than either individual technique alone. ISSN: 0016-7169.

Abu-Ghararah, Ziad H. Programme for the Environment of the Red Sea and Gulf of Aden and United Nations Environment Programme. 1997. *Assessment of Land-Based Sources and Activities Affecting the Marine Environment in the Red Sea and Gulf of Aden*. Geneva,

Geology of Yemen

Switzerland: United Nations Environment Programme. Page(s): 62. Descriptors: Water -- Pollution -- Red Sea; Water -- Pollution -- Aden, Gulf of; Coastal ecology -- Red Sea; Coastal ecology -- Aden, Gulf of; Marine pollution -- Red Sea; Marine pollution -- Aden, Gulf of; Government publication; International government publication. Notes: maps; 30 cm. Note(s): At head of title: "UNEP, PERSGA, Regional Seas." Includes bibliographical references (p. 52-55). OCLC: 44465081.

Acres, B. D. and Land Resources Development Centre (Great Britain). 1980. Soils and Land Suitability of the Montane Plains. Surbiton: Ministry of Overseas Development. Descriptors: Agricultural development projects -- Yemen (Republic); Montane Plains and Wadi Rima Project; Government publication. Abstract: [V. 1.] --[v. 2.] Maps. Notes: 2 v., ill., tables; 30 cm. Note(s): "YAR-01-49/REC-52/80." Responsibility: B.D. Acres. OCLC Accession Number: 68764041.

Adnan A. H. Al-Qurashi and Tahir Husain. 2001. Sustainable Water Resources Development Plan for the Middle-East Countries. ASCE. Bridging the Gap: Meeting the World's Water and Environmental Resources Challenges. Descriptors: Water resources; Middle East; Sustainable development. Abstract: This paper presents an overview of water resources alternatives in the Middle East countries which (in alphabetical orders) include: Bahrain, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Palestine, Saudi Arabia, Syria, Turkey, United Arab Emirates, and Yemen. The prediction by international organizations on water situation by year 2025 is also presented in the paper. Both surface water and renewable ground water potential in the region are explored and statistics on potential water availability is presented. Future research areas based on sustainable development concept are also identified in the paper. Notes: Bridging the gap: Meeting the World's water and environmental resources challenges (state of the Practice—Proceedings of the World Water And Environmental Resources Congress, May 20-24, 2001, the rosen plaza hotel, orlando, florida; sponsored by Environmental And Water Resources Institute of ASCE; cooperating organizations: American Public Works Association, American Water Resources Association, Elsevier Science Ltd., Florida Water Environment Association, Interstate Council on Water Policy, National Water Resources Association, universities council on Water Resources, Water Environmental Federation, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, U.S. Environmental Protection Agency, U.S. Geological Survey) by Don Phelps, (editor) and Gerald Shelke, (editor) Reston, VA: ASCE, Database: ASCE. ISBN: 0-7844-0569-7.

"The agricultural land situation in South Arabia." 1966. Un/FAO 1966 - World Land Reform Conference - Rome, Italy, 20 Jun - 2 Jul 1966 - Country Paper, South Arabia - 6 p. - cf /62559. Government of South Arabia. Keywords: Irrigation; Tenure; Farmland; Agricultural Structure; Democratic Yemen. Report Number: RU-WLR/C/66/38. FAO Library Accession Number: 062621.

Ahlbrandt, Thomas S. 2002. "Madbi Amran/Qishn Total Petroleum System of the Ma' Rib-Al Jawf/Shabwah, and Masila-Jeza Basins, Yemen." Reston, VA: US. Volume: 2202-G, page(s): 28 pages. Abstract: Since the first discovery of petroleum in Yemen in 1984, several recent advances have been made in the understanding of that country's geologic history and petroleum systems. The total petroleum resource endowment for the combined petroleum provinces within Yemen, as estimated in the recent U.S. Geological Survey world assessment, ranks 51st in the world, exclusive of the United States, at 9.8 BBOE, which includes cumulative production and remaining reserves, as well as a mean estimate of undiscovered resources. Such undiscovered petroleum resources are about 2.7 billion barrels of oil, 17 trillion cubic feet (2.8

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billion barrels of oil equivalent) of natural gas and 1 billion barrels of natural gas liquids. A single total petroleum system, the Jurassic Madbi Amran/Qishn, dominates petroleum generation and production; it was formed in response to a Late Jurassic rifting event related to the separation of the Arabian Peninsula from the Gondwana supercontinent. This rifting resulted in the development of two petroleum-bearing sedimentary basins: (1) the western Ma'rib Al Jawf / Shabwah basin, and (2) the eastern Masila-Jeza basin. In both basins, petroleum source rocks of the Jurassic (Kimmeridgian) Madbi Formation generated hydrocarbons during Late Cretaceous time that migrated, mostly vertically, into Jurassic and Cretaceous reservoirs. In the western Ma'rib Al Jawf / Shabwah basin, the petroleum system is largely confined to syn-rift deposits, with reservoirs ranging from deep-water turbidites to continental clastics buried beneath a thick Upper Jurassic (Tithonian) salt. The salt initially deformed in Early Cretaceous time, and continued halokinesis resulted in salt diapirism and associated salt withdrawal during extension. The eastern Masila-Jeza basin contained similar early syn-rift deposits but received less clastic sediment during the Jurassic; however, no salt formed because the basin remained open to ocean circulation in the Late Jurassic. Thus, Madbi Formation-sourced hydrocarbons migrated vertically into Lower Cretaceous estuarine, fluvial, and tidal sandstones of the Qishn Formation and were trapped by overlying impermeable carbonates of the same formation. Both basins were formed by extensional forces during Jurassic rifting; however, another rifting event that formed the Red Sea and Gulf of Aden during Oligocene and Miocene time had a strong effect on the eastern Masila-Jeza basin. Recurrent movement of basement blocks, particularly during the Tertiary, rather than halokinesis, was critical to the formation of traps. Notes: USGS Bulletin. URL: <http://pubs.usgs.gov/bul/b2202-g/b2202-g.pdf>.

Ahmed, Alhan; Sharabi, AbdulJalil; Abdulqader, Nabil. 2008. Annual report on hydrological network in Wadi Surdud area 2008. Republic of Yemen, National Water Resource Authority.

Ahmed, Abdulla M. 1996. "Using Water Resources for Irrigation in Semiarid Land; a View from the Republic of Yemen; the Ohio Academy of Science 105th Annual Meeting; Program Abstracts; Theme; Sustainable Development [Modified]." The Ohio Journal of Science. Ohio Academy of Science, Columbus, OH, United States: United States. Volume 96, Issue 2, Pages 29. Descriptors: agriculture; Arabian Peninsula; Asia; conservation; ecosystems; irrigation; land use; semi-arid environment; terraces; terrestrial environment; water resources; Yemen. Database: GeoRef. ISSN: 0030-0950.

Air Command and Staff College, Maxwell AFB, AL and Mullis, Tony R. 1997. "The Limits of Air Control: The RAF Experience in Aden, 1926-1967." March 1997. Page(s): 61 Report Number: AU/ACSC/0604D/97-03 XC-ACSC Monitor Series: ACSC. Abstract: The resurgence of the concepts of air control and air occupation has renewed debate on the efficacy of air power as a tool to achieve national objectives in situations short of conventional war. To better understand what air control is and what it has to offer for the future of air power, this study examines the British experience in colonial Aden from 1926 to 1967. Through examination of primarily secondary sources of the British political and military objectives in Aden, this paper provides the student of airpower with salient insights on the concept, development, and application of air control as a viable option to achieve national strategic objectives. The study examines the historiography of the air control debate by discussing the issues associated with the concept. Unlike other studies on air control, this paper examines the British air control experience in a particular region from beginning to end. Most studies on air control have limited their analysis by restricting their discussion of air control to pre-World War II examples. This

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study's intent was to examine air control not only during its heyday in the 1920s, but during the more trying days of the Cold War as well. The British experience in Aden provided an excellent example of air control's successes and limitations. By analyzing what worked with the British air control effort in Aden, what benefits it offers today, and what limitations influence air control's success, this study demonstrates the applicability and cost effectiveness of air control as a foreign policy instrument in certain political situations, particularly in military operations other than war (MOOTW). The study concludes with a realistic scenario of how air control as a viable political/military option can be applied to future MOOTW situations. Abstract Classification: Unclassified Technical Reports Collection Citation Format: FOIA (U2) Technical Reports Collection. Master's thesis. DTIC: ADA398059. URL: <http://handle.dtic.mil/100.2/ADA398059>.

Air Command and Staff College, Maxwell AFB, AL and Russell, Michael G. 1988. "Marxism in Islamic South Yemen." April 1988. Page(s): 36 Report Number: ACSC-88-2280. Abstract: South Yemen is a unique Arab-Islamic state because it has a Marxist government. This blending of Islam and Marxism is a concern for pro-Western Arab governments and United States interests in the region. This study concludes that unique internal and external factors promoted Marxists to power in South Yemen. Additionally, there is slight probability that South Yemen can export its Marxist revolution to other pro-Western Arab states. Currently, the greatest threat to US interests is the military presence of the Soviet Union in strategically located South Yemen. Abstract Classification: Unclassified Technical Reports Collection. Notes: Student report. DTIC: ADA215991. URL: <http://handle.dtic.mil/100.2/ADA215991>.

Air Force Environmental Technical Applications Center Scott AFB IL and Walters Sr, Kenneth R and Arnold, Richard D. 1992. "Climate and Weather of the Horn of Africa-- Executive Summary." Dec. Page(s): 36 Report Number: USAFETAC/TN--92/006 XC- USAFETAC Monitor Series: USAFETAC. Abstract: Provides a brief executive summary of annual weather and climatology for the region generally known as the 'Horn of Africa,' an area that comprises Somalia, Yemen, Djibouti, Ethiopia, Sudan, and Kenya. Abstract Classification: Unclassified Technical Reports Collection. Technical note; Distribution Statement: Approved for public release; distribution is unlimited. DTIC: ADA260152. URL: <http://handle.dtic.mil/100.2/ADA260152>.

Air Force Inst Of Tech Wright-Patterson Afb, OH, School Of Engineering And Management, and Tannehill, Bryan R. 2008. "Forecasting Instability Indicators in the Horn of Africa." Mar. Page(s): 274 Report Number: AFIT/GOR/ENS/08-21 XC-USCENTCOM* Monitor Series: USCENTCOM*. Abstract: The forecasting of state failure and the associated indicators has been a topic of great interest to a number of different agencies. USAid, CENTCOM, the World Bank, the Center for Army Analyses, and others have all examined the subject based on their own specific objectives. Whether the goal is denying terrorists space in which to operate, deciding how to pre-position materials in anticipation of unrest, stabilizing foreign markets and trade, or preventing or mitigating humanitarian disasters, man made or otherwise, this topic has been of interest for over a decade. The Horn of Africa has been one of the least stable regions in the world over the past three decades, and a continual source of humanitarian crises as well as terrorist activity. Some of the initial modeling of instability was done in response to crises in the Horn of Africa, but research is ongoing. Current models forecasting instability suffer from lack of lead time, subjective predictions, and lack of specificity. The models demonstrated in this study provide 4 year forecasts of battle deaths per capita, refugees per capita, genocide, and undernourishment for Djibouti, Ethiopia, Eritrea, Kenya, Somalia, Sudan, and Yemen. This thesis used principal component analysis, canonical

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correlation, ordinary least squares regression, logistic regression, and discriminant analysis to develop models of each instability indicator using 54 variables covering 32 years of observations. The key variables within each model are identified, and the accuracy of each model is compared with current models. Abstract Classification: Unclassified Technical Reports Collection. Master's thesis; Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA480691. URL: <http://handle.dtic.mil/100.2/ADA480691>.

Air War College, Maxwell AFB, AL and StutsmanFrederick, C. 1986. "U. S. Security Assistance for the Yemen Arab Republic." May. Page(s): 54 Report Number: AU-AWC-86-204. Abstract: Survey of U.S. and Soviet security assistance in Y.A.R. Includes Y.A.R. history and background related to U.S. and Soviet security assistance as well as the author's personal observations and conclusions drawn from a tour of duty in the U.S. Office on Military Cooperation. Sana'a, Y.A.R., from April, 1984 to April, 1985. (Author) Abstract Classification: Unclassified Technical Reports Collection. Notes: Research rept., DTIC Accession Number: ADA177913.

Al-Asbahi, Qahtan Yehya A.M. 2005. Water Resources Information in Yemen. National Integrated Water Resources Management Program: International Work Session on Water Statistics, Vienna.

Al Khorasani, Ahmad and Banajeh, Salem. 2006. "Bacterial Profile and Clinical Outcome of Childhood Meningitis in Rural Yemen: A 2-Year Hospital-Based Study." *J. Infect.* 10. Volume 53, Issue 4, Pages 228-234. Descriptors: Childhood meningitis; Bacterial etiology; Antibiotic resistance; Rural Yemen. Abstract: SummaryBackground Childhood acute bacterial meningitis (ABM) is an important cause of death and long-term neurological disability in Yemen, the only low income-high mortality country in the Arabian Peninsula. The objective of this study was to document the microbial characteristics, the antibacterial sensitivity pattern, and the outcome for children hospitalized with ABM, prior to the introduction of Haemophilus influenzae type b (Hib) vaccine in Yemen. Patients and methods The study was retrospective, conducted at a rural district hospital, serving the rural population of the northern parts of Yemen. All patients aged 1 month-15 years admitted between May 1999 and June 2001, with clinical evidence of meningitis and cerebrospinal fluid (CSF) cultured, were included in the study. Clinical information from case notes, including CSF result and the outcome on discharge, were obtained. Analysis of extracted data was performed using Epi Info software. Results During the 2-year study period, 160 study patients met the inclusion criteria, and 7 (4.4%) were negative for bacterial growth. In the 153 positive cultures there were 46 (30.1%) Streptococcus pneumoniae (SP), 23 (15%) H. influenzae (HI), 81 (52.9) Neisseria meningitidis (NM), 2 (1.3%) Staphylococcus aureus (S. aureus), and 1 (0.7%) Escherichia coli. Sixteen study patients died (overall case fatality rate (CFR) 10%), 7 aged under 12 months, 6 aged 12-60 months, and 3 more than 60 months. Ten deaths were due to SP meningitis, 2 HI meningitis, 3 NM meningitis, and 1 had S. aureus. ISSN: 0163-4453.

Al Sabahi, Esmail, Rahim, Abdul S., bin, Wan Yacob, Al Nozaily, Fadhl and Alshaebi, Fares. 2009. "A Study of Surface Water and Groundwater Pollution in Ibb City, Yemen." *Electronic Journal of Geotechnical Engineering*. Volume 14 F, Pages 1-12. Descriptors: Groundwater pollution; Aluminum; Biochemical oxygen demand; Boreholes; Cadmium; Cadmium compounds; Calcium; Chlorine compounds; Chromium; Contamination; Dissolution; Dissolved oxygen; Dissolved oxygen sensors; Electric conductivity of solids; Groundwater; Heavy water; Hydrogeology; Land use; Landforms; Leachate treatment; Leaching; Lead;

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Nitrogen compounds; Oil spills; Pollution; Refuse disposal; Semiconducting cadmium compounds; Solvents; Surface waters; Wastewater; Wastewater reclamation; Wastewater treatment; Water quality; Water treatment plants; Zinc. Abstract: A study was carried out to determine the land use impact on water pollution at three different sites i.e Al-Sahool, Mitm and Al-Sayyadah valleys around Ibb city, Yemen. Besides determining the status of water pollution, this study also aims to recognize the sources of pollution and the results will be used to identify the relationship between the impact of land use activities and water pollution. Groundwater samples were collected in all valleys. While leachate samples were collected only from Al-Sahool area and surface water samples from Mitm area. Groundwater was sampled from the existing wells that were drilled in these areas. Surface water and leachate were sampled from small stream and leachate ponds. The physico-chemical characteristic of leachate, groundwater and surface water samples such as pH, temperature, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO) were measured in-situ, while fluoride (F), chloride (Cl), sulphate (SO₄), nitrites (NO₂), nitrates (NO₃), ammonia-N (NH₃-N), heavy metals (Pb, Zn, Ni, Cr, Cd, Cu), major cations (Na, Mg, Ca, K, Fe) and biological parameters (COD, BOD₅) were analysed in the laboratory. The results show that, the leachate from the landfill is in methanogenic phase. The BOD₅/COD value of 0.1 mg/l obtained for leachate suggested the partially stabilization. For the groundwater at Al-Sahool area borehole two is the most contaminated borehole, in which physico-chemical parameters are higher, followed by borehole three, borehole four and borehole five. At Mitm area the surface water in general seems to be affected by the discharge of untreated wastewater based on the comparison with unpolluted surface water outside the area. The groundwater quality at Mitm area shows that, only three boreholes are contaminated due to the percolation of untreated wastewater. For Al-Sayyadah area, the low values of physico-chemical parameters indicate a clean area and this is due to the absence of sources of contaminations. In general, Al-Sahool area is the most contaminated area compared to Mitm and Al-Sayyadah areas. The contamination level at Mitm area is higher than Al-Sayyadah area due to the discharge of wastewater directly to the Mitm valley. Therefore, a leachate collection pond should be build to collect and treat the leachate to prevent further contamination as well as build more sanitary landfill facilities in Al-Sahool area to prevent further contamination. An additional wastewater treatment plant at Mitm area is highly recommended to prevent further contamination to surface and groundwater. ISSN: 1089-3032.

Al Sabahi, E., Rahim, S. A., Wan Zuhairi, W. Y., Nozaily, F. A. and Alshaebi, F. 2009. "The Characteristics of Leachate and Groundwater Pollution at Municipal Solid Waste Landfill of Ibb City, Yemen." *Am. J. Environ. Sci.* Volume 5, Issue 3, Pages 256-266. Descriptors: Groundwater; Heavy metals; Ibb landfill; Pollution. Abstract: Problem statement: Yemen one of the developing country suffering from water pollution. Landfill is one of the sources of water pollution. There are several boreholes located close to Ibb landfill used for drinking water. A study of composition of landfill leachate and groundwater pollution was conducted at Ibb landfill, which is located at Al-Sahool area, north of Ibb City, Yemen. Approach: The leachate was sampled at three different locations of the landfill, at the landfill itself and 15 and 20 m downstream of this landfill. Groundwater samples collected from 5 boreholes to study possible impact of leachate percolation into groundwater. Leachate and groundwater samples were collected during dry season only, due to the excessive generation of leachate during this season. Objective of this study was significant to assess degree of groundwater pollution due to Ibb landfill leachate at Al-Sahool area. The leachate and groundwater were physically and chemically characterized by using spectrophotometer HACH, BOD Trak HACH, flame

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photometer (PFP 7) and Inductively Coupled Plasma of Optical Emission Spectrometry (ICP-OES) model Vista MPX. Parameters measured were pH, temperature, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Fluoride (F), Chloride (Cl), Sulphate (SO₄), Nitrites (NO₂), Nitrates (NO₃), ammonia-N (NH₃-N), heavy metals (Pb, Zn, Ni, Cr, Cd, Cu), major cations (Na, Mg, Ca, K, Fe) and biological parameters (COD, BOD₅ and coliform group bacteria). Results: The results showed that, leachate at landfill most likely in methanogenic phase, based on the alkaline pH value recorded (pH = 8.46). The results also showed that 4 out of 5 boreholes were contaminated, where concentration of physico-chemical parameters are above the standard acceptable levels which required for drinking water adapted by Yemen's ministry of water and environment and by word standard. Conclusion: Therefore, landfill is dangerous for environment so government should do sanitary landfill to prevent further contamination to surface water, groundwater as well as soil. Database: SCOPUS. ISSN: 1553-345X.

Al Serouri, Abdul Wahed, Al Rabee, Arwa, Bin Afif, Mohammed and Al Rukeimi, Abdullah. 2009. "Reducing Maternal Mortality in Yemen: Challenges and Lessons Learned from Baseline Assessment." *International Journal of Gynecology & Obstetrics*. 4. Volume 105, Issue 1, Pages 86-91. Descriptors: Emergency obstetric care; Baseline assessment; Maternal mortality; Millennium Development Goals; World Bank; Yemen. Abstract: Objective The Yemen is a signatory of the Millennium Development Goals (MDGs) and one of 10 countries chosen for the UN Millennium Project. However, recent MDG progress reviews show that it is unlikely that the maternal health goal will be reached by 2015 and Yemen still has an unacceptably high maternal mortality of 365 per 100 000 live births. Because 82% of deaths happen intrapartum, the purpose of this needs assessment was to identify and prioritize constraints in delivery of emergency obstetric care (EmOC). Methods Four district hospitals and 16 health centers in 8 districts were assessed for functional capacity in terms of infrastructure; availability of essential equipment and drugs; EmOC technical competency and training needs; and Health Management Information System. Results. ISSN: 0020-7292.

Al-Athar Al-Bii Li-Istikhdam Miyah Al-Sarf Al-Sihhi Fi Al-Rayy Al-zira`i: Ibb, Dhamar Wa-San`a. 2005. *San`a: al-Jumhuriyah al-Yamaniyah, Wizarat al-Takhtit wa-al-Ta`awun al-Dawli, al-Wahdah al-Raisiyah li-Muraqabat al-Faqr*. Descriptors: Water Pollution -- Yemen; Agriculture -- Yemen; Sewage -- Yemen; Water -- Yemen. Abstract: Reuse of sewage water in agriculture in Yemen. Notes: 96 pages; 25 cm. LCCN: 2006-321801. OCLC Accession Number: 84664765.

Alawi, Ali Jabr; Mezhelovsky, Nickolay V. Rybakov, Victor S., et al. 1995. *Republic of Yemen: Groundwater Resources Available for Development: Explanatory Note to the Potential Exploitation Groundwater Resources Map on 1:500 000 Scale*. Sana`a: Ministry and Mineral Resources, Geological Survey Authority and Mineral Exploration Board, Yemen. Descriptors: Groundwater -- Yemen (Republic); Water-supply -- Yemen (Republic); Yemen (Republic) -- Economic conditions. Notes: 1 v. (various pagings): ill., maps (some folded); 29 cm. Note(s): At head of title: Ministry of Oil and Mineral Resources, Geological Survey Authority and Mineral Exploration Board, Yemen. At head of title: Geological Consulting Company Ltd., International Academy of Sciences on Nature and Society, Russia. Includes bibliographical references (p. B1-B10). OCLC Accession Number: 45127461.

Al-Alaya`a, Zaid. 2009. "Water Expert: Sana'a basin to drain away by 2025" (August 8, 2009). *Yemen Observer*, Sana'a, Republic of Yemen. Abstract: Experts such as Mohammed al-Dubaei, a professor of geology, say there is a need to halve Sana'a city's two million population

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in order to confront the water crisis in the city. “Sana’a city cannot stand rapid urbanization,” he said. Water availability in Yemen has been worsening by the year and the government has no clear strategy on how to deal with the problem. They say water shortages, which affect about 80 percent of the country’s 21 million people, are exacerbated by the high fertility rate, rapid urbanization, the cultivation of ‘qat’ (a mild narcotic), a lack of public awareness, and the arbitrary digging of wells. These remarks have been repeated since the symposium of August 2008 organized by the Sheba Centre for Strategic Studies (SCSS) and a local think-tank entitled ‘Water Security in Yemen’. The symposium brought together dozens of local officials and experts on water. According to the latest official statistics, the total amount of water used annually is 3.5 billion cubic metres (cu.m.), of which 93% is used in agriculture, 6% in households and 1% by industry. The renewed fresh water is 2.5 billion cu.m. per year. The gap between used water and renewed fresh water is 1 billion cu.m. a year. The additional problem of a predicted doubling in Yemen’s population by 2025 means that 4.6 billion cu.m. would be required to sustain the country. Water use per capita in Yemen is currently at 125 cu.m. per year, but expected to drop to 62.5 cu.m a year by 2025. Globally, average water consumption per capita is 1,500 cu.m. per year. About 92 % of Yemen’s land is arid, semi-arid and desert. Nasser al-Awlaqi, a professor of economy and a former minister of water, said the water crisis in Yemen was largely due to agriculture, which depended on ground water from deep wells. Accessed Online April 2010, www.yobserver.com/environment/10017024.html

Albanna, Khaled. 2008. “Integrated Water Resources Management in Yemen; 33rd International Geological Congress; Abstracts.” International Geological Congress, Abstracts = Congres Geologique International, Resumes. [International Geological Congress], [location varies], International; Abstracts = Congres Geologique International, Resumes. Volume 33, Abstract 1201321. Descriptors: Abyan Delta; agriculture; Amran Basin; Arabian Peninsula; Asia; data; data management; environmental analysis; exploitation; Ibb Yemen; information management; protection; water management; water resources; Yemen. Abstract: The demand for water in Yemen is increasing and further intensified by continuous growth of population along with particularly in the agriculture sector. Water resources are imperiled by over-exploitation due to insufficient knowledge of available monitoring on this account there is an urgent need for gathering geo-environmental information and its professional evolution .This information will provide the basis for the sustainable management of the scarce resources and the development and initiation of adjusted protective measures. Therefore for this purpose the two government boards, Geological Survey and Mineral Resources Board (GSMRB) and National Water Resources Authority (NWRA) with cooperation of Federal Institute for Geosciences and Natural Resources (BGR), studied the three main locations in Yemen (Amran basin, Ibb area, Abyan detla). The aim of study is constructed Data Bank participates to manage and protects these basins from inefficient use of water. Database: GeoRef in Process. OCLC: 603643642.

Albert, Micah. 2009. “Yemen: Life on the Edge.” World Policy Journal (MIT Press). MIT Press: Fall 2009. Volume 26, Issue 3, Pages 72-80. Descriptors: Political refugees; Food security; Water shortages; Yemen (Republic); Somalia. Abstract: A photo essay and short article on the plight of Somali refugees in Yemen are presented. The stories of some of the refugees fleeing political violence in Somalia are briefly recounted, as are the already existing problems in Yemen with drastic shortages of food and water, and its own political instability. ISSN: 0740-2775.

Albiti, Anisa H., Adam, Ishag and Ghouth, Abdulla S. “Placental Malaria, Anaemia and Low Birthweight in Yemen.” Trans. R. Soc. Trop. Med. Hyg. Volume in Press, Corrected Proof,

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Descriptors: Malaria; Anaemia; Placenta; Birthweight; Pregnancy; Yemen. Abstract: Summary A cross-sectional study was conducted during the period of August 2007–April 2008 at Al-Wahda Teaching Hospital in Yemen to investigate prevalence and risk factors for placental malaria and anaemia and their effects on birthweight. Sociodemographic characteristics were gathered, maternal haemoglobin was measured and blood films were examined for malaria. Newborn birthweight was recorded. Out of 900 parturient women, malaria blood films were positive in 32 (3.6%) cases: in six sets of peripheral, placental and cord samples; in 15 placental and cord samples; and in 11 placental samples only. Malaria was not associated with age and parity, but it was significantly associated with history of fever [odds ratio (OR) 8.5, 95% CI 3.7–19, $P < 0.001$], rural residence (OR 2.5, 95% CI 1.1–5.3, $P = 0.01$) and rainy season (OR 5.1, 95% CI 1.7–15.2, $P = 0.003$). Overall, 694 (77.1%) out of these 900 women had anaemia (Hb < 11 g/dl) and 16 (1.8%) patients had severe anaemia (Hb < 7 g/dl). Anaemia was not associated with age, parity and malaria. Low birthweight was significantly associated with malaria (OR 5.7, 95% CI 1.7–18.5; $P = 0.004$). Thus, preventive measures (bednets and intermittent preventive treatment) should be employed for pregnant women regardless of their age or parity. ISSN: 0035-9203.

Alderwish, A. and Al-Eryani, M. 1999. “An Approach for Assessing the Vulnerability of the Water Resources of Yemen to Climate Change.” *Clim. Res.* Volume 12, Issue 2-3 SPEC. ISS. 6, Pages 85-89. Descriptors: Climate change; Climate scenarios; Management; Modeling. Notes: Cited By (since 1996): 1. Abstract: This paper outlines the methodology followed in the study of climate change impact on water resources in Yemen and presents initial results on the vulnerability of the water resources system. The selected modeling strategy is used for the first time in climate change assessment studies and is briefly discussed. This strategy comprised 4 interacting models: a Rainfall-Runoff Model (RRM), an Irrigation Simulation Model (ISM), a Groundwater Simulation Model (GSM), and an Economic Policy Model (EPM). Adequate indication of the water system’s sensitivity to climate change in arid and semi-arid regions can only be achieved when appropriate temporal and spatial scales of the assessment are used. For instance, only hourly or daily time step models can capture climate impacts on floods of ephemeral wadis. The degree of accuracy required should also be determined by the scarcity/availability of the resources. Database: SCOPUS. ISSN: 0936-577X.

Alderwish, A. and Dottridge, J. 1995. “Modelling Infiltration from Ephemeral Wadi Flows in the Sana’a Basin, Yemen; Modelling River-Aquifer Interactions.” *BHS Occasional Paper.* British Hydrological Society, UK. Mar. Volume 6, Pages 4-16. Descriptors: alluvium aquifers; aquifers; Arabian Peninsula; Asia; discharge; drainage basins; ephemeral streams; fluvial features; ground water; hydraulic conductivity; models; MODFLOW; recharge; Sana’a Basin; sensitivity analysis; shallow aquifers; streamflow; streams; surface water; wadis; water balance; Yemen. References: 11; illus. incl. 2 tables, geol. sketch map. Abstract: Recharge to groundwater from surface flows in ephemeral streams (wadis) in the Sana’a Basin, Yemen, was calculated using the streamflow routing package in MODFLOW. Models of the shallow alluvial aquifer in two wadis were constructed and calibrated in steady state, using the available data on aquifer geometry and hydraulic properties, observed piezometry, abstraction and direct recharge. The transient calibration used measured and estimated floods from the first rainy season of 1993, with adjustment of the quantities of groundwater recharge, specific yield of the alluvium and the hydraulic properties of the stream bed, until the hydrographs observed in wells during and after the rainy season were reproduced. The calculated values of infiltration were in good agreement with the results of a channel water balance model. Sensitivity analyses demonstrated that the

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recharge volumes are strongly influenced by flood duration, but that the flood discharge and distribution of flood intensity are of minor importance. The models will be used predictively to compute recharge over a 10 year period, from estimated wadi flows. Database: GeoRef. ISBN: 0948540702.

Alderwish, A. M. 2009. "Induced Recharge at New Dam Sites-Sana'a Basin, Yemen." Arab. J. Geosci. Pages 1-11. Descriptors: Arid; Artificial recharge; Dams; Water supply; Yemen. Notes: Article in Press. Abstract: In approaching the task of developing recharge estimates for dam sites, several constraints are apparent, including the scarcity of site-specific data for the selected new sites and the availability of simple yet robust analysis techniques. Combined, these constraints require an approach which involves best use of available data, adoption of relatively simple analytical approximations of reality, and the adoption of several key assumptions. In arid country with limited resources, two simple techniques have been used for recharge estimation: (1) a simple water balance model in spreadsheet and (2) a more refined Darcian approach involving an analytical approximation of a flow-net solution. By applying the two models at three new dam sites, the amount of recharge rates calculated over the period 2007-2026 was close. This is because, despite Darcian approach that should have affected the recharge rate as other parameters were introduced in the calculation of qt , e.g., groundwater table mound, reservoir water height, etc., the results show general agreement between the two methods which seem to validate the assumptions made in both methods. A general conclusion of this comparison is that the hydraulic conductivity (K) is the main determining factor in recharge calculations in these situations. The water balance model was used to estimate recharge at Wadi Bahaman, under gravity and cascade dams' scenarios. Using gravity dam at Wadi Bahaman for groundwater recharge proved not suitable based on the relatively small predicted runoff from a small catchment area and geological concerns in the abutment areas. Instead, a series of three low check dams (2 to 4 m high) was proposed. These check dams will slow down the runoff flow, form small reservoirs, and enhance recharge along the valley, without requiring expensive foundations. Estimated groundwater recharge under cascade dams (141,407 m³/year) is greater than recharge estimated for gravity dam (103,853 m³/year) by at least 36%. Database: SCOPUS. ISSN: 1866-7511.

Alderwish, A. M. and Dottridge, J. 1999. "Urban Recharge and its Influence on Groundwater Quality in Sana'a, Yemen; Groundwater in the Urban Environment; Selected City Profiles." International Contributions to Hydrogeology. A.A.Balkema, Rotterdam, Netherlands. Volume 21, Pages 85-90. Descriptors: alluvium aquifers; aquifer vulnerability; aquifers; Arabian Peninsula; Asia; chemical waste; chloride ion; chlorine; clastic rocks; concentration; environmental analysis; ground water; halogens; industrial waste; infiltration; pollution; porous materials; recharge; Sana'a Basin; Sana'a Yemen; sandstone; sandstone aquifers; sedimentary rocks; shallow aquifers; urban environment; water quality; water resources; water supply; water wells; Yemen. References: 11; illus. incl. sect., 1 table, sketch map. Abstract: Urban recharge provides a significant contribution to the groundwater resources of the Sana'a Basin in Yemen. The growing population of this semi-arid area depends on groundwater from alluvial and sandstone aquifers. The public water supply serves only 30% of the population, with a mere 12% connected to mains sewerage. Quantification of the urban water balance showed that over 80% of the urban recharge is derived from cess pits, with smaller contributions from mains leakage, industry, irrigation and wadi flows. As a result, groundwater levels in the city are stable or rising, especially in shallow wells, in contrast to the regional trends. The alluvial aquifer shows signs of contamination, with high conductivity values in central Sana'a. Water quality in the sandstone

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aquifer remains good, with no recorded biological contamination, but the conductivity trends mirror those in the alluvium. These values and the piezometric levels indicate downward leakage from alluvium to sandstone. Database: GeoRef. ISBN: 9054109246. ISSN: 0936-3912.

Alderwish, A. M. and Dottridge, J. 1998. "Recharge Components in a Semi-Arid Area; the Sana'a Basin, Yemen; Groundwater Pollution, Aquifer Recharge and Vulnerability." Geological Society Special Publications. Geological Society of London, London, UK. Volume 130, Pages 168-177. Descriptors: aquifers; Arabian Peninsula; Asia; ground water; hydrographs; infiltration; irrigation; moisture; recharge; Sana'a Basin; semi-arid environment; soils; terrestrial environment; unsteady flow; water balance; water quality; water resources; water supply; water use; Yemen. References: 12; illus. incl. 1 table, sketch map. Abstract: Credible estimates of recharge are essential for assessment of sustainable water resources in semi-arid areas, which rely on groundwater for irrigation and domestic supply. Investigation of the mechanisms and rates of recharge to the aquifers of the Sana'a Basin. Yemen, showed that the main components of recharge are infiltration of surface flows, irrigation return and urban leakage. Limited data and inaccessible, mountainous terrain required the use of robust, low-cost methods of quantifying the recharge components. Infiltration of surface flows from 12 wadis averages 39 Mm (super 3) a (super -1), with high interannual variation. The recharge was calculated using a combination of a rainfall-run-off model and computation of the water balance for the wadi. Irrigation return flows of 30 Mm (super 3) a (super -1), 20 to 40% of the water applied, were derived from measurements of soil moisture and matric potential for the three most extensive crops. Urban recharge from mains leakage and seepage through septic tanks was estimated from a well inventory, water supply records and usage rates, as 59% of the water supplied. The total recharge to the aquifers of the Sana'a Basin in 1993 was estimated to be 102 Mm (super 3), significantly less than the total groundwater abstraction, of about 184 Mm (super 3). Database: GeoRef. ISBN: 1897799985. ISSN: 0305-8719.

Alderwish, Ahmed and Al-Eryani, Mohamed. 1999. "An Approach for Assessing the Vulnerability of the Water Resources of Yemen to Climate Change; National Assessment Results of Climate Change; Impacts and Responses." Climate Research. Inter-Research, Oldendorf/Luhe, Federal Republic of Germany Federal Republic of Germany. 27 Aug. Volume 12, Issue 2-3, Pages 85-89. Descriptors: Arabian Peninsula; Asia; climate change; economics; ground water; hydrology; irrigation; models; public policy; rainfall; runoff; water management; water resources; water supply; Yemen. Notes: CR Special 6; References: 13; illus. incl. 2 tables, sketch map. Database: GeoRef. ISSN: 0936-577X.

Alderwish, Ahmed, Hefny, Kamal and Appleyard, Steve. 2004. "Rapidly-Urbanising Arid-Zone Cities; Urban Groundwater Pollution." International Contributions to Hydrogeology. A.A. Balkema, Rotterdam, Netherlands. Volume 24, Pages 133-153. Descriptors: Africa; aquifer vulnerability; aquifers; Arabian Peninsula; arid environment; Asia; Cairo Egypt; drinking water; Egypt; ground water; land use; North Africa; pollution; recharge; risk assessment; Sana'a Yemen; terrestrial environment; urban environment; urbanization; water management; water resources; water supply; Yemen. Notes: illus. incl. 1 table, sketch map. Database: GeoRef. ISSN: 0936-3912.

Aldridge, B. N. (investigator). 1980. "Surface-Water Data Collection Activities." United States: U. S. Geological Survey, Reston, VA, United States. U.S. Geological Survey Professional Paper. "Geological Survey research 1980: a summary of recent significant scientific and economic results accompanied by a list of geologic, hydrologic, and cartographic investigations in progress" 1980. Volume: P 1175, page: 348. Descriptors: Arabian Peninsula; Asia;

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hydrogeology; hydrology; surveys; Yemen. Date Issued: 1981. Abstract: "Yemen. Surface-water data collection activities. B. N. Aldridge was detailed to the AID mission in the Yemen Arab Republic during October and November 1979 to review the surface-water data-collection activities, principally, of the newly formed Department of Hydrology (DOH). The few existing installations and the data obtained at them were examined, and a reconnaissance for new gage sites was made, partly as a training exercise for the DOH personnel. Some training was given also in field and office procedures for the measurement and computation of streamflow data. Recommendations were developed for improvements in program planning, operational practices, training, manpower management, equipment procurement, and gagingstation construction." ISSN: 1044-9612. Database: GeoRef. URL: <http://pubs.usgs.gov/pp/1175/report.pdf>.

Al-Dubai, Mohamed. 2005. "Control of Water and the Earliest Irrigation Civilization in Yemen - Arabia Felix." 4th Conference of the International Water History Association. Paris: IWHA, 2005. "Abstracts 4th International Conference International Water History Association, UNESCO Headquarters, Paris, 1-3 December 2005." OCLC: 749546144.

Alenichev, Yu M. and Selivanov, V. A. 1981. "Primeneniye Metoda Vychitaniya Poley Rho T Pri Kartirovanii Razryvnykh Narusheniy." Translated title: "Use of Deduction Method of Resistivity Fields for Cartography of Disjunctive Faults." *Izvestiya Vysshikh Uchebnykh Zavedeniy. Geologiya i Razvedka*. Ministerstvo Vyshego i Srednego Obrazovaniya, Moscow, USSR. Volume 1981, Issue 2, Pages 144-148. Descriptors: Arabian Peninsula; Asia; data handling; data processing; distribution; electrical methods; electrical sounding; faults; geophysical methods; geophysical surveys; Hadramaut Valley; momography; nomograms; resistivity; Southern Yemen; structural geology; surveys; Yemen. Notes: IVUGAF; References: 4; illus. Database: GeoRef. ISSN: 0016-7762.

Al-Eryani, Mohamed Lotf. 1979. Hydrology and Ground Water Potential of the Tihama-Yemen Arab Republic. Descriptors: Hydrology -- Tihama (Saudi Arabia and Yemen) -- Mathematical models; Groundwater -- Tihama (Saudi Arabia and Yemen); Thesis/dissertation; Manuscript. Notes: viii, 191 leaves: typescript; ill., maps; 28 cm. Dissertation: Thesis (M.S. - Hydrology and Water Resources)--University of Arizona. Abstract: "Tihama is Yemen's coastal strip of land bordering the Red Sea. It occupies an area of about 20,000 km² and represents the country's most promising agronomic resource. With a total median annual volume of about 1,000 MCM (million cubic meters), surface water enters the Tihama plain through seven major wadis that drain the mountainous catchments to the east. The Tihama's Quaternary section constitutes the region's only known ground water aquifer. It consists of a thick sequence of alluvial sediments. Ground water occurs under water table conditions, and is annually replenished primarily by seepage of surface runoff. Using the technique of flow net analysis, it was found that annual natural ground water discharge through the Tihama aquifer to the Red Sea amounts to about 300 MCM. A confirmation of this magnitude of discharge was possible by computing two water balances at two of the major wadis. Results of the discharge computations can be applied in the planning of future salvage of this non-beneficial loss. Given that the current system of surface and ground water irrigation in the Tihama supports an area of about 150,000 hectares, a recovery of as little as 50 percent of this loss can increase the irrigated area by an additional 15,000 hectares." Note(s): Includes bibliographical references. Electronic reproduction. Tucson, Ariz.: University of Arizona, 2007. Responsibility: by Mohamed Lotf Al-Eryani. OCLC: 213274102. URL: http://etd.library.arizona.edu/etd/GetFileServlet?file=file:///data1/pdf/etd/azu_e9791_1979_404_sip1_w.pdf&type=application/pdf.

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Al-Fatimi, M., Friedrich, U. and Jenett-Siems, K. 2005. "Cytotoxicity of Plants used in Traditional Medicine in Yemen." *Fitoterapia*. 6. Volume 76, Issue 3-4, Pages 355-358. Descriptors: Cytotoxicity; ECV-304 cells; Medicinal plants; Yemen. Abstract: Twenty-five extracts obtained from 14 plant species used in the traditional medicine in Yemen have been screened for cytotoxic activity against human ECV-304 cells. Extracts of *Dracaena cinnabari*, *Eucalyptus camaldulensis*, *Euclea divinorum*, *Euphorbia cactus*, *Pulicaria crispa*, and *Withania somnifera* displayed a remarkable activity. ISSN: 0367-326X.

Al-Fatimi, M., Wurster, M., Kreisel, H. and Lindequist, U. 2005. "Antimicrobial, Cytotoxic and Antioxidant Activity of Selected Basidiomycetes from Yemen." *Pharmazie*. Volume 60, Issue 10, Pages 776-780. Notes: Cited By (since 1996): 5. Abstract: Dichloromethane, methanol and aqueous extracts of 23 selected Basidiomycetes species fruiting bodies collected in Yemen were screened in vitro for their antibacterial activities against three Gram-positive bacteria (*Staphylococcus aureus*, *Bacillus subtilis*, *Micrococcus flavus*), two Gram-negative bacteria (*Escherichia coli*, *Pseudomonas aeruginosa*) and against one yeast fungus (*Candida maltosa*), as well as for their cytotoxic and antioxidant activity. The highest antibacterial activity was shown by extracts from *Agaricus* sp. (Type 1), *Coriopsis caperata*, *Ganoderma colossus*, *Ganoderma resinaceum*, *Phellorinia herculea* and *Tulostoma obesum*. Strong antioxidative effects employing the DPPH assay were exhibited by methanol extracts from *Ganoderma resinaceum*, *Inonotus ochroporus*, *Phellinus rimosus* and *Phellorinia herculea*. The results provide evidence that some of the studied fungi might be potential sources for new biologically active agents. Database: SCOPUS. ISSN: 0031-7144.

Al-Fatimi, M. A. A., Julich, W. -D, Jansen, R. and Lindequist, U. 2006. "Bioactive Components of the Traditionally used Mushroom *Podaxis Pistillaris*." *Evid. Based Complement. Altern. Med. (Journal of evidence-based complementary & alternative medicine)* March 1. Volume 3, Issue 1, Pages 87-92. Abstract: In the course of an ethnobotanical study on fungi used in Yemeni ethnomedicine the fungus *Podaxis pistillaris* (Podaxales, Podaxaceae, Basidiomycetes) was found to exhibit antibacterial activity against *Staphylococcus aureus*, *Micrococcus flavus*, *Bacillus subtilis*, *Proteus mirabilis*, *Serratia marcescens* and *Escherichia coli*. In the culture medium of *P. pistillaris* three epidithiodiketopiperazines were identified by activity-guided isolation. Based on spectral data (NMR, ESI-MS and DCI-MS) their identity was established as epicorazine A (1), epicorazine B (2) and epicorazine C (3, antibiotic F 3822), which have not been reported as constituents of *P. pistillaris* previously. It is assumed that the identified compounds contribute to the antibacterial activity of the extract. URL: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1375231/>; <http://www.hindawi.com/journals/ecam/2006/567502/abs/>.

Al-Fatimi, Mohamed, Wurster, Martina, Schröder, Gudrun and Lindequist, Ulrike. 2007. "Antioxidant, Antimicrobial and Cytotoxic Activities of Selected Medicinal Plants from Yemen." *J. Ethnopharmacol.* 5/22. Volume 111, Issue 3, Pages 657-666. Descriptors: Medicinal plants; Yemen; Antimicrobial; Cytostatic; Antioxidant. Abstract: Ninety crude extracts, including dichloromethane, methanol and aqueous extracts from 30 medicinal plants used in the Yemeni ethnomedicine to treat common infections, were screened in vitro for antimicrobial activities against three Gram-positive bacteria and two Gram-negative bacteria, *Candida maltosa* and five opportunistic human fungal pathogens (two yeasts, three hyphomycetes). Most of the plants showed antibacterial activities. Extracts from *Tamarindus indica* flowers and *Ficus vasta* fruits have been the most active. ISSN: 0378-8741.

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Al-Gahri, M. A. and Almussali, M. S. 2008. "Microelement Contents of Locally Produced and Imported Wheat Grains in Yemen." E-J. Chem. Volume 5, Issue 4, Pages 838-843. Descriptors: Microelement; Spectrophotometric analysis; Wheat; Yemen. Abstract: In the last few decades, wheat-based products have received considerable attention in view of their potential role in transporting of microelements into the human diet. In Yemen, bread is the staple food, produced in different kinds from local and imported wheat. Most of it is not subjected to microelemental analysis. The objective of this study is to determine quantitatively the microelement such as Fe, Cu, Mn, Zn, Co, Cd and Pb in samples of wheat grains produced locally from different cultivated regions in Yemen as well as those imported from USA and Austria. Flame atomic absorption spectrophotometry was used for analysis. The results show that the contents of the microelements in the studied samples are generally within the permissible levels except cadmium. The samples collected from middle altitude and eastern plateau the cadmium is above the permissible level. Database: SCOPUS. ISSN: 0973-4945.

Al-Ganad, Ismail N. and Al-Jawadi, Zaid Y. 2008. "Preliminary Selection of New Touristic & Investment Locations in Yemen, using Remote Sensing Techniques; 33rd International Geological Congress; Abstracts." International Geological Congress, Abstracts = Congres Geologique International, Resumes. [International Geological Congress], [location varies], International; Abstracts = Congres Geologique International, Resumes. Volume 33, Pages @ Abstract 1255293. Descriptors: Arabian Peninsula; areal geology; Asia; beaches; construction materials; geographic information systems; hydrology; information systems; Landsat; Ras Al-Arah; remote sensing; shore features; statistical analysis; surface water; vegetation; Yemen. Abstract: The theme of selecting new touristic & investment locations is one of the important objectives of Yemen future development plans. As known, the geological, environmental, economical & social characteristics of these locations should fulfill the essential requirements of constructing the infrastructure elements of such projects effectively. As a pioneer study in Yemen, Ras Al-'Arah location was chosen to be studied preliminarily due to its unique situation adjacent to Bab Al-Mandab strait, & due to its easy accessibility via modern motor ways. Remote sensing techniques were used to study the characteristics of this location to collect geological, morphological, structural, surface hydrological, rural settlements & vegetation cover data, using Landsat 5, 7 TM radiometrically enhanced & georeferenced images. Remote sensing & GIS specialized softwares were used to perform advanced analyses for the collected data & to produce several related thematic maps statistical analyses charts. Field work was performed to visit several key ground truth points to check the produced maps & charts. Output maps & charts showed several potential characteristics to set Ras Al-'Arah location as a promising touristic & investment site. These characteristics are: ground fresh water abundance, construction materials diversity, stabilized sandy sea shores, good diving sites, low-medium rigidity & easy accessibility. Database: GeoRef in Process. OCLC: 603643642.

Al-Habori, Molham, Al-Mamari, Mohamed and Al-Meerri, Ali. 2004. "Type II Diabetes Mellitus and Impaired Glucose Tolerance in Yemen: Prevalence, Associated Metabolic Changes and Risk Factors." Diabetes Res. Clin. Pract. 9. Volume 65, Issue 3, Pages 275-281. Descriptors: Type II Diabetes Mellitus; Impaired glucose tolerance; Metabolic abnormalities; Prevalence and risk factors; Yemen. Abstract: Objective: To investigate the prevalence of type II Diabetes Mellitus (DM) and impaired glucose tolerance (IGT) and identify the metabolic abnormalities and risk factors associated with these conditions in an urban city of Yemen. Research design and methods: Cross-sectional, population-based study investigating 498 adults (245 males and 253 females) aged 25–65 years. The 1999 modified World Health Organization criteria were adopted

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for the diagnosis of Diabetes Mellitus and IGT. A standard questionnaire was applied and blood lipids, blood pressure, body mass index (BMI) and waist/hip ratio (WHR) were determined. Results: The overall prevalence of type II Diabetes Mellitus was 4.6% (7.4% in males and 2% in females). Impaired glucose tolerance (IGT) and impaired fasting glucose (IFG) were found in 2% and 2.2% of the study population. Factors independently related to any abnormality in glucose tolerance, using logistic regression analysis, were sex, hyperlipidaemia, hypertriglyceridaemia, and hypertension; whereas sex and age related to DM. More than 80% of the type II diabetics were over the age of 40, 35% being hyperlipidaemic, 22% being hypertensive and 18% obese. Sixty percent of IGT subjects were hyperlipidaemic and 20% were obese. Approximately 78% of obese individuals (≥ 30 kg/m²) had normal glucose tolerance. Conclusion: The prevalence of type II DM and its potential increase reflected by the high prevalence of obesity in normal glucose tolerance subjects in the Yemeni population constitutes a major public health problem. ISSN: 0168-8227.

Al-Hamdi, Mohamed I. 2009. Competition for Scarce Groundwater in the Sana'a Plain, Yemen: a Study on the Incentive Systems for Urban and Agricultural Water use. A.A. Balkema. Page(s): 216. Descriptors: Groundwater; Incentives in conservation of natural resources; Nature; Natural Resources; Science- Earth Sciences - Geology; Environmental Science; Technology & Engineering; Agriculture; Water conservation; Water resources development; Water rights; Water-supply. Abstract: The efficient management of water supply becomes even more important in arid areas where supply is at best erratic. This book looks at a range of issues connected to urban and agricultural water use in the Sana'a Plain area, including engineering and logistical problems, environmental and climatic influences on groundwater, legal and political wrangles, economic considerations and options for waste water re-use. ISSN: 9054104260, 9789054104261.

Al-Hamdi, M. and Alaerts, G. 2000. Structure and Cost of the Water Supply Market in Sana'a City, Yemen. In: Water Resources 2000: Building Partnerships. Reston, Va.: American Society of Civil Engineers, 2004. "Joint Conference on Water Resource Engineering and Water Resources Planning and Management 2000, July 30 - August 2, 2000, Minneapolis, Minnesota, USA." ASCE Conf. Proc. Volume: 104, 40517, page(s): 241. Conference: July 30, 2000. OCLC: 65287505. URL: <http://link.aip.org/link/?ASC/104/241/1>.

Al-Hamdi, Mohamed I. 2000. Competition for Scarce Groundwater in the Sana'a Plain, Yemen: A Study on the Incentive Systems for Urban and Agricultural Water use. Rotterdam: Balkema. Page(s): 200. Descriptors: Groundwater -- Yemen (Republic) -- San`a; Water-supply -- Yemen (Republic) -- San`a; Water conservation -- Yemen (Republic) -- San`a; Incentives in conservation of natural resources -- Yemen (Republic) -- San`a; Thesis/dissertation. Notes: xvi; ill. 25 cm. Dissertation: Thesis (doctoral)--Delft University of Technology, 2000. Note(s): Includes bibliographical references. Responsibility: by Mohamed I. Al-Hamdi. ISBN: 9054104260 (pbk.); 9789054104261 (pbk.). OCLC Accession Number: 48145662.

Al-Hassan, L. A. J. and Shwafi, N. A. A. 1997. "Studies on the Caudal Vertebrae of Teleost Fishes, *Pristipomoides Multidens* and *Tylosurus Choram*." Pak. J. Zool. Volume 29, Issue 4, Pages 329-333. Descriptors: Caudal vertebrae; *Pristipomoides multidens*; Red sea; Teleost fish; *Tylosurus choram*; Yemen. Abstract: The different osteological features including the ratio between the caudal vertebral number and the different measurements of vertebral centrum were recorded and studied in the two teleost fish species, *Pristipomoides multidens* and *Tylosurus choram*. The results revealed that the fish vertebrae in general and vertebral centrum in particular are a good systematic criteria to identify the two species in question. The distance

between the base of the haemal spine and the posterior face of the centrum (D2) and the ratios D2/L are the distinctive character for *P. multidentis*, while the ratios H/L, H/W1, H/W2 are the characteristics in the identification of *T. choram*. Database: SCOPUS. ISSN: 0030-9923.

Al-Hebshi, N. N., Nielsen, Ø. and Skaug, N. 2005. "In Vitro Effects of Crude Khat Extracts on the Growth, Colonization, and Glucosyltransferases of *Streptococcus Mutans*." *Acta Odontol. Scand.* Volume 63, Issue 3, Pages 136-142. Descriptors: Caries; *Catha edulis*; Glucosyltransferase; Khat; *Streptococcus mutans*. Notes: Cited By (since 1996): 7. Abstract: Millions of Yemenites, East Africans, and immigrants to Western countries chew khat daily for its amphetamine-like effects. There is little information in the literature concerning the possible effects of the habit on oral microbiota. Our objective was to study in vitro crude khat extract effects on *Streptococcus mutans* growth and sucrose-dependent colonization, and on its glucosyltransferase (GTF) activity and production. Three khat cultivars were used. Lyophilized crude aqueous khat extracts were applied to the different assays at concentrations of 0-1% (w/v). Sucrose-dependent colonization was assessed as the ability of *Streptococcus mutans* UA159 to form adherent biofilms in glass culture tubes. Colony forming units (CFUs) in the planktonic phase served as a measure of bacterial growth, while CFUs in the biofilm phase were used to quantify viability in the biofilms. GTFs activity was tested by incubating a crude GTFs preparation with sucrose and determining the amount of water-soluble and water-insoluble glucans formed. GTFs production was assayed by comparing intensities of GTF bands in Western blots of extracts from control and khat-containing cultures. The khat extracts effectively inhibited biofilm formation. The minimum biofilm inhibitory concentration (MBIC) varied among the cultivars (0.25-1%). The extracts also inhibited synthesis of both glucan types, particularly insoluble glucans (average 85% inhibition at 1%), with significant differences among the cultivars. However, khat increased bacterial growth and at sub-MBIC also viability within biofilms; there were no inter-cultivar differences. It is shown that khat leaves contain water-soluble constituents that inhibit some cariogenic properties of *S. mutans* in vitro. Database: SCOPUS. ISSN: 0001-6357.

Al-Hussaini, Janet Hill. 2008. *Washing Hands in a Sea of Development: Community Participation in Water-Related Health Education in the Republic of Yemen*. Descriptors: Public health -- Yemen (Republic); Water-supply -- Yemen (Republic); Drinking water -- Yemen (Republic); Water quality management -- Yemen (Republic); Sanitation -- Yemen (Republic); Thesis/dissertation; Manuscript. Notes: vii, 91 leaves: col. ill., maps; 28 cm. Dissertation: Thesis (M.A.)--George Mason University, 2008. Note(s): Typescript. Vita: leaf 91. Submitted in partial fulfillment of the requirements for the degree of Master of Arts in Interdisciplinary Studies. Thesis director: Lisa Pawloski. Includes bibliographical references (leaves 87-90). OCLC: 244827912.

Ali, A. A. 2007. "Qat Habit in Yemen Society: A Causative Factor for Oral Periodontal Diseases." *Int. J. Environ. Res. Public Health.* Volume 4, Issue 3, Pages 243-247. Descriptors: Gingivitis; Periodontitis; Qat. Notes: Cited By (since 1996): 1. Abstract: The effect of a common habit among Yemeni population on the periodontal status was investigated. This cross-sectional study was done on 2500 Yemenis with mean age 27.01 years (1818 males and 682 females). Among these 1528 were qat chewers and 972 were non-chewers. Detailed questionnaire and pre-designed scoring system for the periodontal status were employed for each case. Study results indicated that out of 972 non-chewers 116(12%) had periodontal pocketing and 18 (1.9%) cases had gingival recession. On the other hand, out of 1528 chewers, 468 (31.8%) had periodontal pockets and 98 (6.4%) with gum bleeding, $p < 0.05$. These effects were found to increase with

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increased frequency and duration of chewing. It was concluded that habit of qat can cause damage to the periodontal ligament as pocketing and gum recession. Database: SCOPUS. ISSN: 1660-4601.

Ali, A. A. 2007. "Histopathologic Changes in Oral Mucosa of Yemenis Addicted to Water-Pipe and Cigarette Smoking in Addition to Takhzeen Al-Qat." *Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod.* Volume 103, Issue 3, Notes: Cited By (since 1996): 4. Abstract: Background: Because the clinicopathologic effects of takhzeen al-qat are similar to those induced by smoking, the aim of this paper was to study the oral effect of 3 bad oral habits: takhzeen al-qat and cigarette and water-pipe smoking. Study design: This study was done on 33 Yemeni chronic qat users grouped as heavy cigarette smokers (GI), nonsmokers (GII) and water-pipe smokers (GIII). In all cases (n = 33) 2 biopsies were taken (n = 66), one from the buccal mucosa at the chewing side and the other from a similar mucosa at the contralateral (nonexposed) side. Biopsies were prepared for routine H&E staining. Results: Acanthosis appeared in 88% and 0%, abnormal rete ridges in 70% and 3%, hyperparakeratosis in 67% and 0%, and epithelial dysplasia in 30% and 0% of the chewing and nonchewing sides, respectively, in the 3 groups. Epithelial dysplasia appeared in 41% of GI and GIII (smokers) but in only 9% of GII (nonsmokers). Conclusions: Takhzeen al-qat causes distinct histopathologic changes in the oral mucosa at the side of chewing, such as acanthosis, abnormal rete ridges, and hyperparakeratosis. The association between takhzeen al-qat and cigarette or water-pipe smoking may increase the risk of epithelial dysplasia. Database: SCOPUS. ISSN: 1079-2104.

Ali, N. A. A., Jülich, W. -D, Kusnick, C. and Lindequist, U. 2001. "Screening of Yemeni Medicinal Plants for Antibacterial and Cytotoxic Activities." *J. Ethnopharmacol.* Volume 74, Issue 2, Pages 173-179. Descriptors: Antibacterial activity; Cytotoxic effects; Traditional medicinal plants. Notes: Cited By (since 1996): 71. Abstract: Ethanolic extracts of 20 selected plant species used by Yemeni traditional healers to treat infectious diseases were screened for their antibacterial activity against both Gram-positive and Gram-negative bacteria, as well as for cytotoxic activity. Fourteen of the ethanolic extracts showed variable degrees of antibacterial activity. The active ethanolic extracts were partitioned between ethyl acetate and water for a first separation. The ethyl acetate extract of *Lawsonia inermis* was found to be the most active one against all bacteria in the test system. Other promising results could be obtained from extracts of *Aloe perryi*, *Indigofera oblongifolia*, *Meriandra benghalensis* and *Ziziphus spina christi*. Additionally, the ethanolic extracts of the 20 plants under investigation were tested for their cytotoxic effects on FL-cells using the neutral red assay. Extracts of *Calotropis procera*, *Chenopodium murale*, *Pulicaria orientalis*, *Tribulus terrestris* and *Withania somniferum* displayed a remarkable activity. Database: SCOPUS. ISSN: 0378-8741.

Alkaff, Huda. 2002. Facing the Water Scarcity Problem in Yemen. *Ecological Society of America (ESA) 2001 Annual Meeting. Poster Session #38: Landscape Ecology.* Abstract: Yemen is located within an extremely arid region. It has limited renewable freshwater supplies, and is most dependable on its fossil groundwater reserves. In some neighboring areas, depletion of these nonrenewable groundwater resources is taking place at an alarming rate due to overpumping in order to meet agricultural requirements. Population growth, improvement in the standard of living, and urban migration, coupled with the absence of conservation programs, have brought about high domestic water consumption, which itself doubled from 1980 to 1990. As a result, Yemen became a water scarce country in 1990. Based on current trends and future projections, renewable water resources such as surface runoff, desalination, rechargeable alluvial aquifer and reclaimed wastewater are already insufficient to meet the expected demand. Since

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the whole Arabian peninsula region, in which Yemen lies in its southwest corner, is suffering from the same water scarcity and imbalance problems, there is an urgent need for regional water plans and solutions. Mutually agreeable water-sharing terms and treaties among neighboring countries, expansion of available water supply through conservation, efficiency, and reuse, and environmental education, research, and management are some of the important steps towards reducing the current and near-future imbalance between water demand and supply in Yemen and the Arabian peninsula. OCLC: 614188503.

Al-Kebsi, A. and Chandrasekharam, D. 2000. Saltwater Contamination in the Coastal Aquifer, Tihama Plain, Wadi Surdud, Yemen Republic. Groundwater 2000: proceedings of the International Conference on Groundwater Research, Copenhagen, Denmark, 6-8 June 2000, Volume 1, pages 223-224. ISBN: 9058091333; 9789058091338. URL: <http://books.google.com/books?id=i5ewffEu6O8C&lpq=PA223&ots=SxxWOjVglP&dq=Saltwater%20Contamination%20in%20the%20Coastal%20Aquifer%2C%20Tihama%20Plain%2C%20Wadi%20Surdud&pg=PA223#v=onepage&q=Saltwater%20Contamination%20in%20the%20Coastal%20Aquifer,%20Tihama%20Plain,%20Wadi%20Surdud&f=false>

Al-Kohlani, Taha. 2010. Geochemistry of Thermal Waters from Al-Lisi - Isbil Geothermal Field, Dhamar Governorate, Yemen. 2010 World Geothermal Congress (WGC 2010), Bali, Indonesia April 25-29, 2010. Pages 1-11. Abstract: The Al-Lisi – Isbil geothermal and volcanic field, one of Yemen's important fields, is known for its fumaroles, steaming grounds and hot wells. The area is mainly composed of basaltic lava flows, stratified basic tuffs and agglomerate pyroclastics. Less common are differentiated rock-types like rhyolite. The Al-Lisi volcano is an exception which consists entirely of acidic lava flows (rhyolite, obsidian, acidic tuffs and ash rings). Chemical analyses from 29 shallow water wells from the Al-Lisi – Isbil area were reviewed. All the data were interpreted using the WATCH program for speciation and by mineral equilibrium diagrams and other graphical presentation and classification methods. The maximum reservoir temperature for the wells, predicted by calculation of various geothermometers, exceeds 100°C. There is evidence of mixing with cold water. The thermal fluid is of bicarbonate type and the reservoir rocks consist mainly of sandstone (Tawilah Formation) at 1000 m to 1500 m depth. URL: <http://b-dig.iie.org.mx/BibDig/P10-0464/pdf/1481.pdf>.

Allen, Charles. 1990. The Savage Wars of Peace: Soldier's Voices. London: Michael Joseph. Page(s): 290. Notes: xxix, 290 p., [24] p. of plates: ill., maps, ports. 24 cm. ISBN: 0718128826.

Alley, April L. 2008. Shifting Light in the Qamariyya: The Reinvention of Patronage Networks in Contemporary Yemen. United States -- District of Columbia: Government. ProQuest Dissertations and Theses. Abstract: Understanding the dynamics of regimes that combine the external trappings of democracy with the substance of authoritarian rule is a central puzzle facing comparative political scientists. Thus far, much of the literature addressing hybrid regimes has focused on the importance of elections, while neglecting variations in the underlying practice of autocracy. This dissertation moves beyond the focus on elections to explore processes of institutional change and renewal within a particular type of hybrid regime: those dominated by neopatrimonial politics. It asks: Under what conditions do elites in neopatrimonial regimes, who are embedded in networks of patronage, defect by building formal political institutions? And, what impact does their defection have on the existing mode of autocracy? To address these questions, the project inductively constructs a typological theory using comparative and within-case analysis of individual elites in the context of the Yemen. It argues that five variables

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combine to determine if included elites are likely to defect: (1) the degree of patronage inclusion (2) the type of patronage extended, (3) elite identity, (4) life-cycle position, and (5) an ease of defection index. The details of the typological theory do not travel beyond Yemen, yet the study provides analytical insights that inform the analysis of neopatrimonial regimes more broadly. First, it suggests that not all types of patronage are created equal. Scholars wishing to understand the micro-politics of elite bargaining must look beyond an inclusion/exclusion dichotomy to include distinctions in both the degree and type of patronage. Secondly, the project offers a cautionary tale for policymakers and researchers who view defection as a source of democratic change. Powerful elites may choose to defect, but they may do so as a bargaining tactic to reposition themselves in networks of patronage. In these cases, defection may serve to reinvent, rather than attenuate, the existing mode of autocracy. Notes: Ph.D. OCLC: 453941655. URL: <http://cdm15036.contentdm.oclc.org/cgi-bin/showfile.exe?CISOROOT=/p15036coll3&CISOPTR=192&filename=193.pdf>

Allyn, N. Quick, M. Condon, E. and Morris, E. 2001. Solving a Harbour Sedimentation Problem in Yemen. Rhodes, Greece: Wit Press. Page(s): 13-21. Fifth International Conference on Coastal Engineering, Coastal Engineering 2001, September 19, 2001 - September 21. Conference: 2001. Descriptors: Sedimentation; Breakwaters; Climatology; Mathematical models; Mooring; Ports and harbors; Sediment transport. Abstract: The Ash Shihr, Yemen harbour on the Gulf of Aden was built in 1992/93 by Nexen Inc. for the vessel fleet supporting the loading of oil into large tankers at the offshore Single Buoy Mooring (SBM). In designing the harbour, the greatest emphasis was placed on ensuring that the harbour provided effective shelter during the SW summer monsoon season, which can generate deep water waves of up to about 6.4 m significant wave height with a period of 14 seconds. This led to the harbour entrance being placed on the east side of the harbour to minimize wave agitation within the harbour. The dominant factor proved to be the littoral drift of sediment in a westerly direction. This led to the migration of large amounts of sediment into the harbour and the build up of sand on the beach well to the east of the harbour. As this situation developed it was effectively closing the harbour. A sedimentation study of the harbour was performed by Delft Hydraulics [1]. Various solutions were considered including by-pass maintenance dredging, a dredged sand trap, relocating the harbour entrance, and shielding the harbour with a sand trap breakwater. Westmar Consultants Inc. provided the detailed design for a 600 metre long sand trap breakwater which resulted in economically viable construction bids. The work was successfully completed by Yemen based contractors in May 2001. The quality of the work is excellent and the breakwater is performing as designed in trapping sand and preventing the longshore drift from accreting in the entrance. ISBN: 1853128791.

Allyn, Norman; Quick, Michael; Condon, Ed; Lisztwan, Jan and Morris, Eric. 2004. Breakwater for Service Harbour, Gulf of Aden. ASCE. ASCE Conf. Proc. Volume: 136, 40727, page(s): 78. Conference: May 23, 2004. Descriptors: Breakwaters; Harbors; Middle East. Abstract: The Ash Shihr harbour, on the Gulf of Aden was built by Canadian Nexen Petroleum Yemen (CNPY) in 1992/1993 to provide service support to a Single Buoy Mooring (SBM) used for oil tanker loading. The orientation of the harbour was originally designed to minimize wave agitation at the berth. As a result, the entrance to the harbour was placed on the eastern side to provide shelter from monsoon generated waves traveling from the southwest. Immediately after construction, sediment began accreting in the harbour entrance which necessitated maintenance dredging and sand bypassing to allow continued operations in the harbour. Delft Hydraulics performed a study of sedimentation in the harbour in 1998. The results of this study indicated that the harbour is

built on a coastline with substantial longshore sediment transport, with a net rate estimated at 260,000 m³ per year westward. The study also examined solutions to the problem including dredging, relocating the harbour entrance, and constructing a breakwater to the east of the harbour to trap sediment. The sand trap breakwater option was found to result in the lowest maintenance dredging requirements and the lowest total cost. CPNY authorized the detailed design of the sand trap breakwater in 1999. Construction of the breakwater was completed by Yemen based contractors in June 2000. Reports received in April 2003 indicate that the breakwater is performing as expected. Sand bypassing operations are ongoing, but at much reduced levels and acceptable water depths in the harbour entrance have been maintained using a plough dredge. ISBN: 0-7844-0727-4. URL: <http://link.aip.org/link/?ASC/136/78/1>.

Al-Maktari, M. T. and Bassiouny, H. K. 1999. "Bionomics of Anopheline Vectors in Zabid District, Al-Hodeidah Governorate, Republic of Yemen." *East. Mediterr. Health J.* Volume 5, Issue 4, Pages 698-705. Notes: Cited By (since 1996): 1. Abstract: The bionomics of anopheline vectors were analysed in randomly selected centres, representing fixed and spot-check stations. Three anopheline species were found. *Anopheles arabiensis* was the most prevalent species (84.2%) with a sporozoite rate of 0.7%, followed by *A. culicifacies adenensis* (14.9%) and *A. rhodesiensis rupicolus* (0.9%). Maximum indoor resting density was recorded during March, July and August. Positive sprayed sites for females were higher in bedrooms (40.4%) than animal sheds (26.9%). A total of 2560 anopheline larvae were collected of which 79.5% were *A. arabiensis*, 19.4% were *A. culicifacies adenensis* and 1.1 % *A. rhodesiensis rupicolus*. *A. arabiensis* was assumed to be the most efficient malaria vector based on epidemiological evidence and the finding of natural sporozoite infected females. Database: SCOPUS. ISSN: 1020-3397.

Al-Mamary, M., Al-Meer, A. and Al-Habori, M. 2002. "Antioxidant Activities and Total Phenolics of Different Types of Honey." *Nutr. Res.* Volume 22, Issue 9, Pages 1041-1047. Descriptors: Antioxidant activity; Honey; Total phenolics. Notes: Cited By (since 1996): 40. Abstract: The antioxidant activities and total phenolic contents of five different types of Yemeni honey {*Acacia ehrenbergina* (Salam-Tehamah), *Acacia edgeworhi* (Somar-Hadramout), *Ziziphus Spinachristi* L. (Sidr-Hadramout), *Ziziphus Spina-christi* L. (Sidr-Taiz), Tropical blossom (Marbai-Hadramout)}, and four types of imported origins {an American-Tropical blossom (New Orleans), an American-Orange source (Florida), Swiss-blossom, and an Iranian-Tropical blossom} were evaluated. Total phenolic contents of diluted honey samples varied from 56.32 to 246.21 mg/100g honey as Catechin equivalent by the Folin-Ciocalteu method. Four of five Yemeni honey samples contained significantly higher total phenolic content as compared with the imported honeys. Percentage antioxidant activities of diluted honey samples were assayed *in vitro* by the inhibition of liver homogenate oxidation mediated by FeSO₄/ascorbate system. The antioxidant activity of diluted honey samples increased with increasing the levels (50 µl, 100 µl, 200 µl) of honey samples. The total antioxidant activities of diluted samples varied from -6.48% (prooxidant activity) to 65.44% inhibition. The *Acacia ehrenbergina* (Salam-Tehamah) had the highest antioxidant activity and total phenolic content. A positive correlation was observed between percentage antioxidant and total phenolics, which increased with the higher level of samples (R = 90.5 at 200 µl). The present study confirms that Yemeni honey contains significant source of phenolic antioxidants that may have therapeutic potential. Database: SCOPUS. ISSN: 0271-5317.

Almas, Ahmed A. M. 2009. *Water Resources in the Yemen: A Socio-Economic and Engineering Study*. VDM Verlag. Page(s): 160. Descriptors: Technology & Engineering;

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Environmental; General; water; Yemen. Abstract: Yemen is one of the countries which are suffering from extreme water resources shortage. Yemen's agriculture and water resources sectors are in a crisis. The water availability is 150 m³/cap/a. This compares with an average of 1250 m³/cap/a for the Middle East and North Africa. All water resources are exploited beyond the level of recharge. The agriculture industry uses 93% of the potable water, and does not actively encourage sustainable water saving techniques. Qat (*Catha edulis*; recreational drug) cultivation uses 40% of the potable water. The water crisis could be mitigated by reducing qat production, and promoting water reuse of treated wastewater for irrigation, desalination of sea water. The sustainable use of water resources can be mitigated by achieving if the Government of Yemen put in the top priority agenda a national water management strategy that pave to conserve water resources in Yemen. ISBN: 3639218760; 9783639218763.

Almas, A.M.; Scholz, M. 2006. Agriculture and water resources crisis in Yemen: need for sustainable agriculture. *Journal of Sustainable Agriculture*, Vol. 28 (3).

Almas, A. A. M. and Scholz, M. 2006. "Potential for Wastewater Reuse in Irrigation: Case Study from Aden (Yemen)." *Int. J. Environ. Stud.* Taylor and Francis Ltd: Volume 63, Issue 2, Pages 131-142. Descriptors: Wastewater reclamation; Groundwater resources; Recycling; Sewage treatment; Surface water resources. Abstract: Wastewater treatment with waste stabilization ponds (WSP) is a very efficient, low cost and low maintenance operation. The treated wastewater from WSP should be considered as a valuable resource for reuse by water resources managers. Yemen's water resources are currently experiencing a crisis, because all surface water and groundwater resources are exploited beyond the level of recharge. Promoting water reuse of treated wastewater for irrigation could mitigate this water crisis. This paper assesses the performance of a WSP in the city of Aden by examining the quality of treated sewage predominantly of domestic origin. A comparison with international guidelines reveals that it is possible to use the final effluent to a limited extent in irrigation. This paper includes an outline of the social, religious and political reasons for the water crisis, and explores the idea of reuse of effluent for different irrigation practices. ISSN: 0020-7233. URL: <http://dx.doi.org/10.1080/00207230500505569>.

Almas, AAM and Scholz, M. 2006. "Agriculture and Water Resources Crisis in Yemen Need for Sustainable Agriculture." *J. Sustainable Agric.* Volume 28, Issue 3, Pages 55-75. Descriptors: Article Subject Terms: Agriculture; Available Water; Cultivation; Drinking water; Drug abuse; Drugs; Impaired Water Use; Irrigation; Potable Water; Recreation areas; Surface water; Surface-groundwater Relations; Wastewater; Wastewater Irrigation; Water Resources; Water Reuse; Water conservation; agriculture; sustainable agriculture; water availability; Article Geographic Terms: Africa; Middle East; Yemen. Abstract: Yemen's agriculture and water resources sectors are in a crisis. The water availability is 150 m³/cap/a. This compares with an average of 1250 m³/cap/a for the Middle East and North Africa. All surface water and groundwater resources are exploited beyond the level of recharge. The agriculture industry uses 93% of the potable water, and does not actively encourage sustainable water saving techniques. Qat (*Catha edulis*; recreational drug) cultivation uses 40% of the potable water. The water crisis could be mitigated by reducing qat production, and promoting water reuse of treated wastewater for irrigation. However, this is currently socially unacceptable. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 1044-0046.

Almas, Ahmed. 2006. Water Resources Crisis in Yemen: Causes - Solution. 2006 USDA-CSREES National Water Conference on Research, Extension and Education for Water Quality and Quantity. Abstract: Yemen's agriculture and water resources sectors are in a crisis. The

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water availability is 150 m³/cap/a. This compares with an average of 1250 m³/cap/a for the Middle East and North Africa. All surface water and groundwater resources are exploited beyond the level of recharge. The agriculture industry uses 93% of the potable water, and does not actively encourage sustainable water saving techniques. Qat (*Catha edulis*; recreational drug) cultivation uses 40% of the potable water. The water crisis could be mitigated by reducing qat production, and promoting water reuse of treated wastewater for irrigation. However, this is currently socially unacceptable. The following factors have had a great impact on water resources, they are the causes to speed up the water resources deterioration in Yemen, they are: (1) Agriculture activities depleted water resources. (2) water losses. (3) contamination of water resources. (4) Qat cultivation. (5) Digging of too many wells. This paper will investigate these factors and will drive solution which might mitigate the water crisis in Yemen. URL:

<http://www.usawaterquality.org/conferences/2006/Abstracts/Almas.pdf>.

Almas, Ahmed A. M. and Scholz, Miklas. 2006. "Agriculture and Water Resources Crisis in Yemen: Need for Sustainable Agriculture." *J. Sustainable Agric.* 09. Volume 28, Issue 3, Pages 55-75. Descriptors: Sustainable Agriculture; Alternative Agriculture; Water-Supply, Agricultural; Groundwater; Water Conservation; Water Consumption; Yemen (Republic); Africa, North; Middle East; Irrigation; Qat; Social Problems; Sustainable Agriculture Policy; Wastewater Reuse; Wastewater Stabilization Pond; Water Leakage; Water Resources; Yemen. Abstract: Yemen's agriculture and water resources sectors are in a crisis. The water availability is 150 m³/cap/a. This compares with an average of 1250 m³/cap/a for the Middle East and North Africa. All surface water and groundwater resources are exploited beyond the level of recharge. The agriculture industry uses 93% of the potable water, and does not actively encourage sustainable water saving techniques. Qat (*Catha edulis*; recreational drug) cultivation uses 40% of the potable water. The water crisis could be mitigated by reducing qat production, and promoting water reuse of treated wastewater for irrigation. However, this is currently socially unacceptable. ISSN: 1044-0046.

Almas, A.M.; Jefferies, C. 2001. Wastewater collection, handling, disposal and reuse in Southern Yemen- economic development and water management. *Wurzbürger Geographische Arbeiten, Bulletin No. 54*, Wurzburg, Germany.

Al-Mashreki M.H., Mat Akhir J.B., Abd Rahim S., Md Desa K., and Ali Rahman Z. 2010. "Remote Sensing and GIS Application for Assessment of Land Suitability Potential for Agriculture in the IBB Governorate, the Republic of Yemen". *Pakistan Journal of Biological Sciences*. 13, no. 23: 1116-1128. ISSN: 1028-8880.

Al-Medhwahi, Emtinan and Keane, Susan. 2005. Knowledge and Practices of Hygiene, Sanitation and Water use in Rural Yemen. 133rd Annual Meeting and Exposition of the American Public Health Association. Philadelphia, PA. December 10-14, 2005. Abstract: The major causes of child morbidity in Yemen, such as diarrhea disease, acute respiratory infection and parasitic diseases, are caused by or related to environmental factors. The USAID-funded Partners for Health Reformplus Project (PHRplus) is implementing a pilot project to address basic health needs in Thula, including household water supply and sanitation. The purpose of the pilot is to identify major environmental health problems in the district, using field visits, observations, interviews and stakeholder meetings, and implement community-based solutions to these problems, wherever possible. Through consultation with local authorities, the project conducted a survey of households in nine villages. The survey enabled the project team to understand the knowledge and practices of households in these villages in relation to water, sanitation and hygiene in order to identify their needs for improved health through better hygiene

and health education. Results are being used as a baseline to monitor interventions which include-implementing participatory hygiene promotion and other health promotion programs in the areas selected from the baseline survey; and advocating with other donors in building a network for sanitation and hygiene promotion and water resources improvement. URL: http://apha.confex.com/apha/133am/techprogram/paper_108167.htm.

Almhab, A. and Busu, I. 2009. Estimation of Evapotranspiration using Fused Remote Sensing Image Data and Energy Balance Model for Improving Water Management in Arid Area. Proc. - Int. Conf. Comput. Eng. Technol. ICCET Volume: 2, page(s): 529-533. 2009 International Conference on Computer Engineering and Technology, ICCET 2009. Singapore Conference: 22 January 2009 through 24 January 2009. Descriptors: AVHRR; Evapotranspiration; Yemen. Abstract: Remote sensing has proved to be very useful in the investigation of vegetation and hydrological monitoring, especially when studying vast areas. In this paper, the complement between two optical remote sensing data (Landsat TM and NOAA-AVHRR) and a Digital Elevation Model (DEM) is used to estimate hydrological parameters based on derived surface reflectance. These parameters which are used in the Modified Soil Energy Balance Algorithm for Land (M-SEBAL) model have been used to estimate net radiation, soil heat flux, sensible heat flux and evapotranspiration (ET) for Sana'a Basin in Yemen. The area is known for arid and semi-arid weather conditions with undulating topography. Image data from AVHRR on-board NOAA satellites with a large areal coverage, good temporal and spectral resolution are found to be very useful in generating some parameters required for the above process. However, the data have poor spatial resolution. On the other hand, image data from the Thematic Mapper on-board the Landsat satellite, with a high spatial and spectral resolution should be able to provide values for the parameters involved, but the area coverage is significantly reduced. This study has been carried out, using a data fusion technique in order to exploit the respective advantages of these two disparate sources of image data. A general framework is then proposed to generate ET maps for arid and semi-arid regions. This is achieved by means of multi-temporal, multiresolution remote sensing data. Taking into account topographic effects, an attempt has also been made to incorporate DEM information for estimating the net radiation of the areas involved. An application for computing a daily ET map over Sana'a Basin, Yemen is presented. As a result, a daily ET map generated from meteorological observations was compared with estimated ET data simulated from remote sensing data. In conclusion, data from both remote sensing sources give reasonable values with the result from the TM being better than those obtained from the AVHRR. This is attributed to the differences in spatial resolution, in which TM data is higher than AVHRR. The fusion of the two shows improves spatial detail whilst maintaining the spectral signature close to the original. 2009 IEEE. Notes: Conference code: 76101. ISBN: 9780769535210. Database: SCOPUS. OCLC: 318104320.

Almhab, A. and Busu, I. 2008. Estimation of Evapotranspiration with Modified SEBAL Model using Landsat-TM and NOAA-AVHRR Images in Arid Mountains Area. Proc. Asia Int. Conf. Model. Simul. AMSpage(s): 350-355. 2nd Asia International Conference on Modelling and Simulation, AMS 2008. Kuala Lumpur Conference: 13 May 2008 through 15 May 2008. Descriptors: AVHRR; DEM; Evapotranspiration; Sana'a Basin; SEBAL; TM; Yemen. Abstract: This study examines the method for determining surface energy namely surface energy balance algorithm for land (SEBAL). This particular method utilized the combination of meteorological observations with information extracted from remote sensing data. The modified SEBAL model using data from Landsat TM and NOAA- A VHRR sensors, has been used to estimate net

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radiation, soil heat flux, sensible heat flux and ET for Sana'a Basin in Yemen. The area is known for arid and semi-arid weather condition with undulating topographic. Remote sensing data for year 95, 96 and 1998 were used as a primary image for this study. Actual ET was computed during satellite overpass and integrated for 24-h on pixel-by-pixel basis for daily ET distribution. Due to the topographic effects, an attempt has also been made to incorporate DEM information for estimating the net radiation. As a result, a daily ET map generated from meteorological observation was compared with estimated ET data simulated from remote sensing data. In conclusion, data from both remote sensing give reasonable values with result from TM are better compare to those of AVHRR due to difference in spatial resolution, which TM data a higher spatial resolution than AVHRR. ISBN: 9780769531366. Database: SCOPUS. OCLC: 231632993.

Almhab, Ayoub. 2008. Decision Support System for Estimation of Regional Evapotranspiration in Arid Areas: Application to the Republic of Yemen. 21st Congress of the International Society for Photogrammetry and Remote Sensing (ISPRS 2008). OCLC: 500626839.

Almhab, Ayoub and Busu, Ibrahim. 2009. Estimation of Evapotranspiration using Fused Remote Sensing Image Data and Energy Balance Model for Improving Water Management in Arid Area. Singapore, Singapore: Inst. of Elec. and Elec. Eng. Computer Society. Volume: 2, page(s): 529-533. 2009 International Conference on Computer Engineering and Technology, ICCET 2009, January 22, 2009 - January 24. Conference: 2009. Descriptors: Remote sensing; Arid regions; Energy balance; Evapotranspiration; Geologic models; Geomorphology; Heat flux; Image reconstruction; Image resolution; Radiation effects; Soils; Spectral resolution; Surveying; Tracking radar; Water management; Water supply. Abstract: Remote sensing has proved to be very useful in the investigation of vegetation and hydrological monitoring, especially when studying vast areas. In this paper, the complement between two optical remote sensing data (Landsat TM and NOAA-AVHRR) and a Digital Elevation Model (DEM) is used to estimate hydrological parameters based on derived surface reflectance. These parameters which are used in the Modified Soil Energy Balance Algorithm for Land (M-SEBAL) model have been used to estimate net radiation, soil heat flux, sensible heat flux and evapotranspiration (ET) for Sana'a Basin in Yemen. The area is known for arid and semi-arid weather conditions with undulating topography. Image data from AVHRR on-board NOAA satellites with a large areal coverage, good temporal and spectral resolution are found to be very useful in generating some parameters required for the above process. However, the data have poor spatial resolution. On the other hand, image data from the Thematic Mapper on-board the Landsat satellite, with a high spatial and spectral resolution should be able to provide values for the parameters involved, but the area coverage is significantly reduced. This study has been carried out, using a data fusion technique in order to exploit the respective advantages of these two disparate sources of image data. A general framework is then proposed to generate ET maps for arid and semi-arid regions. This is achieved by means of multi-temporal, multiresolution remote sensing data. Taking into account topographic effects, an attempt has also been made to incorporate DEM information for estimating the net radiation of the areas involved. An application for computing a daily ET map over Sana'a Basin, Yemen is presented. As a result, a daily ET map generated from meteorological observations was compared with estimated ET data simulated from remote sensing data. In conclusion, data from both remote sensing sources give reasonable values with the result from the TM being better than those obtained from the AVHRR. This is attributed to the differences in spatial resolution, in which TM data is higher than AVHRR. The fusion of the

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two shows improves spatial detail whilst maintaining the spectral signature close to the original. OCLC: 356094548; 318104320.

Al-Mikhlaifi, A. S. 2009. "Groundwater Quality of Yemen Volcanic Terrain and their Geological and Geochemical Controls." Arab. J. Geosci. Pages 1-13. Descriptors: Groundwater; Health; Rural; Water quality; Yemen volcanic. Notes: Article in Press. Abstract: One hundred thirty boreholes of volcanic aquifers in rural Yemen Highland Groundwaters (YHGs) were chemically investigated to assess the suitability of water for drinking. Focus is to identify inorganic constituents of significant risk to health that occur in groundwaters of this area. Results showed that a number of boreholes contain, apart from fluoride, levels of nitrate, some heavy metals, total dissolved solids, and sulfates that could pose a health risk for consumers. The lateral variations of major ions with depth varied within the same aquifer based on the dynamic equilibrium of groundwater and hydrogeological conditions. The main inorganic groundwater contaminant in volcanic YHG is fluoride which is attributed to groundwater lithology and water type. Fluoride appears high in Ca-poor groundwater and where cation exchanges of Ca for Na are dominant. High F concentration in YHG is an extension of East African fluoride-rich groundwater. Majority of tube wells show that Fe concentration exceeds WHO guideline many folds. Much of the iron and manganese in groundwaters are naturally occurring, since the source rocks are enriched in ferromagnesian minerals. NO₃⁻ and Cl⁻ concentrations that have been detected in some wells may indicate sewage and/or agricultural runoff. Elevated concentration of chemical constituents in groundwater is a sign of groundwater degradation. Database: SCOPUS. ISSN: 1866-7511.

Al-Mikhlaifi, A. S. 2009. Groundwater quality of Yemen volcanic terrain and their geological and geochemical controls. Arabian Journal of Geosciences 3: 193 – 205. Abstract: One hundred thirty boreholes of volcanic aquifers in rural Yemen Highland Groundwaters (YHGs) were chemically investigated to assess the suitability of water for drinking. Focus is to identify inorganic constituents of significant risk to health that occur in groundwaters of this area. Results showed that a number of boreholes contain, apart from fluoride, levels of nitrate, some heavy metals, total dissolved solids, and sulfates that could pose a health risk for consumers. The lateral variations of major ions with depth varied within the same aquifer based on the dynamic equilibrium of groundwater and hydrogeological conditions. The main inorganic groundwater contaminant in volcanic YHG is fluoride which is attributed to groundwater lithology and water type. Fluoride appears high in Ca-poor groundwater and where cation exchanges of Ca for Na are dominant. High F concentration in YHG is an extension of East African fluoride-rich groundwater. Majority of tube wells show that Fe concentration exceeds WHO guideline many folds. Much of the iron and manganese in groundwaters are naturally occurring, since the source rocks are enriched in ferromagnesian minerals. NO₃⁻ and Cl⁻ concentrations that have been detected in some wells may indicate sewage and/or agricultural runoff. Elevated concentration of chemical constituents in groundwater is a sign of groundwater degradation. DOI: 10.1007/s12517-009-0068-7. URL: <http://www.springerlink.com/content/x33g64tkk62w7472/>.

Al-Montaser, Mansour. 2010. "A Race for Drilling Water Wells." Yemen Today. March 16, 2010. Abstract: The drilling race is reaching a crescendo. Farmers throughout the country have courted the owners of drilling rigs, as farmers have desperately searched for new access to groundwater springs for irrigation purposes. The futile search of the farmers mirrors the precarious situation Yemen is facing as a whole, as research continues to warn that underground wells are being depleted faster than they can be replenished, leading to imminent disaster in

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certain parts of the country. In several areas of Sana'a governorate, people live in disparate situations due to the drop in water tables and the general depletion in community wells. In many situations, these drops can be directly correlated to the creation of multiple new wells within the areas, draining the reservoirs. Despite these figures, people within the surrounding villages have exhibited complete apathy about the water situation, not learning the vital lesson from water depletion of the traditional wells. Mohsen al-Shaje, an inhabitant of al-Sharafa in Bani Hushaish, explained how the local area is already facing a water crisis. This crisis is due in large part, he feels, to the indiscriminant creation of new wells within the area. Many efforts have been undertaken in the area to dig new wells, undertaken by locals, in the hope of accessing new sources of water. However, the majority of these wells failed, when the depth of drilling in some of the wells reached over 800 meters without striking water. Al-Shaje pointed out that the scarcity of clean water has a direct negative effect on the socio-economic health of the people. He stressed that citizens' lives have become increasingly miserable as they have been forced to live like the nomads of old, moving from one area to another, looking for water for drinking, household usage and for the irrigation of their farms. Mohammed al-Gharir agrees with al-Shaje that such quick fix solutions are tentative at best. Al-Gharir gave an example of the final well dug by citizens of the area. The well reached 480 meters and cost nearly YR 40 million. As they dug deeper, the cost of drilling just one meter rose to YR16,000. In addition to the increased costs, there were also problems finding a pump capable of lifting water from this depth. The drilling companies approached pump suppliers with the desire to pump water from a depth of 850 meters. The quoted cost rose to twenty million, an outrageous cost for the poor citizens of the region. To make matters more difficult, the water found at such depths is not even suitable for washing, let alone drinking, due to its color and odor. Deserting the area: The people of the area are dependant on the use of tanks to receive water from other areas of the directorate, with costs reaching over YR 4,000,000. These problems have led to the emigration of several families to other areas of the district, which has led to the loss of ancestral farms, families' main source of income. In turn, this emigration has led to the desertification of the agricultural lands that have been deserted by the people due to inaccessibility of water. Zubairy called on the concerned authorities to find an appropriate solution that would provide water to the people of this region. He noted that the area enjoys excellent position for the construction of dams, which he considers the only hope in addressing the coming crisis. URL:

<http://www.yobserver.com/reports/10018348.html>

Al-Mooji, Yusuf. 2000. A Systematic Analysis of the Process of Formulating and Harmonizing Preliminary Water Standards in Yemen. Beirut: UN. Page(s): 10. Descriptors: Water Resources; Yemen; Environmental Standards; Government publication; International government publication. Notes: charts. Note(s): Prepared by Yusuf Al-Mooj. UN Job no.: N990868 E. Material type: Reports/studies. General Info: Distribution: Limited. OCLC Accession Number: 80620373.

Al-Mooji, Yusuf Auteur; Zuppi, G. -M and Directeur de thèse. 1995. Characterization of groundwaters in the Wadi Mawr area and the origin of salinity in the Tihama plain of Yemen = Caractérisation des eaux souterraines dans la région de l'oued Mawr et origine de la salinité dans la plaine du Tihama au Yemen. Descriptors: Terre; Ocean; Espace: Hydrologie; Hydrogéologie/Geochemie; Yemen-Eau Souterraine; Salinite; Nappe Eau; Hydrochimie; Carbonate; Na; Sulfate; Na; Chlorure; Eau Saumatre; O 18-O 16 Isotope Stable; Evaporation; Deuterium; Nc; Modele;Evaporite; Yemen; Ground Water; Salinity; Aquifers; Hydrochemistry; Carbonates; Na; Sulfates; Na; Chlorides; Na; Brackish Water; O-18; O-16; Stable Isotopes;

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Evaporation; Deuterium; Nc; Models; Evaporites; Thesis; dissertation. Abstract: quatre types d'eaux souterraines sont presents dans le systeme aquifere superficiel: des eaux bicarbonatees, des eaux sulfatees, des eaux chlorurees (thermales ou non) et des eaux mixtes dont la composition n'est dominee par aucun anion en particulier. Les eaux douces bicarbonatees (teneur totale en ions dissous, tdi = 25,8 a 50,6 meq l⁻¹) se trouvent dans les puits superficiels implantes au long du lit de l'oued. Les eaux sulfatees sont saumates (tdi = 76,9 a 148,9 meq l⁻¹), en raison de leur proximite aux affleurements des evaporites miocenes. Les eaux chlorurees saumates a saeles (tdi jusqu'a 966 meq l⁻¹), thermales ou non, sont plus repandues. Leur composition resulte d'une dissolution d'evaporites et d'une remontee des eaux thermales profondes dans l'aquifere alluvial superficiel. En majorite, les puits de la region contiennent des eaux mixtes, douces a saumates (50 <tdi < 100 meq l⁻¹) qui proviennent d'un melange entre les eaux thermales et les eaux douces infiltrees dans le lit de l'oued, comme en temoignent les compositions chimiques et isotopiques, ainsi que les temperatures. La composition isotopique des echantillons de precipitations (δ¹⁸O: -2,30 a +0,77; δ²H: -7,90 a +19,50), se regroupent autour de la droite des eaux meteoriques locales etablie pour addis (δ²H = 7,3 δ¹⁸O + 11,4), mais quelques echantillons montrent les effets d'une forte evaporation; d'autres presentent des exces en deuterium voisins de 15, qui pourraient refleter des apports de vapeur condensante de type mediterraneen dans la region. La composition isotopique de la majorite des eaux non-thermales douces a saumates est comparable a celle des precipitations et des eaux de surface. Les eaux des sources chaudes et les eaux associees aux evaporites miocenes sont significativement appauvries en isotopes lourds par rapport aux eaux non-thermales du tihama ou a celle de la region des plateaux, et ne contiennent pas de tritium. La composition isotopique du sulfate dissous dans l'eau thermique indique qu'il provient du gres permien. La modelisation de l'evolution geochemique des eaux souterraines du tihama a ete realisee en utilisant netpath. Les resultats de la modelisation confirment les interpretations presentees auparavant sur la base des analyses chimiques et isotopiques. L'application des geothermometres chimiques et isotopiques aux differentes sources suggere des temperatures de reservoirs d'environ 150 A 200C. Notes: 278 P. Dissertation: These de doctorat: Terre, Ocean, Espace: Paris 11: 1995. Note(s): 1995PA112225. 191 REF. Other Titles: Characterization of Groundwaters in the Wadi Mawr Area and the Origin of Salinity in the Tihama Plain of Yemen; Responsibility: Yusuf Al-Mooji; sous la direction de G.-M. Zuppi. OCLC: 490269612.

Al-Nozaily, F. and Alaerts, G. 2002. "Performance of Duckweed-Covered Sewage Lagoons in Sana'a, Yemen, Depending on Sewage Strength." *Journal of Water Supply: Research and Technology - AQUA*. IWA Publishing: Volume 51, Issue 3, Pages 173-182. Descriptors: Water supply; Effluent treatment; Nitrification; Nitrogen; pH; Sewage lagoons; Wastewater. Abstract: The performance of a duckweed (*Lemna gibba*) sewage lagoon (DSL) was investigated in non-continuous batch system reactors using high strength sewage under natural environmental conditions in Sana'a. Wastewater effluent from the anaerobic ponds of the Sana'a waste stabilization ponds (WSPs) was used with dilution factors (DF) of 0, 2, 3 and 4. The initial COD concentration range applied was 254-600 mg COD l⁻¹ (150-250 mg BOD l⁻¹) and NH₄⁺ of 25-100 mg N l⁻¹, while the duckweed stock density used was 500 g wet weight m⁻². The duration of the experiments was 10 days with a harvesting frequency of 5 days. NH₄⁺ in this very concentrated Sana'a sewage was possibly the most important limiting factor for growth of *L. gibba*. High pH near the end of the reaction time and lower temperatures at night-time probably also contributed to slower growth. Relative growth rate (RGR) decreased from 0.170.04 d⁻¹ at an NH₄⁺ concentration of 23-40 mg N l⁻¹ to around 0.00 d⁻¹ at a concentration of 100 mg N l⁻¹.

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Fresh wastewater helped to grow duckweed, especially at NH_4^+ 50 mg N l⁻¹, while after 5 days, algae proliferation and probably the exhaustion of other essential nutrients started to inhibit duckweed growth. COD removal correlated strongly with the applied initial surface loading. At a higher initial COD loading (s) of 869 kg COD ha⁻¹, the removal loading (r) 710 kg COD ha⁻¹ 10 day⁻¹, while at a lower initial COD loading of 344 kg ha⁻¹, the removal loading was 210 kg COD ha⁻¹ 10 day⁻¹. Total Nitrogen removal (r,N) increased with initial NH_4^+ concentration and with initial surface loading (N). At initial nitrogen loading (N) of 28 and 164 kgN/ha, the removal loading (r,u) was 25 kgN/ha.10 d and 148 kgN/ha.10 d, respectively. At the same time, the first order COD kinetic removal rate constant increased from 0.10 to 0.16 d⁻¹ at initial COD concentration of 254 and 621 mg/l, respectively. The total nitrogen kinetic removal constant increased from 0.16 day⁻¹ at NH_4^+ concentration 93 mg N l⁻¹ to 0.26 day⁻¹ at NH_4^+ 34 mg N l⁻¹. The high DO and pH encountered under outdoor environmental conditions are probably the main cause of the high N removal compared with removal under laboratory conditions. Therefore, total nitrogen removal was taking place through nitrification/denitrification and probably NH_3 stripping. ISSN: 0003-7214.

Al-Safadi, M. 1995. A Pilot Study of Lake Ma'rib, Yemen. *Hydrobiologia*. Volume: 315, no. 3, page(s): 203-203-209. Abstract: The geography and biology of Ma'rib lake, one of the largest artificial freshwater lakes in the Republic of Yemen, are comprehensively reviewed. Following the construction of a dam across wadi Sheba' (Ma'rib) in late 1986 to provide an irrigation water supply and to protect cultivate lands from flood damage, the ecology of the impoundment was studied at intervals between 1989 and the present. The freshwater macrofauna of the lake so far recorded comprised leeches, crustaceans, insects, snails, fish, toads and waterfowl. The total number of species was low, probably due to a lack of food sources and poor habitat diversity. ISSN: 0018-8158. Database: Technology Research Database.

Al-Safadi, M. M. 1991. "Freshwater Macrofauna of Stagnant Waters in Yemen Arab Republic." *Hydrobiologia*. Volume 210, Issue 3, Pages 203-208. Descriptors: freshwater; insects; macrofauna; molluscs; wadis; Yemen Arab Republic. Notes: Cited By (since 1996): 1. Abstract: We inventorize the freshwater macrofauna of 4 different wadis, representing the low and highlands, in Yemen Arab Republic. The fauna comprised 6 molluscan, 21 Coleopteran, 8 Hemipteran, 2 amphibian and one fish species. Of the Coleoptera, 8 species are new records to Yemen Arab Republic. The genus *Exitianus* is recorded for the first time in Yemen Arab Republic. Diversity in the uplands and lowlands was similar, but biomass was much higher in the lowlands than in the highlands. Database: SCOPUS. ISSN: 0018-8158.

Al-Sakkaf, Rafik, Zhou, Yangxiao and Hall, Michael J. 1999. "A Strategy for Controlling Groundwater Depletion in the Sa'Dah Plain, Yemen." *Int. J. Water Resour. Dev.* Carfax Publishing Company: Volume 15, Issue 3, Pages 349-365. Descriptors: Groundwater resources; Agriculture; Arid regions; Economic and social effects; Irrigation; Laws and legislation; Sustainable development. Abstract: Over-exploitation of the groundwater resources is the major problem leading to groundwater depletion in the Sa'dah Plain, one of the major semi-arid highland basins of Yemen. Groundwater-irrigated agriculture is the chief economic activity in the Plain. Consequently, depletion places socioeconomic development in jeopardy. Owing to the lack of institutional arrangements and management instruments, government intervention is not likely to alleviate the crisis. One non-governmental approach that takes advantage of the existing local sociopolitical structure and customary law would be to adopt an annual abstraction quota. Approaching the crisis at a grass-roots level and relying on the conformity of the local citizens with customary law are the main characteristics of this strategy, the optimum objective of which

is sustainable utilization of water resources. ISSN: 0790-0627. URL: <http://dx.doi.org/10.1080/07900629948862>.

Al-Sakkaf, R.A.; Zhou, Y.; Hall M.J. 1999. A strategy for controlling groundwater depletion in the Sa'dah Plain, Yemen. *Water Resources Development*, Vol. 15, No. 3, pgs. 349-365.

Al-Shahwani, M. F. 2005. "Bacterial Distribution Analysis of the Atmosphere of Two Hospitals in Lbb, Yemen." *East. Mediterr. Health J.* Volume 11, Issue 5-6, Pages 1115-1119. Abstract: A bacteriological distribution analysis of the air was carried out at 8 sites in each of 2 general hospitals in Ibb during the period February-June 2002. Only 3 sites, reception hall, hospital passages and outpatient clinic, gave meaningful values for the distribution of bacteria in the atmospheric air. In these locations, mean values for total plate count, lactose fermenting bacteria, haemolytic bacteria and non-lactose fermenting bacteria were 478.6 colony forming units (cfu)/ m³, 24.9 cfu/m³, 6.5 cfu/m³, and 4.8 cfu/m³ respectively. The reception hall had the highest bacterial count, followed by hospital passages and the outpatient clinic. The highest bacterial count was for 08.00, followed by 14.00 and 18.00. Database: SCOPUS. ISSN: 1020-3397.

Al-Shamiri, A., Al- Zubairy, A. H. and Al-Mamari, R. 2010. "The Prevalence of *Cryptosporidium* Spp. in Children, Taiz District, Yemen." *Iranian Journal of Parasitology*. Tehran University of Medical Sciences: 06. Volume 5, Issue 2, Pages 26-32. Descriptors: Cryptosporidiosis; Children -- Diseases; Drinking water; Enzyme-linked immunosorbent assay; Disease prevalence; Taizz (Yemen); Yemen (Republic); Children; *Cryptosporidium*; Diagnosis; Prevalence; Yemen. Abstract: Background: This is the first work done on cryptosporidiosis among the children in Taiz, Yemen. Methods: A number of 712 samples were collected from children of different ages (ranging from 1 month to 12 years) from Dec 2006 to Aug 2007. The collected samples were examined by Sheather's sugar floatation and Modified Ziehl- Neelsen stain as well as ELISA methods. The test results were statistically analyzed by SPSS software. Results: The overall positive percentage was 43.7%. The higher incidence (36.2 %) was occurred in males while the lowest incidence (32.7 %) was observed in females ($r= 0.876$; $P=0.001$). The correlation between infected cases and the type of drinking water was $r =0.121$. Among the cases examined by ELISA (92 cases), 26.1 % were infected. The correlation between seropositivity and gender was $r= 0.652$ ($P=0.031$). Conclusion: *Cryptosporidium* spp. is a significant pathogen among children at Taiz. Fresh water supplies, education, eating habits and domestic animals are considered the main sources for transmission of cryptosporidiosis. ISSN: 1735-7020.

Alshawsh, Mohammed A., Mothana, Ramzi A., Al-shamahy, Hassan A., Alslami, Salah F. and Lindequist, Ulrike. 2009. "Assessment of Antimalarial Activity Against *Plasmodium Falciparum* and Phytochemical Screening of some Yemeni Medicinal Plants." *Evid. Based Complement. Altern. Med.* December 1. Volume 6, Issue 4, Pages 453-456. Abstract: Developing countries, where malaria is one of the most prevalent diseases, still rely on traditional medicine as a source for the treatment of this disease. In the present study, six selected plants (*Acalypha fruticosa*, *Azadirachta indica*, *Cissus rotundifolia*, *Echium rauwalfii*, *Dendrosicyos socotrana* and *Boswellia elongata*) commonly used in Yemen by traditional healers for the treatment of malaria as well as other diseases, were collected from different localities of Yemen, dried and extracted with methanol and water successfully. The antiplasmodial activity of the extracts was evaluated against fresh clinical isolates of *Plasmodium falciparum*. The selectivity parameters to evaluate the efficacy of these medicinal plants were measured by in vitro micro test (Mark III) according to World Health Organization (WHO) 1996 & WHO 2001

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protocols of antimalarial drug tests. Among the investigated 12 extracts, three were found to have significant antiplasmodial activity with IC₅₀ values less than 4 {micro}g/ml, namely the water extracts of *A. fruticosa*, *A. indica* and *D. socotrana*. Six extracts showed moderate activity with IC₅₀ values ranging from 10 to 30 {micro}g/ml and three appeared to be inactive with IC₅₀ values more than 30 {micro}g/ml. In addition, preliminary phytochemical screening of the methanolic and aqueous extracts indicated the presence of saponins, tannins, flavonoids, terpenoids, polysaccharides and peptides. URL:

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2781778/>.

Al-Shibani, L. A., El-Heggiagi, M. B., Burshan, N. M. and Bassiouny, H. K. 2007. "Development of Schistosomal School-Based Health Education Model for Yemeni Schoolchildren." *J. Egypt. Soc. Parasitol.* Volume 37, Issue 2, Pages 649-658. Abstract: In this study, 152 students (90 males & 62 females) of primary (5th & 6th grades, 52 males & 30 females) and preparatory (1st & 2nd grades, 38 males & 32 females) schoolchildren of different age and sex group inhabited in two endemic villages with *Schistosoma mansoni* in Taiz Governorate were examined. The highest prevalence and intensity of *S. mansoni* were among males at the age group from 10 - < 12 years. A significant relationship was recorded between prevalence and intensity of infection and those who used pond water for human usage. The prevalence was significantly higher among children who received previous praziquantel treatment as well as those who didn't have TV, Radio and/or Video. The results were discussed on the light of certain variables. Database: SCOPUS. ISSN: 0253-5890.

Al-Shiwafi, N., Rushdi, A. I. and Ba-Issa, A. 2005. "Trace Metals in Surface Seawaters and Sediments from various Habitats of the Red Sea Coast of Yemen." *Environ. Geol.* Springer Verlag: Volume 48, Issue 4-5, Pages 590-598. Descriptors: Ocean habitats; Coastal zones; Concentration (process); Data acquisition; Marine biology; Natural water geochemistry; Seawater; Sediments; Trace analysis. Abstract: The purpose of this study was to determine and assess the concentrations of trace metals in surface seawaters and sediments from different coastal habitats of the Red Sea coast of Yemen. Surface seawater and sediment samples were collected, treated and analyzed for cadmium, cobalt, manganese, chromium, lead, iron, nickel, copper, zinc and vanadium by the atomic absorption spectrometric analysis. The concentrations were high for cadmium, cobalt and lead and low or consistent with the natural background concentrations for the rest of the metals. However, the coastal habitats of the Red Sea coast of Yemen are still considered unpolluted, it is concluded that the cadmium cobalt and lead levels in surface seawaters are high and could have negative effects on marine life of the sites. Further studies are needed to characterize the sources, fate, biogeochemical processes and impacts of these trace metals on coastal habitats and marine life of the region. Springer-Verlag 2005. ISSN: 0943-0105. URL: <http://dx.doi.org/10.1007/s00254-005-1315-1>.

Al-Shiwafi, N., Rushdi, A. I. and Ba-Issa, A. 2005. "Trace Metals in Surface Seawaters and Sediments from various Habitats of the Red Sea Coast of Yemen." *Environmental Geology* (Berlin). Springer International, Berlin, Federal Republic of Germany. Volume 48, Issue 4-5, Pages 590-598. Descriptors: Arabian Peninsula; Asia; biota; cadmium; chemical composition; chromium; coastal environment; cobalt; copper; discharge; ecology; habitat; Indian Ocean; lead; manganese; marine environment; marine sediments; metals; nickel; pollution; Red Sea; sea water; sediments; trace metals; Yemen. Notes: References: 27; illus. incl. 3 tables, sketch map. Database: GeoRef. ISSN: 0943-0105. URL: <http://www.springerlink.com/content/1432-0495/>.

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Al-Shiwafi, N. Rushdi, A. and Ba-Issa, A. 2005. Trace Metals in Surface Seawaters and Sediments from various Habitats of the Red Sea Coast of Yemen. Springer-Verlag, Tiergartenstr 17, Heidelberg, 69121, Germany, [mailto:subscriptions@springer.de]. Environ. Geol. Volume: 48, no. 4-5, page(s): 590-590-598. Abstract: The purpose of this study was to determine and assess the concentrations of trace metals in surface seawaters and sediments from different coastal habitats of the Red Sea coast of Yemen. Surface seawater and sediment samples were collected, treated and analyzed for cadmium, cobalt, manganese, chromium, lead, iron, nickel, copper, zinc and vanadium by the atomic absorption spectrometric analysis. The concentrations were high for cadmium, cobalt and lead and low or consistent with the natural background concentrations for the rest of the metals. However, the coastal habitats of the Red Sea coast of Yemen are still considered unpolluted, it is concluded that the cadmium cobalt and lead levels in surface seawaters are high and could have negative effects on marine life of the sites. Further studies are needed to characterize the sources fate, biogeochemical processes and impacts of these trace metals on coastal habitats and marine life of the region. Notes: TY: GEN. ISSN/ISBN: 0943-0105. Database: Technology Research Database. URL: <http://search.proquest.com/docview/29936391?accountid=12084>.

Al-Shwafi, Nabil and Rushdi, Ahmed I. 2008. "Heavy Metal Concentrations in Marine Green, Brown, and Red Seaweeds from Coastal Waters of Yemen, the Gulf of Aden." Environ. Geol. Volume 55, Issue 3, Pages 653-660. Descriptors: Metals; Absorption; Cadmium; Cadmium compounds; Chromium; Cobalt; Concentration (process); Copper; Copper alloys; Discharge (fluid mechanics); Fluid mechanics; Heavy metals; Iron; Lead; Lead alloys; Manganese; Manganese compounds; Molecular weight; Nickel; Nickel alloys; Pollution; Seawater; Seaweed; Transition metals; Vanadium; Zinc; Zinc sulfide. Abstract: The purpose of this study was to investigate the concentration levels of heavy metals in different species of the main three marine algal divisions from the Gulf of Aden coastal waters, Yemen. The divisions included Chlorophyta-green plants (Halimeda tuna, Rhizolonium kochiamum, Caldophora koiei, Enteromorpha compressa, and Caulerpa racemosa species), Phaeophyta-brown seaweeds (Padina boryana, Turbinaria elatensis, Sargassum binderi, Cystoseira myrica, and Sargassum boveanum species), and Rhodophyta-red seaweeds (Hypnea cornuta, Champia parvula, Galaxaura marginata, Laurencia paniculata, Gracilaria foliifera, and species). The heavy metals, which included cadmium (Cd), cobalt (Co), copper (Cu), chromium (Cr), Iron (Fe), manganese (Mn), nickel (Ni), lead (Pb), zinc (Zn), and vanadium (V) were measured by Atomic Absorption Spectrophotometer (AAs). The concentrations of heavy metals in all algal species are in the order of Fe Cu Mn Cr Zn Ni Pb Cd V Co. The results also showed that the uptake of heavy metals by different marine algal divisions was in the order of Chlorophyta Phaeophyta Rhodophyta. These heavy metals were several orders of magnitude higher than the concentrations of the same metals in seawater. This indicates that marine alga progressively uptake heavy metals from seawater. ISSN: 0943-0105. URL: <http://dx.doi.org/10.1007/s00254-007-1015-0>.

Al-Shwafi, N. A. A. 2008. "Concentration of Petroleum Hydrocarbons in Sediment Coastal of Aden City-Yemen." Pollut. Res. Volume 27, Issue 1, Pages 37-40. Descriptors: Coast; Marine-sediment; Petroleum hydrocarbons; Shimadzu DR-8100 spectrofluorometer; Yemen. Abstract: Because of potential health hazards, there is a great concern about setting up a baseline levels for residual petroleum hydrocarbons in the Yemeni coastal areas, in particular Aden beach. The levels of the petroleum hydrocarbons concentration were determined by using Shimadzu DR-8100 spectrofluorometer from nine selected sampling sites along Aden shoreline

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during April, 2001. The concentrations of residual petroleum hydrocarbons were found in comparable concentrations for unpolluted marine environments were generally lay within the normal range of values reported for other regions the world. The variation within the site were mainly attributed to the human activity, oil tanker, blowout, oil pipelines, storage tanks, vessels deballasting in the Gulf of Aden and Red Sea. The significant relationships found between residual petroleum hydrocarbons and organic carbon contents in sediments indicated that oil contamination was one of the possible sources for increasing the concentrations of organic materials in sediments. Database: SCOPUS. ISSN: 0257-8050.

Alsohybe, Nabeel T. 2007. The Implementation of e-Government in the Republic of Yemen: An Empirical Evaluation of the Technical and Organizational Readiness. United States - Minnesota: Capella University. ProQuest Dissertations and Theses. Description: ix, 123 p. : ill., graphs, tabs. Abstract: Due to the increased organizational dependence on information systems and technology, most of today's organizations and governments have plans to implement information technology and e-government in all of their job processing and communication tools. The Republic of Yemen is a third world country that is trying to implement e-government not just in its private organizations but also in its governmental agencies. The Republic of Yemen's government has initiated an e-government plan that starts with five ministries, which represent the heart of, the economy and social services in The Republic of Yemen. The Yemeni government is trying to find the appropriate e-government model to enhance the economical growth and provide the people with the best and fastest services offered by this new technology. To evaluate the situation in The Republic of Yemen, this paper evaluated the technical and organizational readiness for e-government implementation. The primary objective was to identify the challenges facing the implementation process and offer appropriate solutions to overcome these challenges. This study examined some successful e-government models for their effectiveness and flaws, which will help during e-government implementation in The Republic of Yemen. This study employed mixed method research approach that includes quantitative and qualitative data collection and analysis techniques such as personal interviews and survey questionnaires. The researcher conducted personal interviews with 96 ministry officials and employees from 12 ministries. The purpose of these personal interviews was to get an overview of the e-government readiness in the Ministries and determine if they are ready to embrace such technology. The second part of the study was the survey questionnaire which was distributed to about 480 employees of all levels in the twelve ministries to see how much they know about information technology and e-government to determine what these employees need most to start using this technology. Only 382 participants replied to all questions in the survey and the rest filled only parts of the surveys; therefore, they were omitted because of missing answers which might have changed the outcome, and may have led to false analysis and led to wrong conclusions. Capella University; Ph.D. OCLC: 317404368.

Al-Subbary, Abdulkarim, Nichols, Gary, Bosence, Dan and Mabesoone, Jannes M. (chairperson). 1994. "Contribution to the Lithology and Paleogeography of Tawilah Group, Yemen; 14th International Sedimentological Congress; Abstracts." International Sedimentological Congress. International Association of Sedimentologists, Comparative Sedimentology Division, Utrecht, Netherlands. Volume 14, Pages G.2-G.3. Descriptors: Al Baydah Yemen; Arabian Peninsula; Asia; Cenozoic; chemically precipitated rocks; clastic rocks; Cretaceous; cross-bedding; depositional environment; ferricrete; fluvial environment; high-energy environment; lacustrine environment; laminations; lithofacies; marine environment; Medj-zir Formation; Mesozoic; outcrops; Paleocene; paleocurrents; Paleogene; paleogeography;

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planar bedding structures; regression; sandstone; sea-level changes; sedimentary rocks; sedimentary structures; shallow-water environment; Tawilah Group; Tertiary; thickness; unconformities; Yemen. References: 11; strat. cols., sketch map. Database: GeoRef. OCLC: 31671877.

Al-Taiar, Abdullah, Assabri, Ali, Al-Habori, Molham, et al. 2009. "Socioeconomic and Environmental Factors Important for Acquiring Non-Severe Malaria in Children in Yemen: A case-control Study." *Trans. R. Soc. Trop. Med. Hyg.* 1. Volume 103, Issue 1, Pages 72-78. Descriptors: Malaria; Children; Socioeconomic factors; Risk factors; Yemen; Middle East. Abstract: Summary Little is known about the relative importance of environmental and socioeconomic factors for acquiring malaria in Yemen. A case-control study was conducted to determine the importance of these factors for acquiring malaria among children in Yemen. Cases of non-severe malaria were recruited from health centres; community controls were from the neighbourhood of the cases. Data were collected by personal interview and direct inspection during home visits. In total, 320 cases and 308 controls were recruited. In the multivariate analysis, environmental factors (living near streams and freshwater marshes), earth roofs of houses and history of travel were all significantly and positively associated with the occurrence of malaria, whilst regular spraying with insecticides at home was a protective factor. There was no association with socioeconomic factors, including crowding, education and occupation of parents, and ownership of house assets. An index created based on a number of indicators of wealth showed a significant association with malaria in the univariate analysis but was not significant in the multivariate analysis. Control activities can be targeted on identifiable environmental factors such as stream and freshwater marshes, although this needs further investigation. Extra protective measures may be needed by all those who travel in Yemen. ISSN: 0035-9203.

al-Taiar, Abdullah, Chandler, Clare, Al Eryani, Samira and Whitty, Christopher J. M. 2009. "Knowledge and Practices for Preventing Severe Malaria in Yemen: The Importance of Gender in Planning Policy." *Health Policy Plan.* November 1. Volume 24, Issue 6, Pages 428-437. Abstract: Objective In Yemen, morbidity and mortality due to malaria is high. We explored malaria-related treatment seeking, prevention practices and knowledge of transmission amongst parents in order to inform health education strategies. Yemen is culturally very distinct from most malaria-endemic countries. We aimed to identify beliefs which may be barriers to malaria prevention and treatment, and hypothesized that household gender relationships might impact on practice. Methods Focus group discussions amongst women and men in urban, semi-urban and rural areas, followed by questionnaire interviews with parents or guardians of children with severe malaria, mild malaria, and healthy children from the community. Findings Recognition of malarial symptoms was good but delays in seeking medical treatment after symptom onset were common, with 78% of parents reporting delay. Delays primarily related to financial constraints, but also to difficulties with treatment seeking when male family members were not available. When contact with a health worker occurred prior to admission to the hospital, the treatment was potentially inappropriate in 29% and ineffective in 57%. There were distinct differences between men and women in their perspective on malaria. Knowledge of malaria transmission was vague and mosquitoes were not emphasized, particularly amongst mothers. Bednets were reported to be used rarely and without insecticide treatment, and some beliefs such as that malaria is transmitted by breastfeeding were potentially harmful. Conclusions: Some beliefs were potential barriers to malaria prevention strategies. The different beliefs and roles identified between men

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and women need to be taken into account in health promotion messages. ISSN: 1460-2237. OCLC: 43257616.

Althary, Abdulla Mohamm. 1983. An Evaluation of the Ground Water Potential of the Sana'a Basin, Yemen Arab Republic. Descriptors: Groundwater -- Yemen -- Sana'a Region; Water resources development -- Yemen -- Sana'a Region. Notes: ix, 89 leaves: ill. 28 cm. Dissertation: Thesis (M.S.)--University of Arizona, 1983. Note(s): Includes bibliographical references. Reproduction: Electronic reproduction. Tucson, Ariz.: University of Arizona, 2007. Responsibility: by Abdulla Mohammed Althary. OCLC Accession Number: 213092018.

Al-Thour, K. 1997. "Facies Sequences of the Middle-Upper Jurassic Carbonate Platform (Amran Group) in the Sana'a Region, Republic of Yemen." *Mar. Pet. Geol.* Volume 14, Issue 6, Pages 643-660. Descriptors: Sedimentary rocks; Carbonate minerals; Geographical regions; Sedimentology; Sediments; Stratigraphy. Abstract: Rocks of the Amran Group in the Sana'a region of Yemen disconformably overlie the Kohlan Formation and unconformably underlie the Tawilah Group. Sea-level rises have produced landward migration of facies belts and the development of deeper water facies over shallow ones. The geometry of the depositional environments identified has enabled the passage of relatively short-lived transgressive-regressive cycles of sedimentation to be recognized. Three facies associations are introduced: (1) Carbonate platform facies, (2) Carbonate-marl alternation facies, and (3) Shallow water coral and stromatoporoid build-up facies. These facies are widely distributed and the whole sequence reflects deposition on a broad platform upon which shoals separated platform carbonates from basin sedimentation and an open marine environment. The repetition and interfingering of both fining- and shallowing-upward cycles within the study areas suggest that deposition occurred within the same basin with slightly different conditions in different places. The main factors controlling their deposition are sea-level changes and tectonics. ISSN: 0264-8172. URL: [http://dx.doi.org/10.1016/S0264-8172\(97\)00030-5](http://dx.doi.org/10.1016/S0264-8172(97)00030-5).

Al-Thour, Khalid A. 2000. "Diagenesis of the Middle-Upper Jurassic Carbonate Platform (Amran Group), Yemen; Middle East Models of Jurassic/Cretaceous Carbonate Systems." Special Publication - Society for Sedimentary Geology. Society for Sedimentary Geology (SEPM), Tulsa, OK. Nov. Volume 69, Pages 155-171. Descriptors: alteration; Amran Group; Arabian Peninsula; Asia; biozones; burial diagenesis; carbonate platforms; carbonate rocks; carbonate sediments; carbonatization; cement; cementation; compaction; dedolomitization; diagenesis; dolomitization; dolostone; hardground; Jurassic; limestone; lithofacies; lithostratigraphy; marine environment; Mesozoic; Middle Jurassic; oxidation; porosity; secondary porosity; sedimentary rocks; sediments; shallow-water environment; solution; Upper Jurassic; weathering; Yemen. References: 28; illus. incl. chart, strat. col., 4 tables, sketch map. Abstract: The Middle to Upper Jurassic shallow marine carbonate platform (Amran Group) is predominantly limestone to the west and northwest of Sana'a and limestone and dolomite to the east and northeast of Sana'a. Diagenesis of the Amran Group encompasses many processes with conspicuous effects, including cementation, dissolution, neomorphism, and compaction (both physical and chemical), producing secondary microporosity, micritization, and dolomitization. Dolomite cements are common and were precipitated mostly during later diagenesis in cavities and fractures. Replacive dolomitization occurred during shallow burial (small rhombic types) and during burial diagenesis with the formation of saddle dolomite. Integration of field, petrographic, and geochemical analysis (ICP) indicates that lithification of these carbonates occurred during symsedimentary and burial diagenesis, with much of the alteration controlled by eustatic sealevel change and regional tectonism. Four major subenvironments, in which

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diagenesis of the Amran Group was operative, can be recognized. (1) Synsedimentary diagenesis is characterized by the formation of isopachous and syntaxial cements, hardgrounds (with associated borings and burrows, and shelter, fenestral, framework, interparticle, and intraparticle porosity), geopetal structures, and intraclasts, indicating deposition under marine conditions. (2) Shallow burial diagenesis shows other specific features such as leaching, recrystallization, and early dolomitization (both replacive and void-filling) and mold-filling cements. Moldic and vuggy porosity distribution, early compaction, collapse breccia, and silt deposition indicates that the Amran Group continued to receive meteoric water following sediment stabilization, enlarging some molds and vugs by solution. (3) Deep burial diagenesis is characterized by dissolution, blocky calcite cement, late compaction (fractures and sutured grains), and saddle dolomite. (4) Uplift diagenesis is characterized by reopening of stylolites along fractures and development of dolomitization under meteoric conditions. The occurrence of nonferroan calcite and ferric oxides in rhombohedral zones in dolomite indicates that dedolomitization was driven by oxidation and alteration of ferroan dolomite zones and probably reflects alteration related to recent weathering. Database: GeoRef. ISBN: 1565760751. OCLC: 45904403.

Alwan, Mohamed Abdul Alim and UNDP. 1992. Natural Gas and its Utilization for Power Generation in Yemen: Country Paper. Amman: UN. Page(s): 4. Descriptors: Statistical Data; Natural Gas; Gas Industry; Electric Power; Liquefied Natural Gas; Yemen; Government publication; International government publication. Notes: tables. General Info: Distribution: General. Responsibility: prepared by Mohamed Abdul Alim Alwan, Deputy Minister, Ministry of Electricity and Water. OCLC: 78184238.

Aly, Said A. 2002. "Application of Well-Log Analysis for Detecting and Evaluating the Water Bearing Formations in the Western and Southwestern Parts of Taiz Governorate, Yemen." Annals of the Geological Survey of Egypt. Egyptian Geological Survey and Mining Authority, Cairo, Egypt. Volume 25, Pages 471-486. Descriptors: aquifers; Arabian Peninsula; Asia; Cenozoic; clastic rocks; Cretaceous; electrical methods; geophysical methods; ground water; hydrodynamics; igneous rocks; Mesozoic; mineral composition; physical properties; porosity; sandstone; saturation; sedimentary rocks; shale; Taiz Yemen; Tertiary; volcanic rocks; well-logging; Yemen. Notes: References: 17; illus. incl. geol. sketch maps, strat. col. Abstract: The aim of this study is to detect and evaluate the water bearing formations and to determine the petrophysical characteristics that affect strongly the well productivity by utilizing the well log analysis. Two types of aquifers were detected in the study area through the electrofacies methods. The first one is the Tertiary volcanics, which is characterized by low radioactivity, high electrical resistivity and low spontaneous potential. The second aquifer is the Cretaceous sandstone. It is characterized by a high radioactivity, very low resistivity and high values of spontaneous potential. The Tertiary volcanic aquifer, which is encountered in the western part of Taiz region increases in thicknesses to the west. The Cretaceous sandstone aquifer is located in the southwestern part of the study area and it decreases in thicknesses towards north and west. The volcanic aquifer is composed mainly of basalt with small intercalations of shale while the sandstone aquifer is formed of sandstone with shale. The clay minerals present in the two aquifers are mainly montmorillonite, illite and chlorite with some amounts of mica and glauconite. The porosity is relatively higher in the volcanic aquifer than that of the sandstone one due to the secondary origin of the first and the primary origin of the second. The water saturation is high in the two aquifers but it is better in the sandstone aquifer. The movable water saturation is generally higher than residual water saturation indicating that the specific yield of these aquifers is excellent. The depth to water ranges from 12 to 28 m in volcanic aquifer but it

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changes from 245 to 267 m within the sandstone aquifer at the western part of Taiz region, while at the southwestern part, the depth to water is 4 m in the sandstone aquifer. Database: GeoRef. ISSN: 1110-0435.

Alzandani, Bakeel A. 2010. *The Bush Doctrine, the War on Terror, and American Promotion of Democracy in the Middle East: The Cases of Egypt and Yemen*. United States -- Nebraska: Political Science. ProQuest Dissertations and Theses. Abstract: Unlike the previous U.S. Administrations, the Bush Administration believes that national security and promoting democracy go hand-in-hand. In arguing that success in the war on terror demands democratic reform in the Middle East, Bush broke a long-standing division between Realism (which stresses security) and Liberalism (which posits that institutional change can enhance security in the long term). Bush, in other words, proposed that security and democracy are positive sum and increases in democracy promotion will yield positive security gains. Neoconservatives believed that the major cause of terror is the lack of freedom and democracy in the Middle East. Thus in the Bush era U.S. foreign policy aims to promote democracy in the region as a solution to terrorist activities against the United States and the West. Clearly, government officials in the Bush Administration believed that democracy promotion could guarantee security concerns of the United States. This dissertation tries to answer the questions: did the Bush Administration succeed in pursuing both security and democracy through its War on Terror policy, or did it end up pursuing security at the expense of democracy? This dissertation examines in detail statements by the Bush Administration about Democracy Promotion, including the ways in which neoconservatives treated democracy post-9/11. This will contain explicit budgetary and program information. ISBN: 9781124101057; 1124101055. OCLC: 696782644.

Ameen, Jamal R. M. and Naji, Jamil A. 2001. "Causal Models for Road Accident Fatalities in Yemen." *Accident Analysis & Prevention*. 7. Volume 33, Issue 4, Pages 547-561. Descriptors: Road accident fatalities; Correlation and causality; Collinearity; Regression; Qat; Yemen. ISSN: 0001-4575.

American Univ Washington DC Foreign Area Studies and Nyrop, Richard F. 1985. "Area Handbook Series: The Yemens Country Studies." Jun. Page(s): 401 Report Number: DA-PAM-550-183 Monitor Series: PAM-550-183. Abstract: Contents: Historical Setting; North Yemen; South Yemen. Abstract Classification: Unclassified Technical Reports Collection. Notes: 2ND EDITION, Distribution Statement: Approved for public release: Distribution unlimited. DTIC Accession Number: ADA176960.

[Ancient Water System, Aden, Yemen]. 2003. Descriptors: Waterworks -- Yemen (Republic) -- Aden -- Slides; Antiquities -- Yemen (Republic) -- Aden -- Slides; Slide (sld). Abstract: A.A-A.C. General view. Notes: 3 slides; Geographic: Aden (Yemen) -- Buildings, structures, etc. -- Slides. Note(s): Built by Himyarites. Also available in digital format. OCLC Accession Number: 53448470.

Anderson, Joshua Michael. 2007. *Climatic and Structural Controls on the Geomorphology of Wadi Sana, Highland Southern Yemen*. Tampa, Fla.: University of South Florida. Descriptors: Yemen. RASA. Wadi Hadramawt. Paleoclimate. Geochronology. Paleohydrology. Abstract: Middle Holocene climate change forced significant environmental response and influenced human activities throughout southern Arabia. Climate models and proxy data indicate that climate along the southern Arabian peninsula changed from a moist phase, spanning the early to middle Holocene, to an arid phase, which persisted for the last ca. 5,000 years. A weakening and southward shift of the Southwest Indian Monsoon System, forced by northern hemisphere insolation variations in the precession band and/or glacial boundary

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conditions, is suggested as the mechanism for the abrupt shift to more arid conditions. Geoarchaeological evidence suggests that agriculture was more widespread and evolved alongside the development of irrigation technologies during a period when rainfall was more plentiful than today. Here we investigate the surficial record of the dynamic fluvial response to the late Quaternary climate shift and reconstruct the geochronology of the geomorphic evolution of a significant portion of the ca. 125 km length of Wadi Sana, a north-flowing tributary to the Wadi Hadramout system. Using differential-corrected GPS-based survey, combined with analysis of the sedimentary record, the RASA (Roots of Agriculture in Southern Arabia) Project has created a paleohydrologic reconstruction of Wadi Sana in order to provide a context for understanding how fluvial landscapes, hydrologic regime, and human activity reacted to ivchanging middle Holocene climate. Radiocarbon and luminescence dating of remnant silt terraces suggests that fine-grained sediment began accumulating on an older (late-Pleistocene) coarse cobble surface between 12,000-7,000 years ago and continued aggrading until about 5,000 years ago. Paralleling the climate shift, Wadi Sana began incising and eroding the thick sediment infilling about 4,500 years ago, which has continued to the present time. Field reconnaissance and map analysis reveals structural and lithologic controls on the source and availability of these fluvial sediments for downstream deposition during the late Pleistocene and Holocene. Hydrologic modeling of active present-day channels within Wadi Sana estimates stream velocities at 2.2 m/s and stream discharges of 444 m³/s. We propose that a change in hydrologic regime, driven by the monsoon shift, is the cause of the middle Holocene channel adjustment from an aggradational to incising mode in Wadi Sana. Notes: Dissertation: Thesis (M.S.)--University of South Florida, 2007. Note(s): Includes bibliographical references. Responsibility: by Joshua Michael Anderson. OCLC: 180701835.

Anderson, Joshua, Oches, Eric A., McCorriston, Joy and Harrower, Michael J. 2004. "Geomorphic Response to Middle Holocene Climate Change in Highland Southern Yemen; Geological Society of America, 2004 Annual Meeting." Abstracts with Programs - Geological Society of America. Geological Society of America, Boulder, CO. Nov 2004. Volume 36, Issue 5, Pages 122-123. Descriptors: Arabian Peninsula; archaeology; Asia; Cenozoic; highlands; Holocene; middle Holocene; paleoclimatology; Quaternary; Yemen. Abstract: Middle Holocene climate change forced significant environmental response and influenced human activities throughout southern Arabia. Climate models and proxy data indicate that climate along the southern Arabian Peninsula changed from a moist phase, spanning the early to middle Holocene, to an arid phase, which persisted for the last ca. 5,000 years. A weakening and southward shift of the East African-Indian monsoon system, forced by insolation variations, is suggested as the mechanism for the abrupt shift to more arid conditions. Abundant archaeological evidence suggests that agriculture was much more widespread and evolved alongside the development of irrigation technologies during a period when rainfall was more plentiful than today. Through geoarchaeological survey we have investigated the surficial record of the dynamic fluvial response to the mid-Holocene climate shift and documented a rich archaeological record of neolithic artifacts, human settlement, and water management structures through the ca. 80km length of Wadi Sana, a significant north-flowing tributary to the Wadi Hadramawt system. Using differential-corrected GPS-based survey, combined with field and lab analysis of the sedimentary record, the RASA (Roots of Agriculture in Southern Arabia) Project has created a paleohydrologic reconstruction of Wadi Sana in order to provide a context for understanding how fluvial landscapes, hydrologic regime, and human activity reacted to changing middle Holocene climate. Radiocarbon and luminescence dating of remnant silt terraces suggests that

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fine-grained sediment began accumulating on an older (late-Pleistocene?) coarse cobble surface between 14,000-8,000 years ago and continued aggrading until about 5,000 years ago. Paralleling the climate shift, Wadi Sana began incising and eroding thick sediment infilling about 4,500 years ago, which has continued to the present time. Our primary hypothesis is that a change in hydrologic regime, driven by the monsoon shift, is the cause of channel adjustment from an aggradational to incising mode in Wadi Sana. Additional paleohydrologic modeling will quantify paleoflow, paleodischarge, and provide estimates of sediment flux in the Wadi Sana system. Database: GeoRef. ISSN: 0016-7592.

Anon. 1986. "Yemen Water Contract Tests Nerve." *World Constr.* Volume 39, Issue 12, Pages 40. Abstract: With an ancient history but only independent for 20 years, South Yemen provides a working environment that stretches contractor's skills and tolerance to the full. With rebuilding identified as a priority by the new government, and benefiting from aid supplied by both eastern block and western nations, the country is tackling its enormous development problems. Some of the aid is being used to build a 56 km long, 800 mm diameter, water pipeline from Wadi Bana, in the east, to Bir Nasir, on the outskirts of Aden. Originally designed by the French, British consultants John Taylor & Sons were called in to revise the project, and the British contractor Bovis was in 1983 awarded the contract to build the pipeline, four large steel reservoirs, and associated works. Database: SCOPUS. ISSN: 0043-8375.

Anonymous. 1993. *Unkonventionelle Wasserprospektion; Felderprobung Der Rutengaenger-Methodik in Trockenzone*. Unconventional Water Detection; Field Test of Dowsing Technique in Dry Zones. Federal Republic of Germany GTZ, Eschborn, Federal Republic of Germany. Karl und Veronica Carstens-Stiftung . Descriptors: Africa; Antilles; aquifers; Arabian Peninsula; Asia; associations; Atlantic Ocean Islands; basin management; Bavaria Germany; Cape Verde Islands; Caribbean region; Central Africa; Central Europe; Congo; crystalline rocks; discharge; Dominican Republic; drilling; drinking water; East Africa; Europe; experimental studies; exploration; Far East; faults; fractures; Germany; Greater Antilles; ground water; Hispaniola; international cooperation; joints; karst; Kenya; methods; Namibia; Niger; Philippine Islands; Sinai; Southern Africa; Sri Lanka; style; water harnessing; water resources; water supply; water wells; wells; West Africa; West Indies; Yemen. Abstract: This report presents new insights into an unconventional option of locating water reserves which relies on water dowsing. The effectiveness of this method is still rightly disputed. Now, however, extensive field studies - in line with provable and reliable historic accounts - have shown that a few carefully selected dowsers are certainly able to detect faults, fissures and fractures with relative alacrity and surprising accuracy in areas with, say, crystalline or limestone bed-rock. A series of GTZ projects involving this technique were carried out in dry zones with unexpectedly high rates of success. In particular, it was possible to locate a large number of relatively small underground aquifers in thinly populated areas and to drill wells at the sites where water is needed; the yields were low but sufficient for hand-pump operation throughout the year. Finding or locating a sufficient number of relatively small fracture zones using conventional techniques would have required a far greater work input. The relevance of the method used was tested under various aspects. On the one hand, project areas with different geological characteristics were chosen and, on the other hand, the relevant circumstances and project results were carefully examined by geology experts. So far, neither critical consideration of all possible objections nor attempts at reasoning have yielded a conventional explanation for the persistent success of the dowsing technique - an outcome which has been corroborated by a number of specifically designed control experiments and comparative tests. The trend of the reported findings is

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concordant with that exhibited by the findings from recent scientific research carried out, for example, by a Swedish geological institution and universities in Munich. Provided that certain conditions are met, the results obtained show the dowsing technique to be a serious alternative for ground-water prospection. It can thus be concluded from these present experiences that the effectiveness of locating ground water in certain hydrogeological situations could be raised significantly if conventionally organised operating teams were to make additional use of appropriately tested and selected dowsers in order to pinpoint drilling spots. Along these lines, a model of integration, which has already been tested on a pilot scale in some of the GTZ projects presented herein, is discussed and proposed for future provisional use. The high success rates described in this report suggest the design of specific tests for future use which may contribute to a scientific clarification of the dowsing phenomenon. At the same time, there is the possibility of an especially useful transfer of practical knowledge concerning waterresource development. Finally, due to its biophysical background the issue might be of importance to bionics; further treatment should aim at technical simulation of the proven albeit unexplained - effects of the dowsers in order to create new and more effective measuring procedures. Notes: Edition: 2. erw. Aufl. References: 25; illus. incl. tables, sects. ISBN: 3880854882. Database: GeoRef in Process. Availability: 1994 B 113. GeoRef Accession Number: 101087-1.

Ansell, Christine. 1981. *The Benefit of Rural Water Projects: An Impact Survey of Five Villages*. Sanaa, Yemen: New TransCentury Foundation. Descriptors: Water-supply, Rural -- Yemen (Republic); Sanitation, Rural -- Yemen (Republic); Water resources development -- Yemen (Republic); Cisterns -- Yemen (Republic). Notes: 23 leaves: map; 28 cm. Note(s): "Under contract to U.S.A.I.D., contract no. AID-NE-CA-1647 project no. 279-0044." "October, 1981." Responsibility: Christine Ansell. LCCN: 2010-467302. OCLC Accession Number: 705349542.

Ansell, Christine; Burrowes, Robert and American Save the Children/Yemen. 1981. *Communicating hygiene/sanitation Messages to Villagers: An Experiment in Wadi Ayyan*. Westport, Conn.: American Save the Children/Yemen. Page(s): 55. Descriptors: Public health personnel -- Yemen (Republic); Water-supply -- Yemen (Republic); Sanitation -- Yemen (Republic); Public health -- Yemen (Republic). Notes: iii; ill. 28 cm. Responsibility: by Christine Ansell and Robert Burrowes. OCLC: 11138432.

Ansell, Christine; Burrowes, Robert; American Save the Children/Yemen and Oxfam. 1981. *Training Manual in Elementary hygiene/sanitation and its Instruction*. Westport, CT: American Save the Children/Yemen. Descriptors: Public health personnel -- Yemen (Republic); Water-supply -- Yemen (Republic); Public health -- Yemen (Republic); Drinking water -- Yemen (Republic); Water quality management -- Yemen (Republic); Sanitation -- Yemen (Republic); Diarrhea. Notes: v, [94] leaves: ill. 28 cm. Note(s): Cover title. Responsibility: by Christine Ansell and Robert Burrowes. OCLC Accession Number: 11138420.

Apel, M. and Steudel, C. 2001. "Rediscovery of *Sphaerocarcinus Bedoti* Zehntner, 1894 Decapoda: Brachyura: Portunidae) at Socotra Island (Republic of Yemen) Andplacement in the Genus *Caphyra* Guerin, 1832." *J. Crust. Biol.* May. Volume 21, Issue 2, Pages 538-544. Descriptors: Marine crustaceans; Taxonomy; Synonymy; Distribution records; phaerocarcinus bedoti; Caphyra; Portunidae; Yemen, Socotra; Socotra; Animal morphology; Conspecifics; Swimming crabs; Marine. Abstract: Two brachyuran crabs collected at Socotra Island (Republic of Yemen) in the northwestern part of the Indian Ocean turned out to be conspecific with *Sphaerocarcinus bedoti* Zehntner, 1894, so far only known from a single female collected at Amboina, Indonesia, without any information on its ecology. Based on the new material and

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especially the availability of a male for comparison of the morphology of the copulatory appendages (gonopods), *Sphaerocarcinus* Zehntner, 1894, is synonymised with *Caphyra* Guerin, 1832. The extremely convex and globose carapace shape of the type specimen from Amboina turned out to be atypical and possibly caused by parasitic infection. Ecologically, *C. bedoti*, like most species of the genus *Caphyra*, lives epibiontic on soft corals (Octocorallia: Alcyonaria). Database: BioOne Abstracts and Indexes. ISSN: 0278-0372.

Arab Organization for Agricultural Development. 1975. Dirasat Bi-Al-Jumhuriyah Al-`Arabiyah Al-Yamaniyah: Istighlal Al-Mawarid Al-Maiyah Bi-Mintaqatay Sa`ada Wa-Siham: Tatawwur Taswiq Al-Khudar Wa-Al-Fawakah. al-Khartum: Jami`at al-Duwal al-`Arabiyah, al-Munazzamah al-`Arabiyah lil-Tanmiyah al-Zira`iyah. Page(s): 118. Descriptors: Water resources development -- Yemen (Republic) -- Sa`dah (Province); Fruit -- Yemen (Republic); Vegetables - - Yemen (Republic). Notes: 11, 15;; 26 cm. Note(s): Cover title. Includes bibliographical references (p. 117-118). OCLC Accession Number: 41197012.

Arab Organization for Agricultural Development; International Service for National Agricultural Research and UNDP. 1993. A Review of the Agricultural Research System in the Republic of Yemen: Report to the Ministry of Agriculture and Water Resources. The Hague: ISNAR. Page(s): 162. Descriptors: Agriculture; Agricultural Research; Agricultural Policy; Yemen; Agricultural Engineering; Government publication; International government publication. Notes: xii; charts, maps, tables. Note(s): Material type: Reports/studies. General Info: Distribution: General (not for deposit). Responsibility: Arab Organization for Agricultural Development, International Service for National Agricultural Research, United Nations Development Programme. LCCN: 95-227865. OCLC Accession Number: 153315455; 27931763.

Arar, A. 1991. Wastewater Reuse for Irrigation in the Near East Region. Kyoto, Jpn: Volume: 23, 10-12, page(s): 2127-2134. Proceedings of the 15th Biennial Conference of the International Association on Water Pollution Research and Control, July 28, 1990 - August 3. Conference: 1990. Descriptors: Wastewater Treatment; Agriculture; Environmental Protection; Health Hazards; Irrigation; Water Resources--Conservation; Water Supply. Abstract: Limited water supplies available in many countries of the Near East has led to a growing interest in the rational use of this increasingly important resource. Because wastewater irrigation ensures the reuse of resources and achieves better treatment of wastewater, plans have recently been formulated for large-scale use of this non-conventional source of water. Consequently, in several countries of the Near East Region, wastewater reuse in agriculture is an accomplished and accepted fact, with a high degree of social and political commitment. Intensive and direct reuse is being practised in Kuwait, Saudi Arabia, Libya, the United Arab Emirates and Tunisia. Direct, but unsupervised reuse is being practised in Yemen Arab Republic, Morocco and Syria. All forms of wastewater reuse is practised in Egypt. Indirect and direct restricted reuse is practised in Jordan. However, given the health and environmental hazards associated with reuse of wastewater, the formalization of wastewater treatment and reuse in all countries is urgent. Furthermore, in most countries poor coordination amongst the different agencies concerned with water supply, wastewater treatment, irrigation, public health and the environment is a key constraint for further wastewater reuse. ISSN/ISBN: 0273-1223; 0080407749. OCLC: 644931690.

ARCADIS, Euroconsult. 2003. Yemen Irrigation Improvement Project (IDA Credit No. 3412 – YEM). Main Technical Assistance Package for IIP. Republic of Yemen Ministry of Agriculture and Irrigation.

Geology of Yemen

Arfaa, F. 1972. "Studies on Schistosomiasis in the Yemen Arab Republic." *Am. J. Trop. Med. Hyg.* Volume 21, Issue 4, Pages 421-424. Notes: Cited By (since 1996): 3. Database: SCOPUS. ISSN: 0002-9637.

Arkell, W. J. 1952. "Jurassic Ammonites from Jebel Tuwaiq, Central Arabia." *Royal Society (London) Philosophical Transactions, Series B*, number 633, volume 236, pages 257-313.

Arizona Univ Tucson Dept of Geosciences and Wallace, Terry C. 1989. "The Effects of Structure and Source Complexity on Waveforms: Crustal Structure of Tibet and the Recovery of Complex Seismic Sources." 07 Sep. Page(s): 198 Report Number: GL-TR-89-0259 Contract Number: F19628-87-K-0046 Monitor Series: TR-89-0259. Abstract: In an attempt to better understand the effects of both source and path on regional distance waveforms, we investigated the crustal structure of Eurasia and developed an algorithm for investigating complex seismic sources. Part I is a study based on the inversion of 130 regional distance waveforms for average crustal thickness and upper mantle Pn velocity beneath Tibet. Results indicate an increase in Pn velocity, coincident with the increase in crustal thickness, of about 0.2 km/s beneath the Plateau. Impulsive Pn arrivals from paths that cross the Tibetan Plateau can be modeled with a positive upper mantle gradient, indicating an upper mantle lid approximately 100 km thick beneath southern Tibet. This 'shield-like' structure has important consequences for the propagation of regional phases Pg, Pn and Sn. Part II discusses an algorithm for time dependent moment tensor (TDMT) inversion. The algorithm was developed to investigate complex seismic sources, such as multiple earthquakes and, ultimately, explosions with tectonic release contamination. The TDMT inversion algorithm was tested with 3 synthetic data examples with varying degrees of complexity. It was also tested on the long-period body waves for 3 earthquakes: the 1982 Yemen, the 1971 San Fernando, and the 1952 Kern County earthquakes. Preliminary modeling in the nearfield of nuclear explosions yielded mixed results. Abstract Classification: Unclassified Technical Reports Collection. Notes: Final rept. May 87-May 89, DTIC Accession Number: ADA218202.

Army Command and General Staff College, Fort Leavenworth, Ks, School of Advanced Military Studies and Dooghan, James K. 2006. "Muslim Prison Ministry: Hindering the Spread of the Radical, Militant, Violent and Irreconcilable Wing of Islam." 25 May. Page(s): 70 Report Number: XA-USACGSC/SAMS Monitor Series: USACGSC/SAMS. Abstract: Prisons and detention centers are recruiting grounds for radical Islamists. Unfortunately, the National Military Strategic Plan for the War on Terrorism Campaign Plan is not a sufficient enough strategy to hinder the conversion of detainees into terrorists. However, addressing violent Islamic ideology at the grass roots level may decrease the number of terrorists recruited and increase the number of Muslims favoring a nonviolent interpretation of the Qur'an. The author recommends reducing terrorist recruitment through an anti-violent Islamic ministry program that educates detainees and prisoners through Muslim clerics. This indirect approach focuses on conflict resolution and relies on Muslims who reject a violent interpretation of the Qur'an. Both Islamic and western countries are beginning to rely on moderate Muslim ministers to promote nonviolent ideologies to counter terrorist recruitment efforts. Egypt and Yemen have already witnessed conversions of militant Islamists to moderate Islamists. The United Kingdom and France are appealing to moderate Muslim clerics to address the growing number of radicalized Muslims in their prisons. The U.S. Bureau of Prisons' Muslim chaplaincy program provides guidelines for selecting Muslim religious service providers for prison ministry programs. The solution is not an ecumenical reconciliation of the various religions of the world, but a peaceful coexistence among

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religions, beginning with an intellectual understanding of Islamic ideologies and empathy for the Muslims caught in the war between terrorists and the coalition forces. Abstract Classification: Unclassified Technical Reports Collection. Distribution Statement: Approved for public release; distribution is unlimited. DTIC: ADA450078. URL: <http://handle.dtic.mil/100.2/ADA450078>.

Army Command and General Staff College, Fort Leavenworth, Ks, School of Advanced Military Studies and Machon, Matthew J. 2006. "Targeted Killing as an Element of U.S. Foreign Policy in the War on Terror." 25 May. Page(s): 69 Report Number: XA-USACGSC/SAMS Monitor Series: USACGSC/SAMS. Abstract: On 5 November 2002, an armed Central Intelligence Agency (CIA) operated Predator Unmanned Aerial Vehicle (UAV) launched a lethal missile strike, killing Qaed Salim Sinan al-Harethi, a high ranking al-Qaeda member and suspected architect of the USS Cole bombing, in an isolated and sparsely populated region within Yemen. This missile strike appears to have initiated a new and highly controversial phase in the Global War on Terror; moving the Bush administration away from the law enforcement-based tactics of arrests and detentions of al-Qaeda suspects that it had employed outside Afghanistan in the months since the fighting there had ended. Since the 2002 Yemen strike US officials have acknowledged at least 19 occasions since September 11th on which Predators have successfully fired Hellfire missiles on terrorist suspects overseas. While it is uncertain how many unacknowledged strikes the US has conducted, now that al-Qaeda has decentralized its operations around the globe, it's likely that the war against the network will assume an increasingly covert nature, involving intelligence cooperation and targeted strikes against al-Qaeda suspects rather than major conventional military offensives. This monograph examines the prohibition on assassination embodied within Executive Order 12333 and its effect on a U.S. policy of targeted killing of transnational terrorist leadership. Next this monograph will examine the numerous interpretations of applicable international law regarding terrorism and the states response. This examination will contrast the law enforcement model proposed by adherents of international humanitarian law, with international humanitarian law and the law of war model advocated by those who see the current 'war on terror' as an armed conflict between states and trans-national terrorists. Given the level of secrecy and lack of transparency i Abstract Classification: Unclassified Technical Reports Collection. Monograph; Distribution Statement: Approved for public release; distribution is unlimited. DTIC: ADA450537. URL: <http://handle.dtic.mil/100.2/ADA450537>.

Army Command and General Staff College, Fort Leavenworth, Ks, School of Advanced Military Studies and Mady, Ahmed M. 2005. "Roles and Effects of Media in the Middle East and the United States." 26 May. Page(s): 80 Report Number: XA-USACGSC/SAMS Monitor Series: USACGSC/SAMS. Abstract: This monograph compares the role of contemporary media, especially television, in the Middle East and the United States. Emphasis is placed on the more salient roles played by the media in the Middle Eastern and U.S. perspectives of the world. These roles include the impact of media on military operations, politics, foreign policy, economics, society, and culture. The paper begins with definitions of the terms Middle East and media. Next, the author presents a survey of the Middle East's media establishment and its characteristics across the region. The countries included in the survey are Egypt, Sudan, Libya, Tunisia, Algeria, Morocco, Mauritania, Syria, Iraq, Lebanon, Jordan, Palestine, Turkey, Israel, Saudi Arabia, Kuwait, Qatar, Bahrain, United Arab Emirates, Oman, Yemen, and Iran. The focus then shifts to the United States, where the history and influence of the media establishment there is reviewed. Although media in the United States and the Middle East appear quite different, they share many attributes, including the need to deal with ownership, adapt to rapidly changing

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technology and methods, operate in diverse environments, and deal with the various challenges to forthright news reporting and commentary. Based on this analysis, the author concludes that the media -- now more than ever -- have the capacity not only to reflect on the world, but also to transform it. How this capacity makes itself felt remains largely a function of context and culture. Still, there are underlying common denominators, including the growing intrusiveness of a burgeoning and specialized media establishment in both regions. This and related developments mean that, like Ben Franklin's adage about the poor and taxes, the media will always be with us. The author concludes that this understanding has significant ramifications for the relationship between the media and the military in both the United States and the Middle East. Abstract Classification: Unclassified Technical Reports Collection. Distribution Statement: Approved for public release; distribution is unlimited. DTIC: ADA435946. URL: <http://handle.dtic.mil/100.2/ADA435946>.

Army Command And General Staff Coll Fort Leavenworth Ks School Of Advanced Military Studies and Murphy, John E. 2009. "Air Policing." May. Page(s): 59 Report Number: XA-USACGSC/SAMS Monitor Series: USACGSC/SAMS. Abstract: Currently, the United States finds itself in a predicament similar to that which Great Britain experienced after emerging from the First World War as she dealt with the governance of a growing empire. Some air-minded proponents are asking whether the air policing policy developed and implemented by Great Britain during the interwar years offers any relevancy for the contemporary Iraqi situation. Specifically, does air policing offer a means to mitigate the reduction in capability associated with the drawdown of conventional U.S. ground forces in Iraq? This monograph presents case studies of the employment and evolution of British air policing operations from 1919 to 1934. The case studies examine the origins, development, and mature employment of British air policing doctrine in the Third Afghan War, Somaliland, Mesopotamia, and Aden. Air strikes were a significant factor in preventing tactical defeats from having strategic consequences and in preserving political will. The ability to rapidly transport and resupply small ground force teams proved essential to conducting rapid decisive actions, provided for increased security and freedom from attack, and reduced the requirement for ground-based logistics support. The ability to rapidly transport civilian governing personnel across the physical vastness of a governed territory also was extremely effective. Psychological operations conducted from aircraft were effective at communicating and reinforcing government directives. Reconnaissance provided actionable intelligence, enabled overwatch of small unit teams, and permitted observation of otherwise unreachable sections of territory. While the study shows that the British doctrine of Inverted Blockade is unsuitable for contemporary Iraqi counterinsurgency operations, and the doctrine of Interference offers only minor utility, the employment of air power in close coordination with ground forces and in direct support of local governance could be extremely effective. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: View Full Text (pdf); File: /U2/a506166.pdf; Size: 355 KB; Monograph; Distribution Statement: Approved for public release; distribution is unlimited. DTIC: ADA506166. URL: <http://handle.dtic.mil/100.2/ADA506166>.

Army Command and General Staff College, Fort Leavenworth, Ks, School of Advanced Military Studies and Olson, Brian S. 2008. "Withdrawal from Empire: Britain's Decolonization of Egypt, Aden, and Kenya in the Mid-Twentieth Century." 30 Sep. Page(s): 71 Report Number: XA-USACGSC/SAMS Monitor Series: USACGSC/SAMS. Abstract: Powerful nations often find themselves physically and geographically embroiled in the affairs of other nations in the form of empires, protectorate treaties, military occupations, and peacekeeping and stability

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operations. Generally speaking, they all eventually withdraw these forces and empower the sovereign nation in self-governance. Withdrawal from Empire provides lessons from three case studies of how Great Britain withdrew forces and superintendence from Egypt, Aden and Kenya during the End of Empire era in the mid-Twentieth Century. After outlining several popular theories of why Britain elected to (or was forced to) withdraw from these colonies, the cases are addressed individually. To provide background and situational context to the studies, the case studies begin with a narrative history of Britain's incursions into the specific lands on Africa and the Arabian Peninsula. The narrative traces Britain's influence in these nations and her eventual reasons and methods of withdrawal. An analysis of the plans, methods and post-withdrawal status of the new independent nations and their relationship with Britain leads to some basic lessons on how other nations should consider withdrawing forces from occupied territories. While the analysis is uses four comparison criteria it is primarily focused on governance, economics, and security issues. Some examples of the lessons learned involve whether and how occupying nations should establish a timeline for withdrawal, how to train and educate the new or newly independent nation in governance, and the utility of leaving behind some forces or advisors to continue to guide the new nation or participate in its governance, economy or security. Abstract Classification: Unclassified Technical Reports Collection. Distribution Statement: Approved for public release; distribution is unlimited. DTIC: ADA510241. URL: <http://handle.dtic.mil/100.2/ADA510241>.

Army Command and General Staff Coll Fort Leavenworth KS and Gonnella, Joseph. 2005. "Terrorism Prevention: How does Special Operations Fit in?" 17 Jun. Page(s): 117 Report Number: XA-USACGSC Monitor Series: USACGSC. Abstract: The 2002 U.S. national security strategy is a proactive, world-integrated strategy against terrorism. The United States chose to highlight preemption as a viable option to deal with terrorists or rogue states. The aim of this thesis is to address the planning and execution of this policy at the operational level with regard to prevention more so than preemption. As such, strategic and operational decisions regarding actions to be taken against impending terrorist threats will need to be made to prevent the onset of hostile acts against the United States. The decision to act also will incur associated military and political risks. Once possible terrorist activity is detected, the United States may choose to use diplomatic, economic, or informational means of preventing it, but often the only sure way of stopping terrorist attacks will be by military means. The decision to preempt or prevent terrorism using the military equates to the use of force and can be accomplished with conventional or special operations forces (SOF). The thesis includes a chapter that utilizes METT-TC to analyze the circumstances that exist to allow a combatant commander to gain maximum situational awareness. It explains the capabilities that he must look for when choosing appropriate forces to achieve success, the types of threats and different states he may face, and considerations he must take into account regarding the U.S. public and the international community. It concludes with a Classical Terrorism-Prevention Flowchart to assist in deciding which type of forces to use. Another chapter interprets, analyzes, and explains five cases pertaining to preventive/preemptive strikes. The circumstances of each case are placed into the Flowchart to compare the classical solution to applying force to the solution that was actually used. The chapter concludes with an analysis of SOF and how SOF's capabilities present a better opportunity for both military and political success. Abstract Classification: Unclassified Technical Reports Collection. Distribution Statement: Approved for public release; distribution is unlimited. DTIC: ADA436674. URL: <http://handle.dtic.mil/100.2/ADA436674>.

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Army Field Artillery School Fort Sill OK Morris Swett Technical Library Div and MillerL, L., Jr. 1985. "The Middle East, and Her Geographic Approaches." 15 Sep. Page(s): 38 Report Number: USAFAS/MSTLD/SB112. Abstract: This bibliography presents periodical citations on the Middle East, and Approaches. Emphasis is on military and Naval articles which provide background understanding for some of the historic and contemporary issues which concern everyone. Coverage: Aden; Afghanistan; Bahrain; Cyprus; Diego Garcia; Iran; Iraq; Israel; Jordan; Kurdistan Region; Kuwait; Lebanon; Muscat; Oman; Pakistan; Palestine Region; Qatar; Saudia Arabia; Syria; Turkey; Yemen. Abstract Classification: Unclassified Technical Reports Collection. Notes: Final rept. DTIC: ADA157344.

Army Medical Research Inst Of Infectious Diseases Fort Detrick Md Virology Div and Turell Michael J Linthicum Kenneth J Patrican Lisa A Davies F G Kairo Alladin Bailey, Charles L. 2008. "Vector Competence of Selected African Mosquito (Diptera: Culicidae) Species for Rift Valley Fever Virus." Jan. Page(s): 9 Report Number: TR-07-052 XA-USAMRIID/VD Monitor Series: USAMRIID/VD. Abstract: Outbreaks of Rift Valley fever (RVF) in Egypt, Yemen, and Saudi Arabia have indicated the potential for this disease to spread from its enzootic areas in sub-Saharan Africa. Because little is known about the potential for most African mosquito species to transmit RVF virus (RVFV), we conducted studies to determine the vector competence of selected African species of mosquitoes for this virus. All eight species tested (*Aedes palpalis* (Newstead), *Aedes mcintoshi* Huang, *Aedes circumluteolus* (Theobald), *Aedes calceatus* Edwards, *Aedes aegypti* (L.), *Culex antennatus* (Becker), *Culex pipiens* (L.), and *Culex quinquefasciatus* Say, were susceptible to infection and all except *Ae. calceatus*, *Ae. aegypti* and *Cx. quinquefasciatus* transmitted RVFV by bite after oral exposure. Estimated transmission rates for mosquitoes that successfully transmitted RVFV by bite ranged from 5% for *Ae. mcintoshi* to 39% for *Ae. palpalis* for mosquitoes that fed on a hamster with a viremia 108 plaque-forming units of virus/ml. We did not recover RVFV from any of 3,138 progeny of infected female mosquitoes. RVFV is unusual among arboviruses in that it has been isolated in nature from a large number of species and that numerous mosquitoes and other arthropods are able to transmit this virus in the laboratory. The recent introduction and spread of West Nile virus into the Americas and the spread of RVFV to the Arabian Peninsula illustrates the potential for viruses, once enzootic in Africa, to spread to other parts of the world. Abstract Classification: Unclassified Technical Reports Collection. Distribution Statement: Approved for public release; distribution is unlimited. DTIC: ADA486086. URL: <http://handle.dtic.mil/100.2/ADA486086>.

Army Natick Labs Mass Earth Sciences Lab and FegleyRobert, S. 1968. "Clothing Almanac For Southwest Asia." Jul. Page(s): 56 Report Number: ES-39 USA-NLABS-TR-69-6-ES Monitor Series: TR-69-6-ES. Abstract: Monthly military clothing requirements are given for Southwest Asia, including here the countries of Turkey, Cyprus, Syria, Lebanon, Israel, Jordan, Iraq, Iran, United Arab Republic (east of the Nile River), Saudi Arabia, Yemen, South Yemen and the Protectorates, Sultanates and Sheikdoms of the Arabian Peninsula. This region includes portions of Clothing Allowance Zones I, II, and III, which are further divided into mountainous and non-mountainous Clothing Requirement Areas. In general, Zone I comprises the southern and western perimeter of the Arabian Peninsula. Zone II comprises the rest of the Peninsula and the coastal areas of the Mediterranean Sea and Persian Gulf. Zone III includes the northern half of this region. Mountainous areas generally require the use of items listed for the next colder zone, or any additional items required for troop protection. Clothing items are grouped alphabetically in tables for each of the six areas. A map is provided to indicate the extent of each area in Southwest Asia. The Almanac includes a descriptive summary of physical features of this

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region, its climate, biotic conditions, and the relation of these factors to the issue of special clothing items. (Author) Abstract Classification: Unclassified Technical Reports Collection. Notes: Technical rept., DTIC: AD0682729.

Army Training And Doctrine Command Fort Leavenworth Ks Deputy Chief Of Staff For Intelligence. 2005. "Terror Operations: Case Studies in Terrorism. U.S. Army DCSINT Handbook no. 1.01." 15 Aug. Page(s): 106 Report Number: XA-TRADOC/DCSI Monitor Series: TRADOC/DCSI. Abstract: This supplemental handbook presents four terrorist incidents in a case study methodology. The handbook supports a U.S. Army Training and Doctrine Command, Assistant Deputy Chief of Staff for Intelligence - Threats capstone reference guide on terrorism, DCSINT Handbook No. 1, A Military Guide to Terrorism in the Twenty-First Century. Understanding terrorism spans foreign and domestic threats of nation states, rogue states with international or transnational agents, and actors with specific strategies, tactics, and targets. The central foci of the handbook are foreign and domestic threats against the United States in a contemporary operational environment (COE). The handbook supports operational missions, institutional training, and professional military education for U.S. military forces in the Global War on Terrorism (GWOT). It promotes an improved understanding of terrorist goals and objectives; motivation; planning strategy; behavior; conduct of operations; and tactics, techniques, and procedures (TTP). The primary audiences for the handbook are U.S. military forces that are deployed, that are in transit to or from an operational mission, and that are primarily nondeployable as installation or institution support. Other applicable groups may include interdepartmental, interagency, intergovernmental, nongovernmental, private volunteer, and humanitarian relief organizations. Compiled from source materials, the handbook promotes a Threats perspective and enemy situational awareness in combating terrorism. The following case studies are analyzed in detail: the Tokyo Subway Sarin Attack, the Murrah Federal Building Bombing, the Khobar Towers VBIED Bombing, and the USS Cole Bombing. Each case study presents learning objectives, an overview, background, planning and preparation, the attack itself, supplemental vignettes, the terrorists and victims, and case discussion questions. Abstract Classification: Unclassified Technical Reports Collection. Distribution Statement: Approved for public release; distribution is unlimited. DTIC: ADA456281. URL: <http://handle.dtic.mil/100.2/ADA456281>.

Army War Coll Carlisle Barracks PA and Al-Bukaiti, Mohamed H. 2004. "Yemen's Fight Against Terrorism." 19 Mar. Page(s): 18 Report Number: XA-USAWC Monitor Series: USAWC. Abstract: This paper examines the relationship between the United States and Yemen in the Global War on Terror (GWOT). Yemen supports the general goals and objectives of the United States in this effort and the Yemen national leadership has launched an initiative to confront and fight terror and work towards ending it at the earliest opportunity. This initiative has included military and law enforcement cooperation with U.S. agencies. These efforts have resulted in the capture and prosecution of several terrorists some of whom were involved in the bombing of the USS COLE. Although cooperation between Yemen and the United States has been positive - and will continue to be so - there are differences regarding the definition of terrorism and the perception of equal application of that definition to all states in the Middle East including Israel that must be addressed if a truly lasting solution to the problem of international terrorism is to be achieved. This paper will review the nature of these differences beginning with the definition of terrorism. Additionally the nature of the Global Terrorist Threat will be reviewed as well as Yemen's strategic requirements for effectively supporting the United States in defeating that threat. The paper concludes with an assessment of the Yemen - United States

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relationship in the fight against terrorism and a series of policy recommendations for both Yemen and the United States centering on international security and economic aspects of the War on Terror. Abstract Classification: Unclassified Technical Reports Collection. Strategy research project. DTIC: ADA424190. URL: <http://handle.dtic.mil/100.2/ADA424190>.

Army War Coll Carlisle Barracks PA and Al-Saud, Fahad. 2000. "Saudi Relations with its Main Contiguous Neighbors." 14 Mar. Page(s): 29 Report Number: XA-USAWC Monitor Series: USAWC. Abstract: Saudi Arabian relations with the outside world are predicated on set of basic principles or factors. They include Islamic values, Arab heritage, geographic continuity, reciprocal respect, and national interest. Therefore any assessment of Saudi Arabian relations must be looked at from this perspective. In our discussion of Saudi Arabian relations with its main neighbors (Yemen, Iran, Iraq, and Jordan), I have shown how influential those factors are in shaping and directing Saudi Arabian policy with those countries in particular and the world in general. This paper will not discuss Saudi relations with other Gulf Co-operation Council (GCC) members since Saudi Arabia is an integral part of GCC and any problems between it and other GCC members do not rise to the level of threat and are solved diplomatically and in a brotherly manner. Saudi Arabian policy makers hope that the outcome of these bilateral relations will be regional security and political stability, respect of national sovereignty, recognized boundaries, normal relations in all fields, and non-interference in internal affairs with each other. In sum the ultimate objective of Saudi Arabia is the preservation of its national security, but diplomacy must be accompanied by the will and real determination to advance and defend this interest. This primarily can be achieved through self-reliance and trustworthy friends and allies. Abstract Classification: Unclassified Technical Reports Collection. DTIC: ADA377948. URL: <http://handle.dtic.mil/100.2/ADA377948>.

Army War Coll Carlisle BARRACKS PA and Crawford, David. 2005. "Should the United States Increase its Engagement with Eritrea?" 18 Mar. Page(s): 31 Report Number: XA-USAWC Monitor Series: USAWC. Abstract: This paper will discuss Eritrea's history, historical and current relationship with the United States (U.S.), and those elements of U.S. national power that should be used in a future strategy concerning Eritrea. The Horn of Africa is becoming increasingly important to the National Security Strategy of the United States. The region is one that directly affects U.S. objectives in the global war on terrorism (GWOT) and regional stability. The U.S. is very much engaged diplomatically, economically and militarily in Ethiopia, Sudan, Djibouti, and Yemen. However, Eritrea receives less than adequate attention in its importance to regional stability or its impact on U.S. national security interests and objectives. Eritrea has a history of affecting whether or not the U.S. accomplishes its objectives in the region. Eritrea is struggling with significant internal developmental issues but wants to be a participant in the GWOT. The transitional government has become authoritarian. Its heavy handedness has often resulted in the loss of freedom of expression and representation in the country. The economic and humanitarian situations are just as dire. Additionally, there is the growing possibility of a terrorist organization supported by Al Qaeda attempting to turn the country into an Islamic state. Eritrea is important to the U.S. because it is a key ally in the GWOT, is critical in maintaining regional stability, and could provide the U.S. access to the Red Sea. The U.S. has the opportunity to assist Eritrea in developing democratic values through the example of the U.S. military. Without a stable and productive Eritrea there will not be peace in the region, the U.S. will not have an Eritrean ally in the GWOT nor have the access Eritrea provides to the Red Sea Basin. Without U.S. support in general and military support in particular, Eritrea is likely to become an authoritarian state and search for support from countries

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not friendly toward the U.S. Abstract Classification: Unclassified Technical Reports Collection. This document is not available from DTIC in microfiche. DTIC: ADA432733. URL: <http://handle.dtic.mil/100.2/ADA432733>.

Army War Coll Carlisle Barracks PA and Mahrouki, H. S. H. 1986. "Oman's Role in the Strategic Balance," Apr. Page(s): 25. Abstract: This paper touches upon the explosive Persian Gulf area and Oman's critical importance to United States strategic interests. Guardian of the Straits of Hormuz, Russia looks with covetous eyes upon Oman from South Yemen, its surrogate to the south, and from Afghanistan and its staging area to the north. This paper touches upon Oman's geographical, historical, religious, economic, and internal significance as the lynch-pin to both the export of oil from the region and import of raw materials into the region. Additionally, this paper addresses the aggressive nature of its neighbor to the south--South Yemen--and its role as a staging area for both Russian and Cuban military adventures. Abstract Classification: Unclassified Technical Reports Collection. DTIC: ADA167346.

Army War Coll Carlisle Barracks PA and Pohland, Eric A. 2002. "The Global War on Terrorism: Is Where Next really the Right Question?" 09 Apr. Page(s): 31 Report Number: XA-USAWC Monitor Series: USAWC. Abstract: The devastating attacks of modern terrorism have necessitated a new national and international posture: responding to terrorism as war. This is the case in the current U.S. led war in Afghanistan, and the successes there have resulted in a great deal of media coverage and speculation on where the U.S. will attack next for 'phase-two' in the war on terrorism. The areas most frequently indicated for this phase-two include: Iraq, Somalia, Pakistan, Yemen, Philippines and Colombia. But a review of the proposed military actions in these countries reflect little in-depth analysis or justification to truly provide serious debate or recommendations required to win the war against terror. This is primarily due to the fact that the vast preponderance of the discussion on a next phase in the war has centered strictly on U.S. military actions, with virtually no attention to U.S. national interests or policy in a manner - equating to a full strategic analysis. Fortunately there are tools and methodologies for just such an analysis. These include criteria on which to base a 'phase-two' decision, as well as a strategic framework on which to build an analysis. That framework is provided succinctly by the Army War College in its 'ends, ways, and means' paradigm. Inclusive in this framework is a presentation of the elements of national power and-their applicability to strategic analysis of national issues. Asking 'where next' for the U.S. military may be a great media ploy, but it will be of little avail in enhancing long-range U.S. interests. It is rather in a strategic context that we need to address the war on terrorism. Abstract Classification: Unclassified Technical Reports Collection. DTIC: ADA402065. URL: <http://handle.dtic.mil/100.2/ADA402065>.

Army War Coll Carlisle Barracks PA and Saleh, Taiseer. 2006. "Yemen National Strategy to Combat Global Terrorism." 15 Mar. Page(s): 11 Report Number: XA-USAWC Monitor Series: USAWC. Abstract: The recent terrorists' acts committed in the Republic of Yemen present a dangerous challenge to the government. The terrorists plan to shake up the pillars of security, stability, and social peace. The terrorists intended to place Yemen among the areas targeted in the world's fight against terrorism. The Republic of Yemen, a member of the international community and the United Nations, denounces and rejects terrorism; and has a national strategy to combat it. Terrorism is alien to Muslim Yemen, society and contradicts its deeply-rooted and noble traditions and values. This paper discusses the history of terrorism in Yemen and examines the national strategy to address it. This examination concludes that the Republic of Yemen has the will and a viable strategy but requires international resources to

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combat terrorism. Abstract Classification: Unclassified Technical Reports Collection. DTIC: ADA448617. URL: <http://handle.dtic.mil/100.2/ADA448617>.

Army War Coll Strategic Studies Inst Carlisle Barracks PA and Pelletiere, Stephen C. 1996. "Yemen and Stability in the Persian Gulf: Confronting the Threat from within." 22 May. Page(s): 53 Report Number: ACN-96014 XA-AWC/SSI Monitor Series: AWC/SSI. Abstract: The author examines the recent eruption of hostilities between Yemen and its neighbor, Saudi Arabia. He describes how the two countries have come to be so alienated from each other, and suggests ways in which Yemen could be assisted economically and also how tensions between it and Saudi Arabia could be relaxed. If Yemen and Saudi Arabia were to get into a real shooting war, the author concludes, this could have significant adverse repercussions for the welfare of American strategic interests in the Persian Gulf. Abstract Classification: Unclassified Technical Reports Collection. DTIC: ADA309435. URL: <http://handle.dtic.mil/100.2/ADA309435>.

Arnold, Guy. 1995. Wars in the Third World since 1945. London: Cassell. Page(s): 670. ISBN: 0304316717; 9780304316717. OCLC: 28115908.

Arthur, Max. 1990. Men of the Red Beret: Airborne Forces 1940-1990. London: Hutchinson. Page(s): 430. Abstract: The books by Arthur, Norton and Thompson all give a brief glimpse of operations by the Paras during the Aden conflict. Notes: xviii, 430 p. [16] p. of plates: ill., maps, ports. 24 cm. Includes index. ISBN: 0091739314. OCLC: 20964768.

Arya, A. Srivastava, L. and Gupta, S. 1985. Survey of Damages during the Dhamar Earthquake of 13 December 1982 in the Yemen Arab Republic. Seismological Society of America. Bulletin of the Seismological Society of America. Volume: 75, no. 2, page(s): 597-597-610. Abstract: The Dhamar province was shaken on Dec. 13, 1982, by a moderate earthquake. This paper describes the damage to houses and other structures and the observed ground fissures, rock falls, and landslides. An isoseismal map of the earthquake-damaged area is presented. ISSN: 0037-1106.

Arya, A. Srivastava, L. and Gupta, S. 1984. Damages during Dhamar Earthquake of December 13, 1982, in Yemen Arab Republic. Bulletin of the Indian Society of Earthquake Technology. Volume: 21, no. 4, page(s): 115-162. Abstract: This moderate earthquake caused considerable loss of life and different degrees of damage to the traditional houses in the Dhamar province of Yemen, in particular to the most prevalent form of construction, stone masonry and adobe. The destruction of these houses is ascribed to failure of superstructures rather than movement of foundations. Damage features such as ground ruptures, failure of dry packed stone retaining walls, rock falls, and rupture of stone on hillsides are described, along with the collapse of an above-ground reinforced concrete water tank. An isoseismal map of the the damaged area is presented. Database: Technology Research Database. ISSN: 0019-6371. OCLC: 7706445.

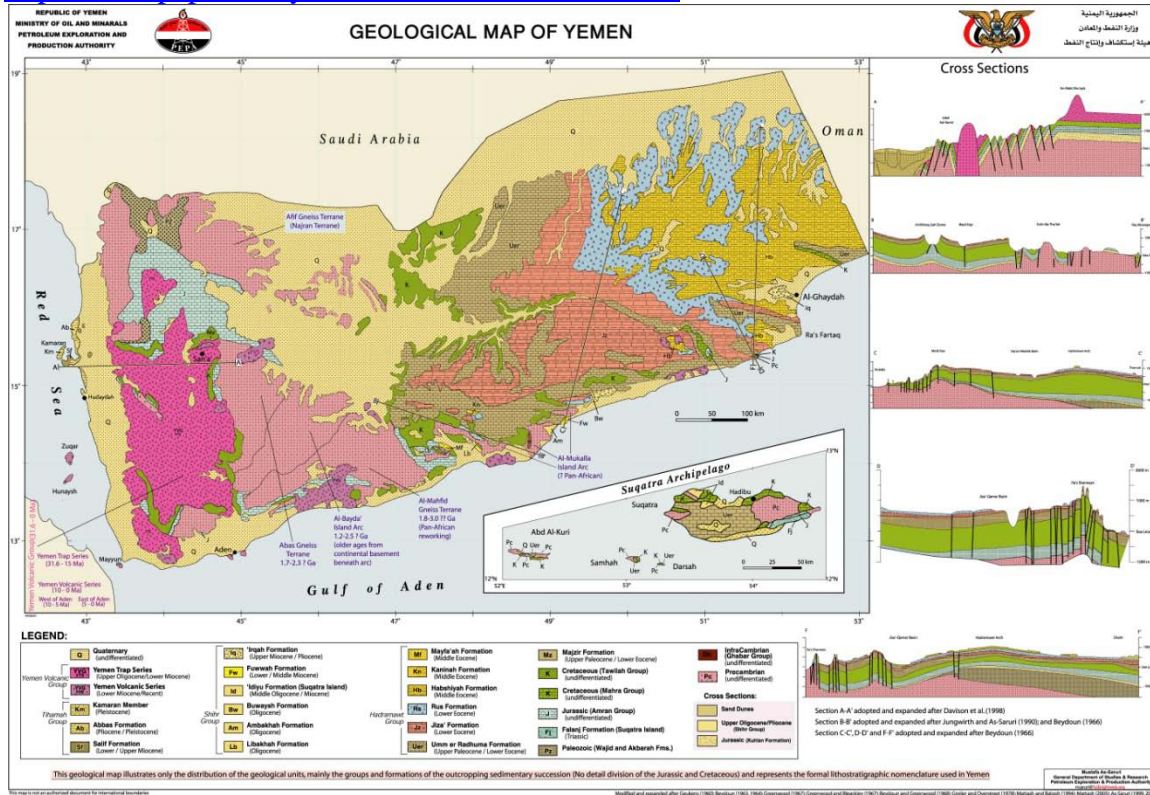
"Asia." 2008. Earth Island Journal. Earth Island Institute: Summer2008. Volume 23, Issue 2, Pages 5-8. Descriptors: Environmentalism; Aquifers; Water-supply. Abstract: This article presents environmental news from Asian nations. Freshwater aquifers in Yemen are being depleted more rapidly than they can be replenished by rainfall, leading some to speculate that a disaster is inevitable. Water shortages have resulted in health problems for citizens and have forced many to move out of the capital. ISSN: 1041-0406.

`Aslan, `Abd al-Wahhab Muhammad. 2000. Ghuyul San`a: Dirasah Tarikhiyah Athariyah Wathaiqiyah. Dimashq, Suriyah; Bayrut, Lubnan: Dar al-Fikr; Dar al-Fikr al-Mu`asar. Page(s): 264. Descriptors: Waterworks -- Yemen (Republic) -- San`a; Irrigation engineering -- Yemen (Republic) -- San`a; Water-supply engineering -- Yemen (Republic) -- San`a. Notes: ill., maps, facsim. 24 cm. Note(s): Includes bibliographical references (p. [171]-186). Responsibility: `Abd

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al-Wahhab Muhammad `Aslan. ISBN: 1575477491; 9781575477497. OCLC Accession Number: 45931756; 646500390.

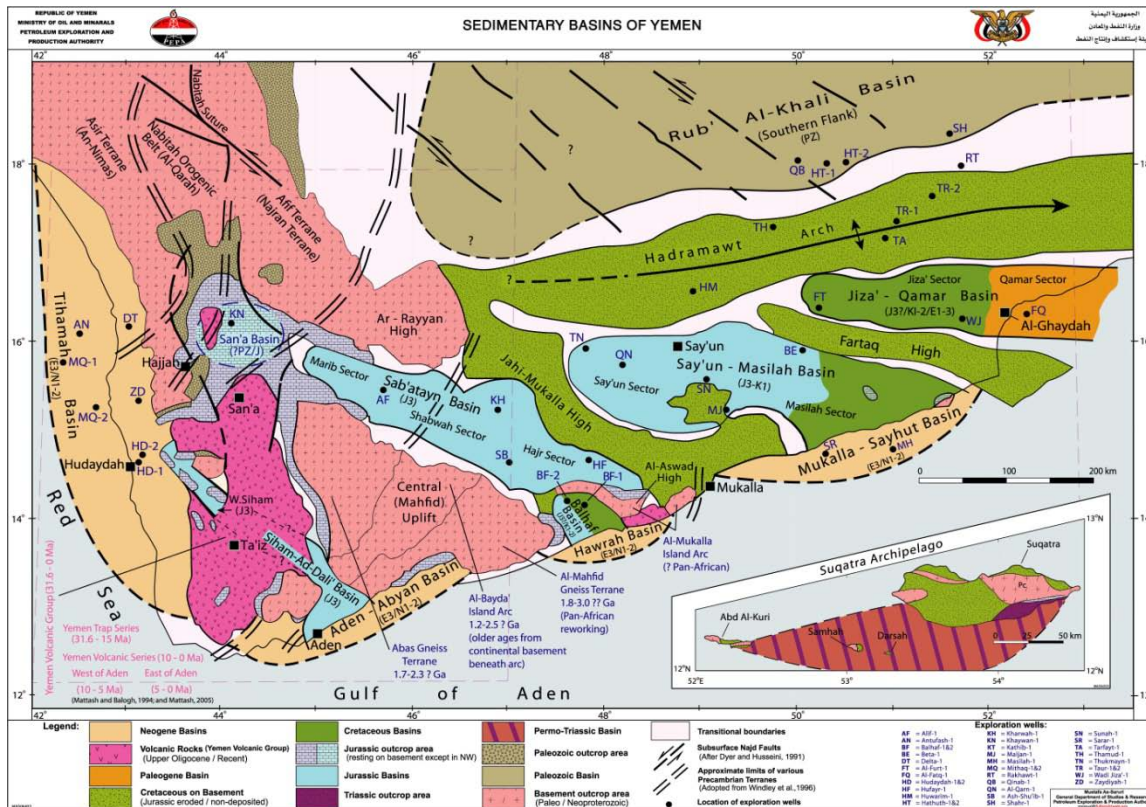
As-Saruri, Mustafa. 2007. Geologic Map of Yemen. Republic of Yemen Ministry of Oil and Minerals Petroleum Exploration and Production Authority (PEPA). "This geological map illustrates only the distribution of the geological units, mainly the groups and formations of the outcropping sedimentary succession (No detail division of the Jurassic and Cretaceous) and represents the formal lithostratigraphic nomenclature used in Yemen." No scale given. URL: <http://www.pepa.com.ye/Downloads/downloads.htm>



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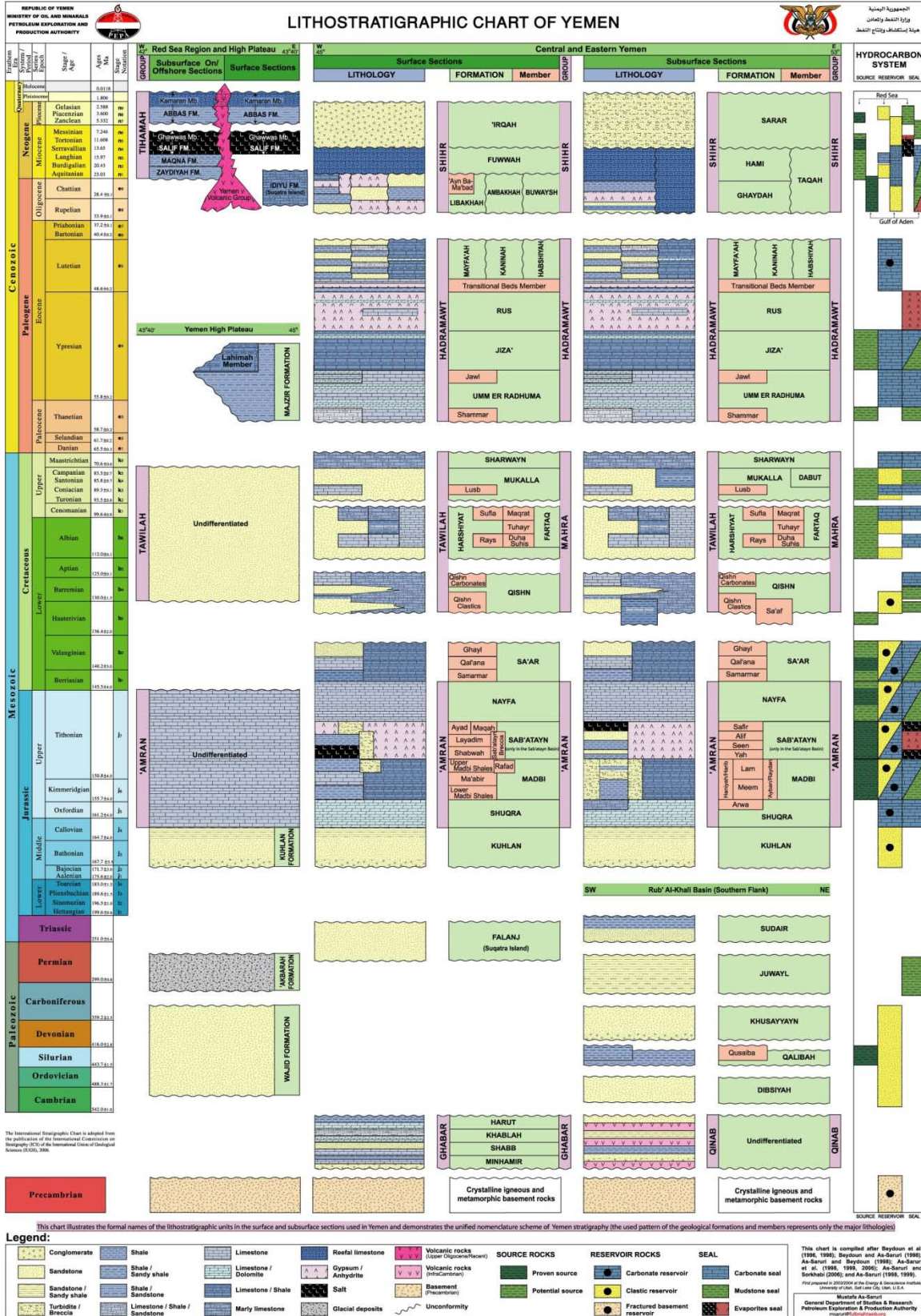
As-Saruri, M. 2007. Sedimentary Basins of Yemen. Republic of Yemen Ministry of Oil and Minerals Petroleum Exploration and Production Authority (PEPA). Modified and expanded after Beydoun et al. (1996, 1997, 1998); Beydoun and As-Saruri (1998); As-Saruri et al. (2006) and As-Saruri and Sorkhabi (2006). URL:

<http://www.pepa.com.ye/images/geology/BasinMap.pdf>



As-Saruri, M. 2007. Sedimentary Basins of Yemen. Republic of Yemen Ministry of Oil and Minerals Petroleum Exploration and Production Authority (PEPA). This chart is compiled after Beydoun et al. (1996, 1998); Beydoun and As-Saruri (1998); As-Saruri and Beydoun (1998); As-Saruri et al. (1998, 1999, 2006); As-Saruri and Sorkhabi (2006) and As-Saruri (1998, 1999). This chart illustrates the formal names of the litho-stratigraphic units in the surface and subsurface sections used in Yemen and demonstrates the unified nomenclature scheme of Yemen stratigraphy (the used pattern of the geological formations and members represents only the major lithologies). URL: <http://www.pepa.com.ye/images/geology/LithoStra.pdf>

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Assessment of Water Resources Situation in the ECWA Region. 1981. Beirut: UN. Page(s): 290. Descriptors: Water Resources; Resources Inventories; Hydrogeology; Regional Cooperation; Western Asia; Bahrain; Democratic Yemen; Iraq; Jordan; Kuwait; Lebanon; Oman; Qatar; Saudi Arabia; Syrian Arab Republic; United Arab Emirates; Yemen; Government publication; International government publication. Notes: xvi; graphs, maps, tables. Note(s): At head of title: Water programme. Bibliography: p. 284-290. OCLC Accession Number: 81732015.

`Atrus, `Ali Sa`d. 2000. Al-Miyah Al-Jawfiah. San`a: page(s): 231. Descriptors: Groundwater -- Yemen (Republic); Water-supply -- Yemen (Republic). Notes: illustrations, maps; 25 cm. Other Titles: Groundwater; Responsibility: talif `Ali Sa`d `Atrus. OCLC Accession Number: 84655475.

Attaala, AM and Rubaia, BS. 2005. "First Record of the Eel *Anguilla Bengalensis* from Arabia with Notes on Freshwater Fishes from Hadhramout, Yemen." Zool. Middle East. 35-44. Volume 34, Pages 35-44. Descriptors: Article Subject Terms: Community composition; Freshwater fish; Geographical distribution; Inland water environment; Introduced species; New records; Article Taxonomic Terms: *Anguilla bengalensis*; *Awaous*; *Barbus*; *Garra*; *Oreochromis mossambicus*; Article Geographic Terms: Middle East; Yemen, Hadhramout; Mozambique mouth-breeder; Freshwater. Abstract: The relatively rich freshwater fauna of Wadi Hajr in southeastern Yemen is studied, and details on the diagnostic characteristics of two newly recorded eel species, *Anguilla bengalensis* and *A. bicolor*, are given. *A. bengalensis* is the first record for the Arabian Peninsula; specimens collected apparently belong to the subspecies *labiata*. Information is also given on four other freshwater fishes new to Yemen or to Wadi Hajr: *Garra tibonica*, *Barbus exulatus*, and *Awaous aeneofuscus* as autochthonous occurrences, and *Oreochromis mossambicus* as an introduced species. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0939-7140.

Attorre, Fabio, Francesconi, Fabio, Taleb, Nadim, et al. 2007. "Will Dragonblood Survive the Next Period of Climate Change? Current and Future Potential Distribution of *Dracaena Cinnabari* (Socotra, Yemen)." Biol. Conserv. 9. Volume 138, Issue 3-4, Pages 430-439. Descriptors: Bioclimatic model; Climate change; *Dracaena cinnabari*; Regression tree analysis; Socotra island; Yemen. Abstract: The potential impact of climate change on *Dracaena cinnabari*, a spectacular relict of the Mio-Pliocene Laurasian subtropical forest in Socotra (Yemen), was analysed. Current distribution, abundance and vertical structure of *D. cinnabari* populations were assessed with 74 plots in nine remnant areas. A deterministic regression tree analysis model was used to examine environmental variables related to the current species distribution. Using this model, a current potential map and a predicted potential map for the ~2080 climatic scenario were generated. *D. cinnabari* has an altitudinal range from 323 to 1483 m a.s.l., with a mean annual temperature of 19.8–28.6 °C and an annual precipitation of 207–569 mm. The current distribution and abundance of *D. cinnabari* is correlated to three factors: moisture index (i.e. the ratio between the annual precipitation and potential evapotranspiration), mean annual temperature and slope. According to this model, *D. cinnabari* occupies only 5% of its current potential habitat. This potential habitat is expected to be reduced with 45% by 2080 because of a predicted increased aridity. Only two out of the nine remnant areas should be considered as potential refugia. The boundaries of the strictly protected Skund Nature Sanctuary, where no (road) infrastructure is allowed, should be extended to include both areas. The construction of new roads leading towards these areas, thereby increasing permanent settlements and grazing pressure, should also be discouraged. ISSN: 0006-3207.

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Aust, Horst. 1994. "Groundwater from Volcanic Rocks; Problems of Groundwater Development and Groundwater Quality as Illustrated by an Example from Yemen." *Natural Resources and Development. Institut fuer Wissenschaftliche Zusammenarbeit: Bundesanstalt fuer Bodenforschung, Tubingen, Federal Republic of Germany Federal Republic of Germany.* Volume 39, Pages 61-76. Descriptors: agriculture; alkali basalts; Arabian Peninsula; Asia; basalts; drilling; erosion; igneous rocks; irrigation; mugearite; northern Yemen; potability; pump tests; rhyolites; semi-arid environment; soil erosion; soil management; soils; terrestrial environment; trachytes; volcanic rocks; Wadi Shadb; water management; water quality; water resources; Yemen. Notes: References: 21; illus. incl. sect., 2 tables, geol. sketch maps. Database: GeoRef. ISSN: 0340-2797.

Aust, Horst. 1993. "Grundwasser Aus Vulkaniten; Erschliessungs- Und Qualitaetsprobleme, Dargestellt Anhand Eines Beispiels Aus Dem Jemen. Groundwater from Volcanic Rocks; Problems of Groundwater Development and Groundwater Quality Illustrated by an Example from Yemen." *Geologisches Jahrbuch.Reihe A: Allgemeine Und Regionale Geologie BR Deutschland Und Nachbargebiete, Tektonik, Stratigraphie, Palaeontologie. Schweizerbart in Komm., Stuttgart, Federal Republic of Germany Federal Republic of Germany; Stratigraphie, Palaeontologie.* Volume 142, Pages 217-232. Descriptors: alkali metals; Arabian Peninsula; Asia; Cenozoic; electrical conductivity; fluoride ion; fluoride; geochemistry; ground water; halogens; hydrochemistry; igneous rocks; irrigation; medicinal waters; metals; potability; pump tests; sodium; Tertiary; volcanic rocks; water quality; water wells; wells; Yemen. Notes: References: 21; illus. incl. sect., 2 tables, geol. sketch map. Database: GeoRef. ISSN: 0341-6399.

"Austal to Build Patrol Boats for Yemen." 2003. *MER - Marine Engineers Review.* Institute of Marine Engineering, Science and Technology: Pages 48. Descriptors: Marine engineering; Aluminum; Boats; Hulls (ship). Abstract: Austal Ships in Australia has been selected to build a fleet of ten high-speed patrol boats for the Republic of Yemen. Based on a proven hull form, and built to commercial standards, the 37.5m aluminium monohulls will, said Austal, 'provide the level of capability the Yemenis require in a reliable, simple to operate vessel that is easy to maintain'. The entire package for the patrol boats, including training, will cost the Yemen authorities some US\$55M. The patrol boats will provide what the company describes as a 'budget-conscious' solution to a set of operational requirements that is common to many nations, including general police missions in coastal waters; customs control and anti-terrorist operations at sea; offshore protection and tracking; surveillance of the Exclusive Economic Zone; defence and protection of national sea areas; and operations within integrated task forces. ISSN: 0047-5955.

Ayele, Tewodros and Al Shadily, Saad A. 2000. "Some of the Engineering Geological and Hydrogeological Problems and Conditions of Ethiopia and Yemen." *Acta Geologica Universitatis Comenianae (Bratislava).* Univerzita Komenskeho, Bratislava, Slovak Republic. Volume 55, Pages 51-62. Descriptors: Africa; agriculture; altitude; aquifers; Arabian Peninsula; Asia; Blue Nile Basin; Cenozoic; climate; cracks; Dessie Ethiopia; drawdown; East Africa; engineering properties; Ethiopia; evapotranspiration; floods; geologic hazards; ground water; hydrology; irrigation; land use; landslides; levels; mass movements; potability; Quaternary; rainfall; suffosion; surface water; Uba Dema Ethiopia; water management; water quality; water resources; water table; Yemen. Abstract: The paper deals with the general information about the two countries studied (Ethiopia and Yemen), and presents the climatic and orographic situation of these areas. After dealing briefly about the geology, the engineering geological and hydrogeological conditions will be discussed. In more recent times the sensitivity of both the

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public and administrative bodies to events like, suffosion, landslides, the scarcity of water (caused by the population increase and the exploitation of lot's of water for irrigation purposes) increased as more and more people and infrastructure are highly and considerably affected. These geodynamic events and hydrogeological problems will be presented. Database: GeoRef. ISSN: 1335-2830.

Azazy, A. A. and Raja'a, Y. A. 2003. "Malaria and Intestinal Parasitosis among Children Presenting to the Paediatric Centre in Sana'a, Yemen." *East. Mediterr. Health J.* Volume 9, Issue 5-6, Pages 1048-1053. Notes: Cited By (since 1996): 3. Abstract: We studied the profile of malaria and intestinal parasitosis among children presenting to the Paediatric Health Centre in Sana'a from January 1998 to December 2000. In stool samples from 9014 children, *Ascaris lumbricoides*, *Entamoeba histolytica*, *Giardia lamblia* and *Trichuris trichiura* were the most common. Infection with parasites of direct life-cycle were similar in boys and girls. Schistosome infection was significantly higher in boys than girls, but girls were more infected with ascariasis. The only species of malaria parasite found in blood samples from 753 children with suspected malaria was *Plasmodium falciparum*, with the highest rates in April-June. The majority of positive cases were Yemeni children, but 10.8% were Sudanese or Ethiopian. Database: SCOPUS. ISSN: 1020-3397.

Aziz, G. M. Abdull and Mukbel, M. A. 1994. "Thermal Performance of Solar Water Heater System in Yemen." *Renewable Energy.* Volume 4, Issue 2, Pages 241-247. Descriptors: Solar radiation; Cost accounting; Energy management; Solar collectors; Solar water heaters. Abstract: A thermosiphonic solar water heating system was designed and fabricated from available materials. The risers of galvanized iron are fixed to an aluminium absorber plate by using an Omega-in and Omega-out technique. The collector absorber has an aperture area of 127 cm × 91 cm and is connected to a storage tank with 124 l capacity. The system was then tested under the climatical conditions of Aden City. The performance of characteristics of the system, under 'nondrawn off' and 'drawn off' hot water conditions, are experimentally determined and then compared with the theoretical results. The results are quite satisfactory. The maximum efficiency reached 79%, with mean storage tank temperature of 60C. ISSN: 0960-1481. URL: [http://dx.doi.org/10.1016/0960-1481\(94\)90010-8](http://dx.doi.org/10.1016/0960-1481(94)90010-8).

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Baban, R. and Ali, M. A. 2001. "The Effect of Introducing Pipelines into Irrigation Water Distribution Systems on the Farm Economy: A Case Study in the Southern Governorates Rural Development Project, Republic of Yemen." *Irrig. Drain.* Volume 50, Issue 1, Pages 41-52. Descriptors: Groundwater; Irrigation; Pipelines; Yemen. Abstract: The Southern Governorates Rural Development Project (SGRDP) is a comprehensive participatory rural development project covering three of the five southern Governorates of the Republic of Yemen, namely Hadramaut, Abyan and Lahij. Its objective is to alleviate poverty in rural areas of these three Governorates. A major component of the project is to develop virgin lands for agriculture and allocate each 5 feddan (FD) plot to those farmers who do not own land (1 FD = 4200 m²). As the annual rainfall in the project area is less than 100 mm and since landlords and other farmers already own lands suitable for agriculture in the major wadis, the only source of irrigation water in the newly developed land is the groundwater (GW). The SGRDP is aware of the scarcity of water resources in the country, particularly in the project area; it therefore makes every possible effort to optimize the use of GW for irrigation by practical means. One way of reducing GW used for irrigation is by replacing major canals in the farms by buried pipelines. This method has been tried in small-scale individual farms outside the project area and it proved that farmers could adapt to the system without difficulty. Sprinkler and drip irrigation systems have been tried in many previous agricultural development projects in the country but with no apparent success, as far as the farmers' adoption of the method is concerned. Thus, the project, as the first stage to reduce the use of GW for irrigation in the newly developed areas, planned to eliminate, initially, the conveyance losses by replacing the open canals by buried PVC pipes. In this paper, it is attempted to show that the use of buried pipes in small scale irrigation schemes is financially feasible, even if the indirect and non-tangible environmental benefits are not considered. This paper deals only with special GW schemes recommended for the project area; however, the outcome could be generalized and applied elsewhere in the country. Database: SCOPUS. ISSN: 1531-0353.

Badertscher, SV; Scheidegger, Y. Leuenberger, M., et al. 2007. Trace Gas Content in Air Inclusions in Speleothems as New Paleoenvironmental Archive? *Geophysical Research Abstracts*. [np]. Descriptors: Article Subject Terms: Air quality; Atmospheric composition; Carbon dioxide; Carbon dioxide sources; Carbon isotopes; Copper; Environmental conditions; Gases; Greenhouse gases; Humidity; Ice; Ice core analysis; Mass spectrometry; Methane; Methane in the atmosphere; Microscopy; Oxidation; Oxidation of methane; Oxygen isotopes; Paleoclimates; Soil; inspection; paleoclimate; Article Geographic Terms: Yemen, Socotra. Abstract: In a companion abstract (Scheidegger et al. 2007) we report a pilot study to extract paleoclimate information from noble gases dissolved in water-bearing inclusions in speleothems. Here, we report the first attempt to use also the air trapped in the water-free inclusions from the same speleothemes for paleoenvironment reconstructions. Based on microscopy inspection we concentrated on a stalagmite from Socotra (Yemen). We clearly could optically distinguish air from water inclusions. The assessed amount of air inclusions is about 3% by volume. Samples of 1-2cm super(3) of a recent (< 50y) and an old (similar to 2000y) section of the stalagmite were crushed under vacuum in a copper tube. The released gases (being predominantely from air inclusions) were analysed by dynamic mass spectrometry. Fractional abundances of the major gas components - N sub(2), O sub(2) and Ar - were found to be atmospheric within the experimental precision of a few percent. However, CO sub(2) was clearly in excess by 2-10 times relative to atmospheric composition. Similarly, methane concentrations (200-600ppm)

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exceeded atmospheric values by 2 to 3 orders of magnitude. In addition, part of the samples were even enriched in N sub(2)O. Hence all major atmospheric greenhouse gases - CO sub(2), CH sub(4) and N sub(2)O - could be determined and quantified in air inclusions of speleothems. Further, we analysed the isotopic composition of the CO sub(2) of the trapped air by a GC-MS technique commonly used for trace gas analysis in ice cores. In a recent sample a delta super(13)C value of -39.4‰, V-PDB and a delta super(18)O value of -7.5‰, V-PDB were observed, whereas an old sample showed a delta super(13)C value of -28‰, V-PDB and delta super(18)O of -6‰, V-PDB. The observed light isotopic compositions point either towards a biogenic carbon dioxide source or an oxidation of methane with low delta super(13)C to CO sub(2). The CO sub(2) results suggest that air inclusions in stalagmite crystals can be used to assess the characteristics of the overlying soil (e.g. productivity, humidity etc.) and its evolution in time. In summary, this pilot study is a first convincing step to assess the suitability of air inclusions in speleothems as another high quality archive to reconstruct past local environmental conditions. Notes: NU: 06252. ISSN: 1029-7006. Database: Meteorological & Geostrophysical Abstracts. OCLC: 8802679.

Bagenholm, G., Kristiansson, B. and Nasher, A. A. A. 1987. "Child Feeding Habits in the People's Democratic Republic of Yemen. I. Breast and Bottle Feeding." *J. Trop. Pediatr.* August 1. Volume 33, Issue 4, Pages 208-212. Abstract: Breast and bottle-feeding among 86 urban, 132 slum, and 747 rural children below 2 years of age in the People's Democratic Republic of Yemen (PDR Yemen) were studied in 1982-83 using current status method. Most mothers began by breast feeding, but a rapid decline was seen, especially in the urban and slum populations with a concomitant high prevalence of bottle feeding. The median duration of breast feeding was 6.5, 10, and 14 months among urban, slum, and rural mothers, respectively. The prevalence of exclusive breast feeding of infants below 3 months of age was significantly higher ($P < 0.05$) in the rural setting compared to both urban and slum areas, and prolonged exclusive breast feeding was only found, though rarely, in rural areas. Rural and slum mothers with suckling infants below 6 months of age tended to state 12 months as the optimal length of breast feeding, whereas mothers with older infants more often stated 2 years. Few mothers used cow's milk formula in the proper concentration and amount. ISSN: 1465-3664.

Bagenholm, G., Kristiansson, B. and Nasher, A. A. A. 1987. "Child Feeding Habits in the People's Democratic Republic of Yemen. II. Supplementary Foods and Weaning Patterns." *J. Trop. Pediatr.* October 1. Volume 33, Issue 5, Pages 278-283. Abstract: The use of supplementary foods among 86 urban, 132 slum, and 747 rural children below 2 years of age in the People's Democratic Republic of Yemen (PDR Yemen) has been surveyed. The very first supplementary food introduced was biscuits, which were given from before 3 months of age in slum areas. Biscuits were considered by mothers to be very suitable for the youngest infants and these new products fit into the traditional Yemeni food classification as beneficial for growth and strengthening of the body'. Commercial baby food was used predominantly in the urban areas and because of convenience. It was often considered superior to home made food. Family food was introduced at a median age of 8.5, 7, and 11 months among urban, slum, and rural children, respectively. Most mothers believed that the supplementary food given was adequate and that their children were thriving normally. However, 4-35 per cent of mothers expressed concern about their children's thriving. The mothers thought that the supplementary food given was the maximum possible because of either the volume, or financial constraints, or her perceiving the amount to be quite adequate. Considerable differences were found between urban and rural

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mothers. Half of the mothers who had experienced food rejection from the child tried to compensate by increasing the frequency of feeding. ISSN: 1465-3664.

Bagnold, R. A. 1951. "Sand Formations, Southern Arabia." *Geographical Journal*. Volume 117, part 1, pages 78-86.

Bain, Chris J. 2007. *Cold War Hot Wings*. Barnsley: Pen & Sword Aviation. Page(s): 318. Abstract: Memoirs of a Cold War fighter pilot 1962-1994. Notes: xxvii, 318 p., [40] p. of plates: ill. 24 cm. ISBN: 9781844155750. OCLC: 124977832.

Baker, J. A., Macpherson, C. G., Menzies, M. A., Thirlwall, M. F., Al-Kadasi, M. and Matthey, D. P. 2000. "Resolving Crustal and Mantle Contributions to Continental Flood Volcanism, Yemen; Constraints from Mineral Oxygen Isotope Data." *J. Petrology*. December 1. Volume 41, Issue 12, Pages 1805-1820. Abstract: Oxygen isotope ratios determined by laser fluorination analysis on olivine, clinopyroxene and plagioclase separated from 31 Oligocene flood basalts and rhyolites from Yemen display small but significant variations (5 ± 1 ‰ for olivine; 5 ± 5 ‰ for clinopyroxene; 5 ± 9 ‰ for plagioclase). The range in $\delta^{18}\text{O}$ values exceeds: (1) the analytical reproducibility of the technique (± 0.15 ‰; 2 SD); (2) the range expected for minerals that would have crystallized from uncontaminated oceanic basalts or primary magmas in equilibrium with mantle peridotite; (3) the range in melt values and equilibrium phenocryst compositions that could be produced by fractional crystallization of these magmas. Samples with the highest $\delta^{18}\text{O}$ values exhibit increases in $^{87}\text{Sr}/^{86}\text{Sr}$ ratio, decreases in $^{143}\text{Nd}/^{144}\text{Nd}$ ratio, and increasing Pb isotopic heterogeneity. Samples with the lowest $\delta^{18}\text{O}$ values have radiogenic isotope ratios that approach those inferred for the Afar plume. The oxygen isotope data provide unequivocal evidence that assimilation of heterogeneous lower and upper Pan-African crust was the primary control on isotopic variation in this continental flood basalt province. Moreover, new radiogenic and oxygen isotope data for Pan-African crustal samples from Yemen have appropriate crustal isotopic compositions to generate the observed isotopic variations in the volcanic rocks. A near-primary high-MgO basalt with low ϵ_{Nd} and extreme Pb isotope ratios contains strongly zoned clinopyroxene crystals that range from green cores through to greenish brown, brownish green and dark brown or black rims. Handpicked crystals of each colour type display the following correlated range in isotope ratios: $^{87}\text{Sr}/^{86}\text{Sr} = 0.7036\text{--}0.7049$; $^{143}\text{Nd}/^{144}\text{Nd} = 0.5129\text{--}0.5127$; $^{206}\text{Pb}/^{204}\text{Pb} = 18.6\text{--}17.9$; $\delta^{18}\text{O} = 5.6\text{--}6.8$ ‰. The Sr-Nd-Pb-O isotope variations are attributed to rapid assimilation of $\sim 25\%$ Pan-African continental crust by hot mafic magma during clinopyroxene crystallization. Contamination in this flood basalt province varied from combined assimilation and fractional crystallization to rapid assimilation of crust by hot mafic magmas with little fractionation. Laser fluorination oxygen isotope analysis of mineral separates allows small differences in $\delta^{18}\text{O}$ to be correlated with radiogenic isotope data and is a powerful tool for evaluating the relative roles of enriched lithospheric mantle and continental crust in suites of continental flood basalts. ISSN: 1460-2415.

Baker, J. A., Menzies, M. A., Thirlwall, M. F. and MacPherson, C. G. 1997. "Petrogenesis of Quaternary Intraplate Volcanism, Sana'a, Yemen: Implications for Plume-Lithosphere Interaction and Polybaric Melt Hybridization." *J. Petrology*. October 1. Volume 38, Issue 10, Pages 1359-1390. Abstract: Quaternary intraplate volcanism near Sana'a, western Yemen, produced a chemically and isotopically diverse volcanic field. The predominantly mafic

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samples include alkali basalt, transitional basalt, basanite and trachybasalt; rarer evolved compositions are typically trachyandesite. No samples represent primary magmas, all having undergone fractionation of olivine + clinopyroxene {+/-} plagioclase {+/-} Fe-Ti oxides {+/-} apatite. Sr-Nd-Pb-O isotopic variation ($^{87}\text{Sr}/^{86}\text{Sr}=0.7032\text{-}0.7046$; $^{143}\text{Nd}/^{144}\text{Nd}=0.51298\text{-}0.51278$; $^{206}\text{Pb}/^{204}\text{Pb}=18.93\text{-}18.05$; $\{\delta\}^{18}\text{O}=+5.2$ to $+5.5$ {per thousand}) is largely the result of mixing between a mantle component, with a composition intermediate between that of mid-ocean ridge basalt (MORB) and the Afar plume, and 0-20% of an Early Proterozoic or Late Archaean silicic lower-crustal component which produced little change in $\{\delta\}^{18}\text{O}$ values. Ratios of very to moderately incompatible trace elements vary widely (e.g. $\text{Ce}/\text{Y}=0.9\text{-}3.7$) and independently of isotopic composition. Semi-quantitative modelling of REE ratios requires this heterogeneity to be the product of mixing between small melt fractions (<1%) from recently incompatible-trace-element-enriched garnet peridotite facies mantle and relatively larger melt fractions (5%) from spinel peridotite facies mantle, with samples containing 40-90% spinel-facies melt. Substantial variations in Zr/Sm and Nb/La ratios also suggest that the spinel-facies mantle may be amphibole bearing. Intraplate volcanism in western Yemen appears to be the result of melting shallow mantle, perhaps in response to small amounts of lithospheric extension, that was metasomatized and hydrated by the Afar plume during, or shortly after, Oligocene flood volcanism. ISSN: 1460-2415.

Baker, J. A., Thirlwall, M. F. and Menzies, M. A. 1996. "Sr-Nd-Pb Isotopic and Trace Element Evidence for Crustal Contamination of Plume-Derived Flood Basalts: Oligocene Flood Volcanism in Western Yemen." *Geochim. Cosmochim. Acta*. Volume 60, Issue 14, Pages 2559-2581. Notes: Cited By (since 1996): 55. Abstract: Oligocene flood basalts from western Yemen have a relatively limited range in initial isotopic composition compared with other continental flood basalts: $^{87}\text{Sr}/^{86}\text{Sr} = 0.70365\text{-}0.70555$; $^{143}\text{Nd}/^{144}\text{Nd} = 0.51292\text{-}0.51248$ ($\epsilon\text{Nd} = +6.0$ to -2.4); $^{206}\text{Pb}/^{204}\text{Pb} = 17.9\text{-}19.3$. Most compositions lie outside the isotopic ranges of temporally and spatially appropriate mantle source compositions observed in this area, i.e., Red Sea/Gulf of Aden MORB mantle, the Afar plume, and Pan-African lithospheric mantle. Correlations between indices of fractionation, silica, and isotope ratios suggest that crustal contamination has substantially modified the primary isotopic and incompatible trace element characteristics of the flood basalts. However, significant scatter in these correlations was produced by: (a) the heterogeneous isotopic composition of Pan-African crust; (b) the difference in susceptibility of magmas to contamination as a result of variable incompatible trace element contents in primary melts produced by differing degrees of partial melting; (c) the presence or absence of plagioclase as a fractionating phase generating complex contamination trajectories for Sr; (d) sampling over a wide area not representing a single coherent magmatic system; and (e) variation in contamination mechanisms from assimilation associated with fractionation (AFC) to assimilation by hot mafic magmas with little concomitant fractionation. The presence of plagioclase as a fractionating phase in some suites that were undergoing AFC requires assimilation to have taken place within the crust and, coupled with the limited LREE-enrichment accompanying isotopic variations, excludes the possibility that an AFC-type process took place during magma transfer through the lithospheric mantle. Isotopic compositions of some of the inferred crustal assimilants are similar to those postulated by other workers for an enriched lithospheric mantle source of many flood basalts in southwestern Yemen, Ethiopia, and Djibouti. The western Yemen flood basalts contain 0-30% crust which largely swamps their primary lead isotopic signature, but the primary Sr-Nd isotopic signature is close to that of the least contaminated and isotopically most depleted flood basalts. LREE/HFSE and LILE/HFSE ratios also correlate with isotopic data as a

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result of crustal contamination. However, Nb/La and K/Nb ratios of >1.1 and <150 , respectively, in least contaminated samples require an OIB-like source. The pre-contamination isotopic signature is estimated to be: $87\text{Sr}/86\text{Sr} \sim 0.7036$; $143\text{Nd}/144\text{Nd} \sim 0.51292$; $206\text{Pb}/204\text{Pb} \sim 18.4-19.0$. This, coupled with low LILE/HFSE ratios, suggest the source has characteristics akin to the Afar plume. A mantle source isotopically more depleted than Bulk Earth, but not as depleted as MORB, coupled with LILE depletion, also characterises other examples of plume-derived flood volcanism. This mantle reservoir is responsible for the second largest outbursts of volcanism on Earth and has radiogenic isotopic characteristics akin to PREMA mantle, but the incompatible trace element signature of HIMU mantle. Database: SCOPUS. ISSN: 0016-7037.

Baker, Joel; Chazot, Gilles; Menzies, Martin and Thirlwall, Matthew. 1998.

Metasomatism of the Shallow Mantle Beneath Yemen by the Afar Plume-Implications for Mantle Plumes, Flood Volcanism, and Intraplate Volcanism. *Geology*. Volume: 26, no. 5, page(s): 431-431-434. Abstract: Amphibole plus or minus apatite-bearing lherzolite xenoliths from Yemen have Sr, Nd, and Pb isotope ratios that are the same as those of Oligocene flood and Quaternary intraplate basalts in Yemen, and also the Afar plume, which is genetically linked with this volcanism. The xenoliths have mineral, chemical, and isotopic characteristics consistent with enrichment of shallow mantle by carbonatitic melts and hydrous fluids from the Afar plume during or shortly after Oligocene flood volcanism. Separation of carbonatitic melts and hydrous fluids from mantle plumes may affect the composition of erupted flood basalts and is consistent with an origin of such plumes by recycling of oceanic lithosphere. Mantle plumes appear to have volatile fluxes that are large enough to affect solidus temperatures, both within plumes and the overlying lithospheric mantle, during the generation of large igneous provinces. The fertile lithosphere formed by plume-derived melts and fluids is an important potential source for intraplate volcanism that can be exploited by melting during later extension or erosional unloading of the lithosphere. ISSN: 0091-7613. Database: Technology Research Database.

Baker, Joel, Snee, Lawrence and Menzies, Martin. 1996. "A Brief Oligocene Period of Flood Volcanism in Yemen: Implications for the Duration and Rate of Continental Flood Volcanism at the Afro-Arabian Triple Junction." *Earth Planet. Sci. Lett.* 2. Volume 138, Issue 1-4, Pages 39-55. Descriptors: Yemen; Ethiopia; triple junctions; flood basalts; K/Ar; Ar-40/Ar-39; Oligocene. Abstract: $40\text{Ar}/39\text{Ar}$ dating of mineral separates and whole-rock (WR) samples has established that basaltic continental flood volcanism (CFV) began between 30.9 and 29.2 Ma in northwestern and southwestern Yemen, respectively. Rhyolitic volcanism commenced at 29.0–29.3 Ma throughout Yemen. Lower basaltic lavas were erupted every 10–100 kyr, whereas upper bimodal volcanic units were erupted every 100–500 kyr, which reflects generation of rhyolitic magmas from basalts that resided for longer periods in lithospheric magma chambers than during the early phase of exclusively mafic magmatism. The youngest dated flood volcanic units were erupted between 26.9 and 26.5 Ma throughout Yemen. The duration of preserved CFV defined by $40\text{Ar}/39\text{Ar}$ dating (4.4 myr) contrasts with the wide range of WR K/Ar dates previously obtained in Yemen (> 50 myr). $40\text{Ar}/39\text{Ar}$ step-heating studies of WR samples has shown that this discrepancy is due to the disturbed Ar systematics of volcanic samples. Most samples have experienced post-crystallization loss of radiogenic Ar and/or contain excess Ar, with only ca. 25% of the WR K/Ar dates within 1–2 myr of true crystallization ages. WR K/Ar data can be screened for reliability using the radiogenic Ar yield and $40\text{K}/36\text{Ar}$ ratio, which reflect the Ar retentivity of the sample, the likelihood that alteration has disturbed a sample's Ar systematics, and the susceptibility of the sample to a finite amount of Ar loss or the presence of a finite amount of excess Ar. Examination of existing WR K/Ar data in the Ethiopian part of this flood

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volcanic province, using these parameters, suggests that much of these data are also misleading. Two phases of flood volcanism are inferred in Ethiopia and Eritrea at 38-30 Ma and ca. 20 Ma. The older phase is equivalent to that in Yemen, and is consistent with the progression in basal volcanic ages obtained in Yemen moving from north to south. The younger phase is related to the onset of upper crustal extension and incipient Red Sea-Gulf of Aden rifting. The sequence of events — surface uplift (?), flood magmatism and subsequent upper crustal extension — in Yemen is consistent with the involvement of a mantle plume at the Afro-Arabian triple junction. However, the overall eruption rate for this flood volcanic province is only 0.03 km³/yr, much slower than that postulated for other plume-related provinces such as the Deccan or Siberian Traps, but perhaps comparable to the Paraná-Etendeka province, which also contains significant amounts of rhyolitic volcanic products like those of Yemen-Ethiopia. The highly variable eruption rates in individual provinces must reflect the very different character of individual plumes, or the control of lithospheric structure and plate tectonic stresses on the surface manifestations of plumes. The long duration of CFV and large amounts of rhyolitic volcanism at the Afro-Arabian triple junction may be attributed to the relatively slow separation of the African and Arabian plates compared with, for example, the rifting of India and the Deccan Traps. ISSN: 0012-821X.

Bakes, Philip A. Robb, Douglas W. Rasmussen, Christian J. and Tracy, Kevin F. 1996. Horizontal Wells in Yemen make a Marginal Field Economic. Calgary, Alberta, Can: Society of Petroleum Engineers (SPE). Page(s): 215-222. Proceedings of the 1996 2nd International Conference on Horizontal Well Technology, November 18, 1996 - November 20. Conference: 1996. Descriptors: Horizontal wells; Oil bearing formations; Oil field development; Oil well completion; Oil well drilling; Oil well production. Abstract: This paper documents the development of a high permeability, medium-heavy oil, bottom water drive field in Yemen from its discovery through to the staged development of the field using multilateral horizontal wells. The 16.5 MM barrels of reserves in the field are only economic when developed by horizontal drilling due to severe coning from the very active underlying aquifer. Vertical wells in the field produced at initial rates of about 400 stb/d of oil. Horizontal wells have resulted in productivity index increases of over ten times the vertical well values. Initial trilateral horizontal well production rates were as high as 8,500 stb/d of oil. The key technology that makes the project successful is the multilateral open hole completions in soft, friable sand. Bilateral and trilateral horizontal wells with 3,000 feet and 4,500 feet of horizontal section were drilled using PDC bit technology in a soft sandstone formation. The horizontal laterals of each well were drilled without tripping for a new bit and hole integrity was maintained. Proceedings - SPE international on horizontal well technology. OCLC: 290430053; 36622544.

1991. Baldwin, Brig H. W. “*The Royal Engineers in the British Arabian Peninsula and the Middle East Command 1958-1957 Part II.*” The Royal Engineers Journal. April 1991. Volume Vol. 105, No. 1, Pages 32-47. ISSN: 0035-8878.

1990. Baldwin, Brig H. W. “*The Royal Engineers in the British Arabian Peninsula and the Middle East Command 1958-1957 Part I.*” The Royal Engineers Journal. December 1990. Volume Vol. 104, Issue No. 3, Pages 246-255. ISSN: 0035-8878.

Balescu, Sanda, Breton, Jean-François, Coque-Delhuille, Brigitte and Lamothe, Michel. 1998. “La Datation Par Luminescence Des Limons De Crue: Une Nouvelle Approche De l’Étude Chronologique Des Périmètres d’Irrigation Antiques Du Sud-Yémen.” Translated title: “Luminescence Dating of Flash Flood Deposits: A New Approach for the Chronological Study of Ancient Irrigation Perimeters in Southern Yemen.” *Comptes Rendus De l’Académie Des*

Sciences - Series IIA - Earth and Planetary Science. 7. Volume 327, Issue 1, Pages 31-37.

Descriptors: luminescence dating; geochronology; flash flood deposits; ancient South Arabian irrigation systems; arid environment; Yemen; datation par luminescence; géochronologie; limon de crue; irrigations antiques sudarabiques; environnement aride. Abstract: This study is an attempt to assess the age of ancient irrigation silts from Southern Yemen using the optically stimulated luminescence (OSL) of the constituent K-feldspar grains. This OSL dating method is tested on the al-Haraja irrigation sequence (wâdî Bayhân) which overlies an archaeological occupation level previously dated at $2\,203 \pm 123$ years BP by ^{14}C . The OSL age estimates range between $2\,097 \pm 177$ years at the bottom of the sequence and $1\,555 \pm 150$ years at the top. This study demonstrates the potential of the luminescence dating method to provide chronological information on the deposition of ancient silts following irrigation in arid environment where ^{14}C datable material is rare. Résumé Une nouvelle méthode de datation par luminescence optique (OSL) est ici mise en œuvre pour tenter d'estimer directement l'âge des dépôts d'irrigation antiques des basses vallées arides du Sud-Yémen, ces dépôts étant totalement dépourvus de matériel datable par ^{14}C . La méthode OSL est testée sur les grains de feldspaths potassiques des limons d'irrigation d'al-Haraja (wâdî Bayhân), qui surmontent un niveau archéologique daté $2\,203 \pm 123$ années BP au ^{14}C . Les âges OSL obtenus sont compris entre $2\,097 \pm 177$ années à la base de la séquence et $1\,555 \pm 150$ années au sommet. Nous démontrons ici, pour la première fois, que des limons d'irrigation d'âge historique sont datables par la méthode OSL. ISSN: 1251-8050.

Bamoumin, A. 2000. Water Resources and its Uses for Agricultural Development in Yemen. The Sultanate of Oman international conference on water resources management, Muscat 12-16 March 1995. Jabrin sessions / International Water Resources Association, Unesco.

Banaimoon, SA, Kitto, MR, Rodrigues, A. and Regunathan, C. 1998. "Aquaculture in Yemen: Utilization of Marine Resources and Prospective Investments." World Aquacult. Sep. Volume 29, Issue 3, Pages 12-15. Descriptors: Article Subject Terms: Aquaculture development; Aquaculture economics; Fish culture; Reviews; Article Geographic Terms: Yemen; aquaculture development. Abstract: The Republic of Yemen has a unique ocean-front, relief position in the Arabian Peninsula. Natural salinity dilution, narrow spectral air /water temperatures, water quality standards, and a 100,000 hectare land strip, measuring one kilometer wide along the shore with suitable soil characteristics all make aquaculture a practical use of the land. Fisheries and aquaculture rank among the priorities in the national development policy. The oceanographic turn with the upwelling events in the Arabian Sea has provided an abundance and variety of fishery resources with seasonal peaks and lows. Fisheries are a priority as a source of food and as a foreign trade commodity. There are no inland fisheries of commercial significance. Mangrove vegetation is relatively scarce. The fishing industry makes a valuable contribution to the animal protein supplies of the country; however, availability is still confined to the coastal population. The goal of the marine farming industry, today's prerequisite, is to be eco-sustainable and profitable. To achieve and maintain these values, an adequate supply of quality seed and feed, efficient production management, judicious financing, an effective husbandry-health program and extensive marketing distribution all form essential components to success. Substantial funds have been invested or otherwise made available for the growth and development of fisheries in Yemen by donor agencies such as The International Development Agency (IDA), The International Fund for Agrarian Development (IFAD), and The Food and Agriculture Organization/United Nations Development Program (FAO/UNDP). Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 1041-5602.

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Banajeh, Salem M. 1998. "Outcome for Children Under 5 Years Hospitalized with Severe Acute Lower Respiratory Tract Infections in Yemen: A 5 Year Experience." *J. Trop. Pediatr.* December 1. Volume 44, Issue 6, Pages 343-346. Abstract: Between 1991 and 1995, 2,554 children under 5 years old hospitalized with severe acute lower respiratory tract infection in Al-Sabe'en, Sana'a, Yemen were studied. 47.7 per cent (1218) were under 6 months of age and 74.1 per cent (1893) were in their first 12 months. Sixty-four per cent (1633) were males. Of the 2554 cases, 221 died (overall, a case fatality rate of 8.7 per cent). 118 of the deaths (53.4 per cent) were in the under 6 months age group and 188 (85 per cent) were in the first 12 months age group. During 1995 the hospital started adopting the WHO standard case-management guidelines for treating severe acute lower respiratory tract infections. There were no significant reductions in case fatality rates in 1995 (CFR 9.8 per cent) compared with those of 1991 (CFR 7.9 per cent), 1992 (CFR 9.4 per cent), 1993 (CFR 7 per cent), or 1994 (CFR 8.5 per cent). Factors such as late hospital admission with cyanosis, malnutrition, rickets as well as increased resistance of the common causative organisms (pneumococci and H. influenzae) to antibiotics recommended by the WHO may have contributed to such a high case fatality rate remaining unchanged. In addition to reducing the risk of developing pneumonia and dying from pneumonia by improving maternal nutrition, health education, promoting breastfeeding, and preventing rickets and nutritional anaemia among the vulnerable age groups, vaccination against pneumococci and H. influenzae type b should be seriously considered as one of the strategies to reduce lower respiratory tract infection-related mortality. ISSN: 1465-3664.

Banajeh, Salem M., Ba-oum, Nadia H. S. and Al-Sanabani, Raja M. N. 2001. "Bacterial Aetiology and Anti-Microbial Resistance of Childhood Diarrhoea in Yemen." *J. Trop. Pediatr.* October 1. Volume 47, Issue 5, Pages 301-302. Abstract: In a 12-month period, 561 stool cultures from Yemeni children aged 1-60 months and presenting with diarrhoea, were analysed to identify the bacterial aetiology and their anti-microbial resistance to the commonly used antibiotics. A total of 190 (33.9 per cent) were positive for bacterial culture. Most of the positive cultures (58 per cent) were from children aged 1-12 months. The majority of the positive cultures were enteropathogenic *Escherichia coli* (58.4 per cent) *Salmonella* spp., and *Shigella* spp. (20 per cent each). *Campylobacter* were found to be an extremely uncommon agent of childhood diarrhoea making only 1.6 per cent of the positive cultures. The majority of the *Salmonella* were group C (60.5 per cent) and group B (29 per cent). Of the *Shigella* isolates, 13 (34 per cent) were *S. flexneri*, and seven (18 per cent) *S. dysentria*. More than two-thirds of the *Salmonella* isolates were resistant to nalidixic acid, chloramphenicol, co-trimoxazole, gentamicin, and amoxicillin, while 42 per cent were resistant to cefotaxime. Most of the *Shigella* isolates were susceptible to nalidixic acid and cefotaxime, and resistant to the other antibiotics. All the tested enteropathogenic *E. coli* isolates were resistant to amoxicillin, 83 per cent were resistant to co-trimoxazole, 62 per cent to chloramphenicol, and 54 per cent to gentamicin, while only 16 and 6 per cent were resistant to nalidixic acid and cefotaxime, respectively. This study, the first in Yemen, draws attention to the urgent need of a national surveillance system, essential for the containment of anti-microbial resistance. ISSN: 1465-3664.

Banks, Maj M. E. B. 1965. *A Company Commander in the Radfan*. In *Brassey's Annual: The Armed Forces Year-Book 1965*. London: William Clowes. Abstract: The armed forces yearbook. Notes: 24 v. ill. 24 cm. ISSN: 0068-0702. OCLC Accession Number: 5950905.

Bano, Masooda. 2007. "Sustaining Gains in Poverty Reduction and Human Development in the Middle East and North Africa * by FARRUK IQBAL." *Journal of Islamic Studies*. May 1. Volume 18, Issue 2, Pages 302-304. ISSN: 0955-2340.

Geology of Yemen

Barraud, J. 1961. Aden - Irrigation in the Aden protectorate - Report to the government. FAO 1961 - EPTA Report no 1435 - 54 p., 15 app. with 1 tab. Keywords: Flood Control; Irrigation; Irrigation Systems; Canals; Dams; Wells; Democratic Yemen. EPTA PROJECT. Report Number: LA-EPTA 1435. FAO Library Accession Number: 051435.

Barrett, Tomas A. 2005. Lessons of Air Control from a Forgotten War: The Radfan Campaign, Aden 1964-67. Maxwell AFB, AL: Air Command & Staff College, Air University. Page(s): 47.

Basahi, I. A. A. 2000. "Marib Dam: The Importance of Environmental and Health Impact Studies for Development Projects." *East. Mediterr. Health J.* Volume 6, Issue 1, Pages 106-117. Notes: Cited By (since 1996): 1. Abstract: Marib Dam was built without an environmental impact assessment study which created many conflicts. In 1995 and 1996 its impact on water quality, agriculture and groundwater recharge and socioeconomics was studied. Lake water could suffer severe eutrophication when floods are weak and algae growth is not controlled. Introducing *Tilapia nilotica* provided biological control of algae growth. The dam positively affected agriculture and groundwater within the designed irrigation scheme but negatively affected them beyond it. The dam also negatively affected health conditions and increased conflicts over water distribution. It positively affected women by allowing them to work in agriculture and participate in decision-making. The dam raised income levels of farmers and encouraged tourism. Database: SCOPUS. ISSN: 1020-3397.

Bassé, Éliane. 1930. "Contributions a l'étude du Jurassique Supérieur (facies corallien) en Ethiopie, et en Arabia Meridionale." *Soc. Géol. France Mém. New ser.* Volume 6, part 3-4, no. 14, pages 1-05-148, plates 4-5.

Bassé, Éliane, et al. 1955. "Fossiles du Jurassique Supérieur et des "Grès du Nubie" de la region de Sanna (Yemen)." *Soc. Géol. France Bull. Ser 6*, no. 4, pt 7-9, pages 655-688, plates 24-28.

Bathurst, JC. 1982. "Equations for Estimating Discharge in Steep Channels with Coarse Bed Material." *Advances in Hydrometry: Proceedings of a Symposium Held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K. 19-30 July 1982.* International Association of Hydrological Sciences Publication. 10 ref. Descriptors: Stage-discharge relations; Flow discharge; Stream gages; Conveyance equations; Mathematical equations; Slopes; Hydrometry; Yemen; Bed-load discharge; Errors. Abstract: The use of process-based conveyance equations for estimating discharge in steep channels with coarse bed material is discussed. As the hydraulic characteristics of such channels often preclude direct gauging techniques, it is necessary to use the indirect slope-area method. In this method, the peak discharges are calculated as functions of channel slope and conveyance, the latter being a function of channel cross-sectional shape and bed material size. Previous application has been hampered by a lack of knowledge concerning flow processes in steep channels, but with the equations now available, variations of conveyance with depth, bed material size, and sediment movement can be estimated. Using data from the Yemen Arab Republic, it is shown that discharge predictions by these equations have an accuracy of about 10% for low flows and are of the correct order of magnitude at flood flow. The test results in the present study agree with the few other field results available. The accuracy depends on the satisfaction of the assumptions behind the equations, particularly that the measurement site not be affected by ponding. It is also important, where sand is present, to note whether or not the coarse bed material is dominating the conditions. Also, errors may result from the use of equations (designed for steady flows) in

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unsteady conditions, for example, at flood peaks. Database: Water Resources Abstracts. OCLC: 10537564.

Bauman, P.; Kellett, R.; Steensma, G.; Cadman, C., Hardisty, P.; Dottridge, J. 2003. Two case studies of geophysical delineation of salt water intrusion in Yemen: Wadi Hadramaut and the Tuban and Abyan Deltas. Presented at the Second International Conference on Saltwater Intrusion and Coastal Aquifers- Monitoring, Modeling, and Management. Merida, Yucatan, Mexico.

Bauman, Paul, Sallomy, Janan, Lyness, Lucien, et al. 1996. "The Exploration for a Deep Aquifer in the Hadhramaut, Yemen; Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems." Proceedings of SAGEEP. Environmental and Engineering Geophysical Society, Wheat Ridge, CO, United States: United States. Apr. Volume 1996, Pages 363-366. Descriptors: aquifers; Arabian Peninsula; Asia; boreholes; clastic rocks; Cretaceous; deep aquifers; exploration; geophysical surveys; ground water; Hadhramaut Yemen; Masila Block; Mesozoic; Mukalla Formation; permeability; remote sensing; sandstone; satellite methods; sedimentary rocks; surveys; water resources; well-logging; Yemen. References: 1; illus. incl. 1 table. Abstract: The Hadhramaut province of Yemen, an area with a population of more than half a million inhabitants, is presently facing a serious water crisis. A groundwater exploration project is presently drilling 23 exploration wells widely spaced over the Masila Block, an oil exploration lease are within the province. The main target is the Cretaceous Mukalla Formation, a 300 m thick highly permeable sandstone. Field reconnaissance was integrated with satellite images; geologic, hydrogeologic, geophysical, topographic maps; and local socioeconomic and political information to choose the well locations. Studying available seismic reflection data was particularly useful for choosing drilling locations over grabens buried in wadi fill. The various pieces of information were integrated in a geographic information system (GIS). To date, eight wells have been drilled and completed. Borehole geophysical logging has played an important role in all phases of well completion. All completed boreholes have tested from 200 to over 1,000 imperial gallons per minute. Database: GeoRef. ISSN: 1554-8015.

Bazza, Mohamed. 2003. "Wastewater Recycling and Reuse in the Near East Region; Experience and Issues; Water Recycling in the Mediterranean Region; Selected Proceedings of the IWA Regional Symposium on Water Recycling in the Mediterranean Region [Modified]." Water Sci. Technol. Water Supply. IWA Publishing, London, UK. Volume 3, Issue 4, Pages 33-50. Descriptors: Africa; agriculture; aquifer vulnerability; aquifers; Arabian Peninsula; arid environment; Asia; coastal environment; Cyprus; ecology; economics; Egypt; fresh water; global; ground water; hydrologic cycle; hydrology; impact statements; international cooperation; Iran; irrigation; Jordan; Kuwait; legislation; Middle East; Morocco; Near East; North Africa; policy; pollution; preventive measures; public policy; recycling; regulations; salt-water intrusion; Saudi Arabia; Syria; technology; terrestrial environment; Tunisia; urban environment; waste water; water balance; water management; water supply; water treatment; water use; Yemen. References: 23. Database: GeoRef. ISBN: 184339457X.

Beattie, C. I. Mills, B. R. and Mayo, V. A. 1998. Development Drilling of the Tawila Field, Yemen, Based on Three-Dimensional Reservoir Modeling and Simulation. Proceedings, 1998 SPE Annual Technical Conference and Exhibition: 27-30 September 1998, New Orleans, Louisiana: Society of Petroleum Engineers (SPE). Volume: Sigma, page(s): 715-725. Part Omega, September 27, 1998 - September 30. Conference: 1998. Descriptors: Oil well drilling; Computer simulation; Estuaries; Mathematical models; Oil field development; Petroleum

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reservoirs; Planning; Random processes; Sediments; Three dimensional. Abstract: Canadian Petroleum Ltd. and partners in the Yemen Masila Block have successfully used detailed three-dimensional reservoir modeling and reservoir simulation to optimize the development of the larger oilfields in the Masila area. The models were used to predict reservoir performance and plan additional development drilling which subsequently demonstrated that the models accurately predicted drilling results. The main producing horizon in the Masila area is the Cretaceous Upper Qishn formation, a clastic-dominated transgressive depositional sequence with fluvial sediments at the base, tidal dominated estuarine sediments in the middle, and marine shoals at the top. This variable array of facies presents modeling challenges but the resulting heterogeneous models provide a realistic representation of actual reservoir characteristics. This paper describes the approach used to stochastically distribute both facies bodies and petrophysical parameters, and to upscale the model for reservoir simulation, while preserving the complex reservoir description. The Tawila field was the first Masila field to have wells drilled on the basis of the modeling effort, with very encouraging results. For these new well locations, the model successfully predicted both reservoir development and oil-water contact movements resulting from production from existing wells. This paper presents key conclusions and predictions from the modeling and reservoir simulation, and compares them to the results from subsequent drilling. As a result of the successful development drilling, these models are now an integral part of reservoir management and development planning for all Masila fields. OCLC: 39964844.

Bedair, HM, Saeed, MA and Al-Saad, HT. 2006. "Status of Oil Pollution in Sediment Samples from the Aden Coast, Yemen." *Int. J. Food Agric. Environ.* Volume 4, Issue 3-3, Pages 284-287. Descriptors: Article Subject Terms: Air pollution; Coastal zone; Coasts; Effluents; Gulfs; Hydrocarbons; Industrial areas; Industrial wastes; Municipal wastewater; Oil; Oil Pollution; Oil spills; Organic Carbon; Particle Size; Petroleum; Petroleum hydrocarbons; Pollution detection; Refineries; Residues; Sediment Contamination; Sediment pollution; Sediments; Total organic carbon; Water pollution; Weight; agriculture; boats; petroleum residues; pollution levels; Article Geographic Terms: Yemen. Abstract: Sediment samples from nine stations (1-9) along the Coast of Aden, Yemen, were analyzed utilizing spectrofluorometry technique in an attempt to estimate the levels of petroleum hydrocarbon residues. The results obtained were sought to provide a baseline data for the estimation of petroleum hydrocarbon pollution level in the Aden Coast. The results obviously indicated a degree of oil pollution, however, still lower in magnitude when compared with status in some other regional sites. The obtained levels of petroleum hydrocarbons ranged from 0.28 $\mu\text{g/g}$ (sediment dry weight) at Station 4 to 26.24 $\mu\text{g/g}$ (sediment dry weight) at Station 7. In order to give a better evaluation of the petroleum hydrocarbon levels in the sediments, the total organic carbon (TOC) percentage and grain size analyses were done by granulometry technique on selected slips of the bulk sediments obtained for this purpose. The mean percent TOC estimations ranged from 0.2 at Station 4 to 1.15 at Station 7. The mean values obtained in this study indicated that the petroleum hydrocarbon levels in the sediment samples of the Aden Coast are lower than the levels in sediment samples obtained with similar methodology and analyses in some of the Gulf States and countries in close vicinity of the region. It is, therefore, recommended that a continual, vigilant program for oil pollution detection is adopted to facilitate accurate determination of the petroleum hydrocarbon levels and sources in the air, water, land and sediments of the Aden Coast, where the major pollution sources may involve tanker and boat discharges and activities, municipal sewage and rural run-off from land. Also, discharges and effluents from oil refineries,

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electricity generating station and industrial activities into the Aden Coast are obvious. Nevertheless, the data obtained with this study is vital as baseline information, at least at this stage for any prospective pollution detection program to be established in the area. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 1459-0255.

Beeby-Thompson, A. 1939. *The Water Problems of the Aden Protectorate*. London: Crown Agents for the Colonies. Descriptors: Water supply & management; Aden. Notes: 2 v. in 1 (30; 63 leaves): 35 cm. Note(s): Typescript. Responsibility: Beeby-Thompson, A. OCLC Accession Number: 704168178.

Beesley, Richard, Serouri, Abdel Al and Filteau, Suzanne M. 2000. "Measurement of C-Reactive Protein in Dried Blood Spots on Filter Paper." *Trans. R. Soc. Trop. Med. Hyg.* 6. Volume 94, Issue 3, Pages 348-349. Descriptors: C-reactive protein; measurement; methodology; blood spots; filter paper; storage; Yemen. ISSN: 0035-9203.

Bernhardt, Charles F. Consortium for International Development and Water Design Team. 1980. *Water Policy Initiatives for Yemen: Recommendations*. Sanaa: Consortium for International Development. Descriptors: Water resources development -- Yemen (Republic); Water-supply -- Yemen (Republic). Notes: 1 v. (various pagings): ill., map; 28 cm. Note(s): "September 1980." "CID Yemen Report 052-1980-1." "CER80-81DH32 (CID)." Includes bibliographical references. Responsibility: by CID Water Team; C. Bernhardt ... [et al.]. OCLC Accession Number: 526741936.

Berridge, Virginia. 2008. "The Khat Controversy: Stimulating the Debate on Drugs." *Soc Hist Med.* April 1. Volume 21, Issue 1, Pages 189-190. ISSN: 0951-631X.

Beydoun, Z. R., Bamahmoud, M. O. and Nani, A. S. O. 1993. "The Qishn Formation, Yemen: Lithofacies and Hydrocarbon Habitat." *Mar. Pet. Geol.* 8. Volume 10, Issue 4, Pages 364-372. Descriptors: Qishn Formation; Yemen; hydrocarbon habitat; source rocks. Abstract: The Barremian-Aptian Qishn Formation of Yemen is broadly described in the context of its role as the lowest widespread transgressive unit of the Cretaceous system in the country and of the two laterally equivalent lithofacies groups that reflect the advance of the Cretaceous sea from east to west. This is undertaken against the background of the tectonic events that preceded its deposition and those that followed it during the remainder of the Cretaceous, so as to better understand its hydrocarbon habitat. The Qishn Formation clastics (sands) have proved to be an excellent and major oil reservoir in eight recent oil discoveries made in the area between the Mukalla and Hoowarin highs of the Hadhramaut province of Yemen. The oil in these discoveries, like the oil (and gas) in 14 of the currently remaining 15 fields and discoveries in the country, is generated from Upper Jurassic organic-rich source rocks and vertically charged the Qishn reservoir in the absence of an effective intervening seal. Subsurface data from the recent discoveries area and from sparse subsurface control in the Jeza' basin to its east indicate the presence in this region of an areally more limited pre-Qishn Cretaceous platform sequence and suggests that the Jeza' basin was an early Cretaceous marine embayment between still positive land masses on either side in which thicker Cretaceous sequences continued to be laid down after the bordering areas were inundated by the Qishn transgression. These basal sequences probably include Qishn source shale levels similar to those found in the southern offshore area; there they are mainly immature, however, or else do not appear to have generated identifiable trapped oil. The Jeza' basin thus appears to hold promising untested potential for oil sourced by unpenetrated Qishn levels (in addition to good Upper Cretaceous Mukalla Formation source levels and Upper Jurassic levels, where preserved and not too deeply buried) which would be at varying degrees of oil and gas maturity. These sources could charge, by multi-stage migration

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from the 'kitchen' areas, various Cretaceous reservoirs, including Qishn clastics or carbonates, in any updip traps. ISSN: 0264-8172.

Beydoun, Ziad R. 1997. "Introduction to the Revised Mesozoic Stratigraphy and Nomenclature for Yemen." *Mar. Pet. Geol.* 9. Volume 14, Issue 6, Pages 617-629. Descriptors: Yemen; Mesozoic; stratigraphy; nomenclature. Abstract: Until the early 1980s the Mesozoic stratigraphy of Yemen was based on measured surface sections exposed mainly in the faulted and dissected shoulders of the Gulf of Aden and Red Sea Rifts or on the high Yemen Plateau. On the basis of correlations between areas, the broad facies belts, palaeogeographies and tectonic frameworks for the Mesozoic epochs were established. The areally extensive Tertiary limestone tableland and Tertiary volcanics, however, masked more local underlying pre-Cenozoic major structural features. Extensive oil exploration drilling backed by regional and/or detailed geophysical surveys (increasingly based on seismic surveys) from the late 1970s, have gradually unraveled a complex Mesozoic tectonic history which had given rise to the formation of a number of NW-SE and E-W trending rift basins and depressions; these were initiated mainly in the Late Jurassic and Early Cretaceous, principally by rejuvenation of ancient basement-controlled fractures during further Gondwanan break-up which led to the separation of India (with eastern Gondwana) from Afro-Arabia. These basins exhibit considerably thicker and rapidly varying stratigraphic sequences which reflect successive phases of rifting, subsidence and depositional settings in time, with the type and provenance of basin-fill helping to detail the developing palaeogeography for each stage. The precise relationships of these varied intra- and inter-basin facies are not yet properly understood. The discovery of commercial oil and gas in several of these Mesozoic rift basins accelerated competitive exploration activity by a host of operating companies leading to the proliferation of informal locally-applicable in-house subsurface lithostratigraphic nomenclature schemes. These, in the extreme cases, either ignore published surface nomenclature, or else utilize existing surface-defined formation names which then become over-loaded with undifferentiated coeval but positionally and environmentally different units without due regard to internationally accepted rules. This confusion is further compounded by detailed local academic research from within and outside Yemen, with little or no access to subsurface data, and by service companies utilizing limited client-supplied data which is then extrapolated on a province-wide or a regional basis; proliferation takes place through data exchange between operators or through circulation of non-exclusive reports, or by means of localized publications. A Stratigraphic Commission was appointed to address this problem and to carry out nomenclature clean-up and simplification. After intensive review of all utilised nomenclature and with full cooperation from the operating companies, its principal findings are summarised in graphic form (in Figure 4 and Figure 5) which include, for example: retention but revision; correction and expansion of the formalised nomenclature in Beydoun and Greenwood (1968) which will apply to all of Yemen; one new formation, previously unrecognised until recent subsurface and outcrop studies (the Saar Formation) has been added; formalisation of several new members in the Madbi Formation (previously informally assigned formation rank); a new member to the Qishn formation, the Sa'af Member (previously informally called the Furt formation); correction to and reassignment of the Nayfa Formation type section to the Ma'abir Member of the Madbi Formation, the type Nayfa provisionally, now being at Mintaq salt dome. Full descriptions of these and of all the revised Mesozoic nomenclature together with that for the Palaeozoic and Cenozoic will be published later in International Lexicon of Stratigraphy format. ISSN: 0264-8172.

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Beydoun, Z. R. 1966. "Geology of the Arabian Peninsula- Eastern Aden Protectorate and Part of Dhufar." USGS Professional Paper 560-H. Abstract: A review of the Eastern Aden Protectorate and part of Dhufar as shown on USGS Miscellaneous Map I-270-A, "Geologic Map of the Arabian Peninsula", 1963. This account is divided into four parts. The first outlines the position of the Eastern Aden Protectorate and part of Dhufar and (a) includes an account of previous geological work carried out, (b) outlines the fieldwork since 1953 done for the Iraq Petroleum Company, Ltd., and associated companies under the leadership of the author, the results of which form the body of this account, and (c) incorporates earlier results with acknowledgment of the very substantial contribution of colleagues and specialists. The second part discusses geography of the area and accessibility and operating conditions. The third part describes and discusses the stratigraphy. Basement, Jurassic, Cretaceous, and Tertiary sedimentary rocks are divided into lithostratigraphic units for which description, faunal lists where applicable, regional correlation of formations with neighboring countries, and economic aspects of various formations are given. Sedimentary and intrusive-extrusive Precambrian and lower Paleozoic (?) (basement) rocks are classified and described, and a probable reconstruction of basement events from field and laboratory observations is given. The basement rocks were in part subjected to low-grade metamorphism, folded, faulted, cleaved, and maturely eroded. Intrusive activity may have extended into the Upper Silurian, as suggested by some isotope age determinations. The oldest rocks overlying the basement peneplain are Middle and Upper Jurassic (?); these consist of basal sands, limestones, marls, and local evaporites. The Cretaceous transgression advanced from the east, and the oldest datable sedimentary rocks are Barremian. Lower to Upper Cretaceous sediments were laid down over the entire area, being predominantly elastics in the west and carbonates in the east, but intertonguing. The Tertiary Period began with a widespread Paleocene transgression during which cliff-forming limestones were deposited over the whole area; these were followed by lower and middle Eocene shales, limestones, and evaporites, and then by regional uplift and geanticlinal folding and faulting. Oligocene and Miocene elastics, reef limestones and local evaporates were then deposited in coastal embayments. The fourth part discusses structure, including (a) a general introduction, (b) description of structural development of the area in the Tertiary, as those events were responsible for the present broad structure of the territory, (c) an interpretation of the Tertiary structure in the area and across the Gulf of Aden in former British Somaliland, (d) examination of evidence from the Somali side with discussion of earlier views, and (e) a brief outline of structural history of the Eastern Aden Protectorate and Dhufar. In the interpretation of the Tertiary structure, the development of the biaxial Hadramawt arch (Hadramut arch) and a comparable Somali arch are attributed to regional compression which buckled the whole thickness of the crust. Important block and step faulting which followed buckling collapsed the flanks of the arches facing the Gulf of Aden. USGS Library. URL: <http://pubs.usgs.gov/pp/0560h/report.pdf>.

Beydoun, Z. R. 1964. "Stratigraphy and Structure of the Eastern Aden Protectorate." London: Overseas Geology and Mineral Resources, Bull. Supp. Ser. 5, 107 pages. Her Majesty's Stationery Office, London.

Beydoun, Z.R. 1960. "Synopsis of Geology of the East Aden Protectorate." 21st International Geological Congress. Copenhagen. 1960. Report 21, part 21, pages 131-149.

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Beydoun, Z. R. and Greenwood, J.E.G. W. 1966. "Lexicon of Stratigraphy for Aden Protectorate and Dhufar." In: *Lexique Stratigraphique Internationale*. Paris: International Geological Congress, Committee on Stratigraphy.

Bin Gadhi, S. M. and Mukbel, M. A. 1998. "A Review of Renewable Energy Activities in Yemen." *Renew. Energy*. 29 March 1998 through 1 April 1998. Volume 14, Issue 1-4, Pages 459-465. Notes: Conference code: 49183; Cited By (since 1996): 1. Abstract: Republic of Yemen is a developing country depending on oil for the energy needs. A look at the availability of renewable energy resources shows that the country is endowed with considerable solar, wind, bio-gas energy resources. This paper presents a review of activities in the field of renewable energy applications in Yemen and future trends, some suggestion and recommendations for using this renewable energy resources are also drawn. Database: SCOPUS. ISSN: 09601481.

Blacker, Gen Sir Cecil. 1993. *Monkey Business: The Memoirs of General Sir Cecil Blacker*. London: Quiller Press. Page(s): 232. Notes: VIII, 232, [16] S.: III. ISBN: 1870948874. OCLC Accession Number: 231652594.

Blom, Ronald G., Crippen, Robert E. and Zarins, Juris. 1998. "Possible Ancient Anthrosols Near Lost City of Ubar Site in Oman; Geological Society of America, 1998 Annual Meeting." *Abstracts with Programs - Geological Society of America*. Geological Society of America, Boulder, CO. Volume 30, Issue 7, Pages 123. Descriptors: agriculture; Anthrosols; Arabian Peninsula; archaeology; Asia; failures; geophysical surveys; imagery; irrigation; Landsat; Lost City of Ubar Oman; mapping; Marib Dam; Oman; remote sensing; soils; surveys; thematic mapper; Yemen. Abstract: During mapping for the Wadi al Jubal Archaeological Project in Yemen, USGS Geologists Overstreet and Grolier mapped anthrosols of pre-Islamic age east of the Marib dam site (15 degrees 24'N, 45 degrees 18'E). These soils were the result of agriculture supported by irrigation enabled by water impounded by the dam, areas which were abandoned after dam failure. During analysis of Landsat Thematic Mapper satellite images of Yemen and Oman for the Mahra Archaeological Project, we noted that these anthrosols had a distinctive image expression. Many anthrosol sites were noted, most, but not all, of them previously documented. Undocumented possible anthrosol sites include an area east of Shisr in Oman, the archaeological site discovered by us to be responsible for some features of the Lost City of Ubar legends. Included in legendary accounts of the Ubar region are reports of fertile oases, and areas that have known the plow. Based on demonstrated reliability of aspects of carefully interpreted legendary accounts, we postulate that we may have located the area of desert agriculture that may have existed to support the frankincense caravansary of Ubar. The possible anthrosol area is located at approximately 18 degrees 10'N, 53 degrees 54'E, and will be the subject of study in a future expedition. Database: GeoRef. ISSN: 0016-7592.

Blom, Ronald G. Crippen, Robert E. Zarins, Juris and Hedges, George R. 2000. *Remote Sensing, Shuttle Radar Topographic Mapper Data, and Ancient Frankincense Trade Routes*. Honolulu, HI, USA: IEEE. Volume: 6, page(s): 2477-2479. 2000 International Geoscience and Remote Sensing Symposium (IGARSS 2000), July 24, 2000 - July 28. Conference: 2000. This paper appears in: *Geoscience and Remote Sensing Symposium, 2000. Proceedings. IGARSS 2000. IEEE 2000 International*. Descriptors: Remote sensing; Radar imaging; Space shuttles. Abstract: Over the last fifteen years, an unusual combination of space technologies coupled with traditional archaeology has given insight into the ancient southern Arabian frankincense trade, including the discovery of the lost 'city' of Ubar in present day Oman. Continued research indicates a series of desert caravansaries to the west in modern Yemen. Pliny, the ancient Roman historian, reports that there were 'octomansiones' (eight fortresses, or mansions) along the desert

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frankincense trade route. Our present work seeks to document this, and illuminate the poorly known civilization which supported frankincense trade. We presently have Landsat Thematic Mapper (TM) coverage of most of southern Arabia. We also have geographically discontinuous SIR-C and ERS coverage. At present we also have publicly released quicklook SRTM data for the border area between Yemen and Oman, and eagerly await full coverage with SRTM topographic data. Topographic data will provide critical insight into trade routes and fortresses with regards to water sources and routes from the coast and mountains, where people lived, to the interior desert. Given the nature of this research, comprehensive geographic coverage provided by SRTM and Landsat are a fundamental requirement. ISBN: 0-7803-6359-0. OCLC: 47883097.

Boehmer, W. K. 1990. "Groundwater Flow in a Faulted Groundwater Basin; Water Resources in Mountainous Regions." *Memoires - Association Internationale Des Hydrogeologues = Memoires - International Association of Hydrogeologists*. Association Internationale des Hydrogeologues; Committee of U.S.A. Members of the International Association of Hydrogeologists, Montpellier, International. Volume 22, Part 1-2, Pages 46-55. Descriptors: aquifers; Arabian Peninsula; Asia; Cenozoic; clastic rocks; Cretaceous; faults; ground water; Holocene; interpretation; mathematical models; Mesozoic; models; mountains; movement; permeability; Quaternary; Rada Basin; sandstone; sedimentary rocks; water management; water quality; water resources; Yemen. Notes: IAHMAP; References: 10; illus. incl. 2 tables, geol. sketch maps. Database: GeoRef. ISSN: 0579-6733.

Bogan, Arthur E. Overstreet, William C. Grolier, Maurice J. and Toplyn, Michael R. 1988. "A Preliminary Report on the Land and Freshwater Gastropods Recovered from Archaeological and Geological Samples from the Yemen Arab Republic." United States: Am. Found. Study Man, Washington, DC, United States. Volume: 4, Descriptors: Al-Jubah Quadrangle; Arabian Peninsula; archaeological sites; Asia; Cenozoic; faunal list; fresh-water environment; Gastropoda; Invertebrata; Mesogastropoda; Mollusca; Quaternary; stratigraphy; taxonomy; terrestrial environment; Yemen. Notes: Includes 5 appendices; illus. incl. 2 tables, sketch maps. Database: GeoRef. OCLC: 6782603. ISSN: 0569-4833.

Bonavia, Franco F., Chorowicz, Jean and Collet, Bernard. 1995. "Have Wet and Dry Precambrian Crust Largely Governed Cenozoic Intraplate Magmatism from Arabia to East Africa?" *Geophys. Res. Lett. American Geophysical Union, Washington, DC*. 01 Sep. 1995. Volume 22, Issue 17, Pages 2337-2340. Descriptors: Afar; Africa; African Plate; Arabian Peninsula; Arabian Plate; Arabian Shield; Asia; basalts; Burundi; Cenozoic; Central Africa; Congo Democratic Republic; continental crust; crust; East Africa; East African Rift; Ethiopia; flood basalts; igneous activity; igneous rocks; intraplate processes; Kenya; lithosphere; mantle plumes; models; moisture; Nubia; Nubian Shield; plate boundaries; plate tectonics; Precambrian; Somali Republic; Tanzania; underplating; uplifts; volcanic rocks; water; Yemen; Zaire. Abstract: To explain Cenozoic continental volcanism between Arabia and East Africa, the existing model infers that a plume impinged beneath Ethiopia, between 30 Ma and 20 Ma, and volcanism extruded within a 1000 km radius. Because relative motion of the Afro-Arabian plate was about northeast in the last 120 Ma, we infer that at 84 Ma a plume, originated from the core-mantle boundary, impinged beneath Nubia-Arabia and is now under the Tanzania craton. This plume caused uplift (Afro-Arabian swell) and magma under-plating. After Fyfe's idea (1992), the conceptual model proposed herein suggests that, following plume impact, there was in Nubia-Arabia only intrusion of mafic dykes because the crust was largely unprocessed (wet). At about 50 Ma the plume was under Ethiopia, and coeval volcanism extruded because the crust was

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highly recycled (dry). In Zaire-Burundi and Tanzania, volcanism is explained to be coeval with the arrival of the plume because there also the crust is recycled. In Arabia and Yemen-Ethiopia continental-flood basalts younger than 30 Ma formed because lithospheric extension along the Red Sea-Gulf of Aden was the cause of (or the result of) plume(s), probably originated from the upper mantle. Database: GeoRef. ISSN: 0094-8276.

Bonnenfant, P. 1997. "Irrigation in the Wadi Zabid Area (Yemen)." Bulletin - Association de Geographes Francais. Volume 1, Pages 12-24. Abstract: A presentation of irrigation systems in the Wadi Zabid area (Yemen) demonstrates recent technical and social changes. The area was opened to the market and peasants have been partly freed from an economic and social status in which they were exploited. Database: SCOPUS. ISSN: 0004-5322.

Bosence, D. W. J. 1997. "Mesozoic Rift Basins of Yemen." Mar. Pet. Geol. 9. Volume 14, Issue 6, Pages 611-616, IN1-IN6. Descriptors: Mesozoic rift basins; hydrocarbons; Yemen; Sabatayn Basin; Marib Basin; Masilah Basin; Socotra. Abstract: This special issue is the first compilation and review of the stratigraphy and basin evolution of the Mesozoic petroleum basins of Yemen. The volume arises from an international symposium on the 'Sedimentation and Tectonics of Rift Basins of the Red Sea-Gulf of Aden area' held at the University of Sana'a in September 1995. Papers relating to the Cenozoic rifting of the Gulf of Aden, Red Sea and Gulf of Suez are to be published shortly (B. H. Purser and D. W. J. Bosence, Sedimentation and Tectonics of Rift Basins: The Red Sea-Gulf of Aden. Chapman and Hall, London, in press). Eight papers within this issue focus on basins within the interior of the country and the margins of the Gulf of Aden/Indian Ocean. The papers cover reviews of the developing stratigraphic concepts for these basins, outcrop studies and subsurface studies of recently explored areas by geoscientists from the U.K. oil industry and from U.K., Lebanese and Yemeni universities. ISSN: 0264-8172.

Bosworth, William, Huchon, P. and McClay, K. 2005. "The Red Sea and Gulf of Aden Basins; Phanerozoic Evolution of Africa." J. Afr. Earth Sci. Elsevier, Oxford, UK. Oct. Volume 43, Issue 1-3, Pages 334-378. Descriptors: Adigrat Series; Afar; Afar Traps; Africa; African Plate; Akbra Shale; Amba Aradon Series; Amran Series; Antalo Series; Arabian Peninsula; Arabian Plate; Arabian Sea; Arabian Shield; Asia; Baid Formation; basement; basin analysis; basins; depositional environment; earthquakes; East Africa; Ethiopia; faults; Foraminifera; fracture zones; Globigerina; Globigerinacea; Globigerinidae; Gulf of Aden; Gulf of Aqaba; Gulf of Suez; igneous rocks; Indian Ocean; Invertebrata; Kohlan Series; lithostratigraphy; mantle; mantle plumes; microfossils; paleoenvironment; paleogeography; plate tectonics; Precambrian; Proterozoic; Protista; Red Sea; Red Sea Rift; rift zones; rifting; Rotaliina; sea-floor spreading; sedimentary basins; sedimentary rocks; sedimentation; seismotectonics; Stratoid Series; strike-slip faults; Tawilah Group; tectonics; transform faults; upper Precambrian; volcanic rocks; volcanism; Yemen. Notes: References: 487; illus. incl. 1 table, geol. sketch maps. Abstract: We here summarize the evolution of the greater Red Sea-Gulf of Aden rift system, which includes the Gulfs of Suez and Aqaba, the Red Sea and Gulf of Aden marine basins and their continental margins, and the Afar region. Plume related basaltic trap volcanism began in Ethiopia, NE Sudan (Derudeb), and SW Yemen at approximately 31 Ma, followed by rhyolitic volcanism at approximately 30 Ma. Volcanism thereafter spread northward to Harrats Sirat, Hadan, Ishara-Khirsat, and Ar Rahat in western Saudi Arabia. This early magmatism occurred without significant extension, and continued to approximately 25 Ma. Much of the Red Sea and Gulf of Aden region was at or near sea level at this time. Starting between approximately 29.9 and 28.7 Ma, marine syn-tectonic sediments were deposited on continental crust in the central Gulf of

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Aden. At the same time the Horn of Africa became emergent. By approximately 27.5-23.8 Ma a small rift basin was forming in the Eritrean Red Sea. At approximately the same time (approximately 25 Ma), extension and rifting commenced within Afar itself. At approximately 24 Ma, a new phase of volcanism, principally basaltic dikes but also layered gabbro and granophyre bodies, appeared nearly synchronously throughout the entire Red Sea, from Afar and Yemen to northern Egypt. This second phase of magmatism was accompanied in the Red Sea by strong rift-normal extension and deposition of syn-tectonic sediments, mostly of marine and marginal marine affinity. Sedimentary facies were laterally heterogeneous, being comprised of inter-fingering siliciclastics, evaporite, and carbonate. Throughout the Red Sea, the principal phase of rift shoulder uplift and rapid syn-rift subsidence followed shortly thereafter at approximately 20 Ma. Water depths increased dramatically and sedimentation changed to predominantly Globigerina-rich marl and deepwater limestone. Within a few million years of its initiation in the mid-Oligocene the Gulf of Aden continental rift linked the Owen fracture zone (oceanic crust) with the Afar plume. The principal driving force for extension was slab-pull beneath the Urumieh-Doktar arc on the north side of the narrowing Neotethys. Drag of Arabia by the northward-moving Indian plate across the partially locked northern Owen fracture zone and the position of the Carlsberg oceanic ridge probably also influenced the geometry of the Aden rift. The trigger for the onset of rifting, though, was the impingement of the Afar plume at approximately 31 Ma. The Red Sea propagated away from the plume head, perpendicular to the extensional stresses then operating in Arabia, and arrived at the bend in the African-Levant margin, which itself may have been a stress concentration ripe for rifting. The local geometry of the early Red Sea rift was strongly influenced by pre-existing basement structures, and as a consequence followed a complex path from Afar to Suez. Each segment of the rift was initially an asymmetric half graben, with well-defined accommodation zones between sub-basins. In the Gulf of Aden, the positions of accommodation zones were strongly influenced by older Mesozoic rift basins. Early rift structures can be restored to their original contiguous geometries along both the Red Sea and Gulf of Aden conjugate margins. In both basins, present-day shorelines restore to a separation of 40-60 km along most of their lengths. The initial rift basins were 60-80 km in width. Oceanic spreading initiated on the Sheba Ridge east of the Alula-Fartaq fracture zone at approximately 19-18 Ma. After stalling at this fracture zone, the ridge probably propagated west into the central Gulf of Aden by approximately 16 Ma. This matches the observed termination of syn-tectonic deposition along the onshore Aden margins at approximately the same time. At approximately 14 Ma, a transform boundary cut through Sinai and the Levant continental margin, linking the northern Red Sea with the Bitlis-Zagros convergence zone. This corresponded with collision of Arabia and Eurasia, which resulted in a new plate geometry with different boundary forces. Red Sea extension changed from rift normal (N60 degrees E) to highly oblique and parallel to the Aqaba-Levant transform (N15 degrees E). North of Suez in Egypt the rift system became emergent, perhaps due to minor compression of the Sinai sub-plate, and the marine connection to the Mediterranean Sea became restricted but not terminated. Red Sea sedimentation changed from predominantly open marine to evaporitic, although deep water persisted in many regions. A third phase of magmatism commenced, locally in Ethiopia but predominantly in western Saudi Arabia and extending north to Harrat Ash Shama and Jebel Druse in Jordan, Lebanon, and Syria. At approximately 10 Ma, the Sheba Ridge rapidly propagated west over 400 km from the central Gulf of Aden to the Shukra al Sheik discontinuity. Oceanic spreading followed in the south-central Red Sea at approximately 5 Ma. Database: GeoRef. ISSN: 1464-343X.

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Botez, G. and Lange, H. G. 1926. "Studii Geo-Hidrologice in Vilaetul, Yemen Geo-Hydrological Studies in the Vilayet of Yemen." Bucuresti: Cultura nationala. Descriptors: Hydrogéologie -- Yémen -- Cartes; Yémen -- Cartes. Notes: Description: 1 carte.: en coul. 51 x 66 cm, pliée 26 x 16 cm. Anuarul Institutului Geologic al României (1908) (1925-1926) vol. 11 (ABES) 037373552; Map Info: 1:300 000. Note(s): Relief représenté par des courbes de niveau et des points cotés. Coupe géologique. General Info: Version: Accompagne: Studii petrografice in Yemen (regiunea Hodeida-Saana) David Roman.- Bucuresti: Cultura nationala, 1967.- (Anuarul institutului geologic al României, vol. XI, 1925-1926). Other Titles: Geo-hydrological studies in the Vilayet of Yemen; Responsibility: schita geologica a regiunei ... de G. Botez; schita geografica a regiunei ... de H. G. Lange = geological sketch of the region ... by G. Botez; geographical sketch of the region ... by H. G. Lange. OCLC Accession Number: 495260291.

Bott, W. F., Smith, B. A., Oakes, G., Sikander, A. H. and Ibrahim, A. I. 1992. "Tectonic Framework and Regional Hydrocarbon Prospectivity of the Gulf of Aden." J. Pet. Geol. Volume 15, Issue 2, Pages 211-243. Descriptors: Petroleum geology; Geothermal energy; Petroleum prospecting; Sedimentology; Tectonics. Abstract: The Gulf of Aden rifting predates that in the Red Sea. Isolated sub-basins developed during the earliest Oligocene following a major emergent (erosional) period during the latest Eocene. Marine sedimentation began in the middle-to-late Oligocene and progressed upwards from marginal marine to bathyal environments with significant turbidite input (primarily on the Yemen side). Stretched and dike-invaded continental crust exists in water depths greater than 1000 m in some areas. Sea-floor spreading began in the late Miocene and progressed westward into the Afar region. Only limited faulting has affected the post-rift, uppermost Miocene to Recent section, which is primarily dominated by prograding sequences and thermal subsidence. With over 40,600 square kilometers of continental shelf in less than 300 m of water, the Gulf of Aden is a frontier exploration area. Only minimal exploration work has been carried out in the offshore, including twelve wells resulting in one sub-commercial discovery and numerous indications of hydrocarbons. The wells drilled to-date have encountered source, reservoir and seals in both the pre-rift and syn-rift section. Heat flow and thermal modelling has shown that the Gulf of Aden continental margins are not areas of excessive heat flow, and hydrocarbon-generative 'kitchens' can be mapped in the pre-rift sequence. The hydrocarbon prospectivity of the Gulf of Aden differs from that in the Red Sea in that the primary hydrocarbon plays are found in the pre-rift sequences. Pre-rift exploration plays exist in horst and rotated fault blocks within NW-SE trending sub-basins controlled by Upper Jurassic to Lower Cretaceous tensional tectonics. A combination structural-stratigraphic trap has proved hydrocarbons beneath the pre-Oligocene erosional unconformity. Syn-rift exploration for clastic reservoirs sealed by anhydrites exists in early Oligocene transtensional sub-basins. The primary structure traps are rollover anticlines associated with listric growth faults. Source maturity is a significant risk for syn-rift plays. ISSN: 0141-6421.

Bouhleb, M. Hail, A. R. FAO and UNDP. 1986. Stock Assessment of Shrimp (*Penaeus Semisulcatus*) Inhabiting the Shallow Water of Yemen Arab Republic: Development of Fisheries in Areas of the Red Sea and Gulf of Aden. Rome: FAO. Descriptors: marine; Yemen, Arab Rep; *Penaeus semisulcatus*; shrimp fisheries; stock assessment; population dynamics. Notes: 58 s. Responsibility: Mahmoud Bouhleb; Abdul Rahman Hail. OCLC Accession Number: 476749783.

Branko Milanovic. 2007. Qat Expenditures in Yemen and Djibouti: An Empirical Analysis. World Bank. MPRA Paper No. 1425. World Bank and Carnegie Endowment for International Peace, Washington, D.C. Abstract: Using household surveys from Yemen and Djibouti, the paper analyzes determinants of qat consumptions in two countries. The results

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confirm huge importance of qat in daily life: with between one-half (in Djibouti) and 70 percent (in Yemen) of all households reporting at least one user. But in Yemen, qat consumption is remarkably flat across income groups, age, and between rural and urban areas. Qat is a normal good and there is no indication that its use substitutes for food. In Djibouti, however, qat consumption increases with income, and appears to act as a substitute for food consumption. In both countries however there is a strong gender bias in the use: men are much more likely to use qat than women. URL:

http://mpira.ub.uni-muenchen.de/1425/1/MPRA_paper_1425.pdf

Brannan, J., Gerdes, K. D. and Newth, I. R. 1997. "Tectono-Stratigraphic Development of the Qamar Basin, Eastern Yemen." *Mar. Pet. Geol.* 9. Volume 14, Issue 6, Pages 701-730, IN7-IN12. Descriptors: basin development; Qamar Basin; Yemen. Abstract: The Qamar Basin is a polyphase rift basin located in eastern Yemen, adjacent to the Indian Ocean. It probably originated as part of an extensive rift system which developed during the Late Jurassic to Early Cretaceous and led to the break-up of Gondwanaland. Rift reactivation during the mid Cretaceous affected limited areas including the Qamar Basin. A third episode of rifting occurred during the Oligo-Miocene prior to sea floor spreading in the Gulf of Aden. Since spreading in the Gulf began in the Middle Miocene, the offshore Qamar Basin has been thermally subsiding. In contrast, the onshore part of the basin has been elevated by over 1 km. The nature of the pre mid-Cretaceous basin fill is unknown. During Santonian to Early Campanian times thick fluvio-deltaic clastics accumulated in a rapidly subsiding depocentre. Marked deepening during the Early Campanian led to deposition of deep water limestones. During the Late Campanian prograding deep marine clastics infilled the basin. Minor transgression during the Maastrichtian caused a resumption of marine carbonate deposition. Sedimentation was interrupted during the Early Palaeocene, following which shallow marine carbonates were deposited over a large area of the Arabian Peninsula. After a hiatus spanning the Late Eocene to Late Oligocene, carbonate sedimentation resumed offshore in an active rift basin. Deep water carbonates and carbonate turbidites accumulated in lows whilst reefs developed on footwall highs. From the late Miocene onwards the reefs have been gradually drowned by rapidly accumulating clastics. Onshore the Tertiary rift episode was associated with major uplift and only a thin veneer of recent wadi deposits overlies the rift topography. The superposition of Jurassic, Cretaceous and Tertiary rifts, which has not been described elsewhere in the region, is tentatively related to the evolution of the Indian Ocean. ISSN: 0264-8172.

"Breaking Bread with the Bedouins." 1993. *BusinessWeek*. 08/16. Issue 3332, Pages 18D-18G. Descriptors: First person narrative; Narration (Rhetoric); Travel; Travelers; Yemen (Republic). Abstract: The article discusses the author's experience on traveling to Al-Abr in Yemen. The author mentions that Al-Abr was used by English traveler Wilfred Thesiger as a base camp in 1949, where he filled his goatskins with water and bought dates and flour for the month-long journey into the desert. The author also mentions that the town is off-limits to tourists because of what the government calls perpetual insecurity among the Bedouin tribes. ISSN: 0007-7135.

Bremere, Ingrida, Kennedy, Maria, Stikker, Allerd and Schippers, Jan. 2001. "How Water Scarcity Will Effect the Growth in the Desalination Market in the Coming 25 Years." *Desalination*. Volume 138, Issue 1-3, Pages 7-15. Descriptors: Water resources; Desalination; Groundwater. Abstract: Desalination technology is finding new outlets in supplying water to meet growing municipal domestic consumption needs in water scarce countries with a per capita availability below 1,000 m³/y. An expansion of the current municipal water desalination market

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was related to the population growth and the groundwater scarcity in the coming 25 years in various regions of the world: Europe, The Caribbean, South East and Western Asia, GCC States and North Africa. First, the current impact of desalination on the renewable groundwater resources in these selected areas was determined. Results indicated that the desalination capacity exceeds 2-10 times the renewable groundwater resources in Qatar, Kuwait, Malta and Saudi Arabia, 10-50% in Libya and Barbados, and less than 0.5% in Jordan, Yemen and Singapore. In the future, a population growth from 51-116 million, 1995-2025, was assumed to be the driving force determining the need for desalination in order to maintain the current urban municipal domestic water consumption (an average of 0.265 m³/cap/d) in these countries. By 2000, a total sea and brackish water desalination capacity of 7.3 million m³/d was installed for municipal purposes in these countries. This indicated a growth in the desalination capacity of 1.9 million m³/d, 35%, between 1995 and 2000. By 2025, the growth in the municipal water desalination market will need to reach 14.8 million m³/d, 200%, to maintain the current urban municipal domestic water needs and to prevent any decline in renewable groundwater resources in the 10 water scarce countries selected in this study. ISSN: 0011-9164.

Breton, **Jean-François et Jean-Claude Roux**, « Le wâdî/Durâ': un modèle d'irrigation antique? » *Chroniques yéménites* [En ligne], 10. 2002, mis en ligne le 07 septembre 2007, Consulté le 10 octobre 2011. Abstract: Dans le gouvernorat de Shabwa, au sud de Ni/sâb, le wâdî /Durâ' a fait l'objet d'études pluridisciplinaires de 1992 à 1996. Ouvrages hydrauliques très variés, inscriptions nombreuses et datations par thermoluminescence des limons montrent que toute la vallée a été mise en valeur intensive pendant près de deux millénaires. Ces résultats permettent-ils d'élaborer un modèle, au moins qualitatif, d'une irrigation antique en relief semi-montagneux? Compte tenu des données disponibles, un modèle définitif ne peut être validé, toutefois les résultats obtenus permettent d'ébaucher une modélisation originale du wâdî /Durâ' et de ses affluents. URL : <http://cy.revues.org/128>.

“Bridge link.” 2007. *International Construction*, Sep 2007, Vol. 46 Issue 7, p7-7; 1/6. Subject Terms: Construction projects; Bridges- Design & construction; Construction contracts; Bin Laden, Sheikh Tarek Mohammed; Stockholders. Abstract: The article reports on the bridge construction plan of Bin Laden Group shareholder Sheikh Tarek Mohammed Bin Laden, in Yemen. The proposed 27.5 kilometers bridge construction will link Yemen and Djibouti on the Horn of Africa, in a bid to connect the Middle East and Africa. Meanwhile, the construction of the bridge has been estimated to take nine years. ISSN: 0020-6415.

Brown, G. F. 1960. “Geomorphology of Western and Central Saudi Arabia.” 21st International Geological Congress. Copenhagen. 1960. Report 21, part 21, pages 150-159.

Brown, G. F. and Jackson, R. O. 1960. “The Arabian Shield.” 21st International Geological Congress. Copenhagen, 1960. Report 21, part 9, pages 69-77.

Brown, Jeff L. “Record-Breaking Suspension Span to Link Two Continents.” *Civil Engineering*. American Society of Civil Engineers: Volume 77, Issue 8, Pages 36. Descriptors: Bridge design; Long span bridges; Arabian Peninsula; Djibouti; Red Sea; Yemen. Abstract: A planned bridge across the Red Sea would create an intercontinental bridge and the first direct ground transport between the Arabian Peninsula and the Horn of Africa. It would be some 700 meters longer than the current longest suspended bridge. The article describes the history and evolution of the project and plans for a fast-track schedule. Two alignments have emerged after a feasibility study, each consisting of two segments, anchored on an island in the Bab al Mandab strait. Its main spurs are exceptionally long, especially considering they are intended to carry highway traffic and railcars. Previous bridges of similar scope are discussed, as well as special

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considerations for this site. They include foundation needs in a geotechnically complex environment. Wind resistance is also an issue. The bridge would be located near the juncture of two tectonic plates. Work on feasibility continues. Database: TRIS. ISSN: 0885-7024.

Brown, Lester R. 2002. "Water Deficits Growing in Many Countries." *Appropriate Technology* 29.3 (2002): 36-. Abstract: In Yemen, a country of 19 million, the water table under most of the country is falling by roughly two meters a year. Under the capital, Sanaa, the water table is falling six meters per year, and the aquifer will be depleted by the end of this decade. Test wells are being drilled two kilometers deep, but they have failed to find water. Yemen must soon decide whether to bring water to Sanaa, possibly from coastal desalting plants, or to relocate the capital. Scores of other countries are also running up regional water deficits, including nearly all of those in Central Asia, the Middle East, and North Africa, plus India, Pakistan, and the US. In an increasingly integrated world economy, the shortfalls can cross national boundaries via the international grain trade. ISSN: 0305-0920.

Brown, Lester R. 2003. The Effect of Emerging Water Shortages on the World's Food; Whose Water is it? The Unquenchable Thirst of a Water-Hungry World. United States: National Geographic Society, Washington, DC, United States. Banff Mountain Summit; Mountains as Water Towers, Banff, AB. Canada Conference: Nov. 23-26, 2003. Descriptors: agriculture; Amu Darya; aquifers; Arabian Peninsula; Aral Sea; Asia; Central Asia; China; Commonwealth of Independent States; Far East; ground water; Huang He; hydrology; Iran; Middle East; North China Plain; Ogallala Aquifer; pumping; rivers and streams; Saudi Arabia; surface water; Syr Darya; United States; water; water management; water resources; water table; Yemen. Database: GeoRef. ISBN: 1894773144; 9781894773140. OCLC: 56371147.

Bruce, A. J. 2006. "Pontoniine Shrimps (Decapoda: Palaemonidae) from the Island of Socotra, with Descriptions of New Species of Dactyлонia Fransen, 2002 and Periclimenoides Bruce, 1990." *Zootaxa*. Issue 1137, Pages 1-36. Descriptors: Crustacea; Dactyлонia carinacula; Decapoda; Indian Ocean; New species; Periclimenoides socotrae; Pleocyemata; Pontoniinae; Socotra; Yemen. Notes: Cited By (since 1996): 1. Abstract: The present report provides information on 20 pontoniine shrimp taxa from the island of Socotra, collected by Dr Michael Apel, including two new species, of the genera Dactyлонia Fransen and Periclimenoides Bruce. Thirteen species are reported from Yemen for the first time, 8 are newly recorded from the north western Indian Ocean. The record of Periclimenoides is the first occurrence of this genus in the western Indian Ocean. The number of pontoniine shrimps known from the north west Indian Ocean is now increased from 32 to 44 taxa. Database: SCOPUS. ISSN: 1175-5326.

Brunner, Ueli. 2002. « Télédétection archéologique dans la Wadi Markha », *Chroniques yéménites* [En ligne], 6. 1997, mis en ligne le 25 novembre 2002, Consulté le 10 octobre 2011. Abstract : L'irrigation de crue était la spécialité de l'Arabie du Sud. Les eaux de crue, produites par les violentes pluies de printemps et d'été, étaient conduites directement dans les champs qui étaient submergés par environ un demi-mètre d'eau. Chaque année plus d'un centimètre de fins sédiments était déposé. A Marib, on trouve aujourd'hui de monotones dépôts de limons de plus de 30 m de haut. Après l'abandon de l'irrigation, ces sédiments clairs furent érodés par l'eau et le vent le long des canaux et des murets des champs, de sorte qu'apparaît aujourd'hui un schéma d'érosion en quadrillage. Les dépôts sédimentaires antiques dus à l'irrigation sont désormais l'élément géographique le plus frappant des grands wadis du Yémen. URL : <http://cy.revues.org/108>

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Brunner, U. 2000. "The Great Dam of Ma'rib in Yemen - an Example of Ancient Irrigation Techniques Adapted to the Local Environmental Conditions." *Wasser Boden*. Volume 52, Issue 10, Pages 4-10. Descriptors: agriculture; Arabian Peninsula; Asia; embankments; history; irrigation; methods; spatial distribution; water management; water storage; Yemen. Abstract: The research in Southern Arabia over the past two decades has revealed an indigenous hydraulic culture. Heavy tropical summer rains in the Yemeni mountains lead to a high runoff which pours down the wadis as flash floods. The Yemeni flood water irrigation system is capable of managing large amounts of water. An earth dam deflects part of the flood into a canal system. Large fields are flooded knee-deep. This soaks the soil sufficiently to produce a yield. The famous Great Dam of Ma'rib functioned in the same manner. The earth dam, up to 20 m high, 620 m long and at its base about 100 m wide, raised the water to the level of the fields. A sluice at each end of the dam served as entrances to the primary canals. A network of rectangularly arranged secondary canals distributed the water over the oasis. In this way irrigation was immediate. Surplus water was conducted back to the wadi by massively built overflows. The safety of the system was ensured by a wide spillway, an overflow at the south sluice regulating the amount of water entering the primary canal and by the weak dam which was washed away by extraordinarily big floods. The discussion leads to the conclusion that the Sabean oasis was irrigated in a sustainable manner in the true sense of the word. The best proof is given by the longevity of the arrangement. The Sabaeans faced only one severe problem; silting of the fields at an average of about 1 cm/year. In the end the Great Dam was used by the Sabaeans to conduct the sayl into another wadi. The reason for this was to evade the highest part of the oasis. The rapidly built dam system of al-Mabna caught the water on the north side of the oasis. From here a safe supply of the area around the capital was still possible. The new dam of Ma'rib and its irrigation system is described briefly. The comparison with the old dam shows the many disadvantages of the new one. Database: SCOPUS. ISSN: 0043-0951.

Brunner, Ueli. 1992. *Besuch im Wadi Marcha (visite au wadi Markha)*, Jemen Report n° 2, (1992).

Brunner, Ueli. 1983. *Die Erforschung der antiken Oase von Marib mit Hilfe geomorphologischer Untersuchungsmethoden* (Étude de l'oasis antique de Marib à l'aide de méthodes d'investigation géomorphologiques), *Archäologische Berichte aus dem Jemen*, vol. 2, Mayence, (1983).

Brunner, Ueli & Harold Haefner. 1990. "Altsüdarabische Bewässerungsoasen (oasis d'irrigation antique en Arabie du Sud)", *Die Erde*, pp. 135-153, (1990).

"BSG Provides Gratings for Sana'a Works." 2000. *Water & Environ Int*. Turret Rai Plc: 02. Volume 9, Issue 64, Pages 4. Descriptors: Sewage disposal plants; Yemen (Republic); British Standard Gratings (Company); DUMEZ-GTM (Company). Abstract: Reports on British Standard Gratings' contract for the supply of galvanized tubular handrailing and open steel flooring from French construction company Dumez-GTM for Sana'a sewage treatment works in Yemen. ISSN: 0956-0157.

Bunker, D. G. 1952-53. "Desert Locust Survey Reconnaissance. 1:500,000 map. Nairobi: Royal Geographical Society, London.

Bunker, D.G. 1953. "The Southwest Borderlands of the Rub' al Khali." *Geographical Journal*. Volume 19, part 4, pages 420-430.

Burdon, D. 1982. *Hydrogeological Conditions in the Middle East*. *Quarterly Journal of Engineering Geology* Vol 15, no 2, p 71-82, 1982.4 Fig, 26 Ref. Abstract: Five factors which influence infiltration to aquifers under conditions of low precipitation and high potential

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evapotranspiration in the Mideast are discussed. The predominance of fossil groundwater is the most striking hydrogeological phenomenon occurring on a regional scale in the Middle East. It is estimated that 65000 cubic kilometers of groundwater are stored in artesian basins. This is a nonrenewable resource. Renewable groundwater resources of the Middle East are of local rather than regional significance. Some originate outside the Middle East as surface flows in the Nile and Tigris-Euphrates and infiltrating into the sediments in and adjacent to the flood plains. Other renewable resources accumulate within the region where high precipitation and mountainous relief are associated. Such areas include the Tertiary fold mountains from the Taurus to the Oman ranges, and the volcanic and basement highlands of Yemen, Asir and Ethiopia. Locally, in areas of lower precipitation, lenses of recent fresh groundwater float on regional more saline groundwater. In some areas subsurface flows toward and through wadi systems are also of importance. Database: Technology Research Database. ISSN: 0481-2085. OCLC: 465359158.

Burns, Peter and Cooper, Chris. 1997. "Yemen: Tourism and a Tribal-Marxist Dichotomy." *Tourism Management*. 12. Volume 18, Issue 8, Pages 555-563. Descriptors: Yemen; politics; Marxism; Islam; Middle-East. Abstract: Tourism in the Middle East is experiencing expansion due to the Middle East peace process and the economic advantages of tourism. However, in the region there are also significant political and cultural constraints to the development of tourism. Yemen has historically been divided into North and South Yemen until the reunification in 1990. Tourism still bears the imprint of this division in terms of its organization, provision of resources and developments. Planning for tourism in Yemen is attempting to reconcile these past divisions and also to manage the growth of tourism in environmentally and culturally sensitive and vulnerable areas. This paper provides an analysis of tourism in Yemen in the mid 1990s, based on fieldwork visits by the authors. ISSN: 0261-5177.

Burns, SJ, Fleitmann, D., Matter, A., Kramers, J. and Al-Subbary, AA. 2003. "Indian Ocean Climate and an Absolute Chronology Over Dansgaard/Oeschger Events 9 to 13." *Science (Wash.)*. American Association for the Advancement of Science. 5 Sep. Volume 301, Issue 5638, Pages 1365-1367. Descriptors: Article Subject Terms: Palaeoclimate; Oxygen isotope ratio; Caves; Monsoons; Atmospheric precipitations; Geochronometry; Rainfall; Annual variations; Climatic changes; Paleoclimatology; Climatic oscillations; Monsoon precipitation; Oxygen isotopes; Paleoclimates; Article Geographic Terms: Yemen, Socotra; PN, Greenland; Indian Ocean; Greenland; ice cores; Speleothems; carbonates; calcite; stalagmites; Marine. Notes: OD: Object Subject Terms: Age y BP (yr); Oxygen-isotope $\delta^{18}\text{O}$; Oxygen-isotope $\delta^{17}\text{O}$; U/Th age determinations; Water depth (mm); Object Statistical Terms: Average; Mean; TR: CS0318005. OD: Object Subject Terms; Age y BP (yr); Oxygen-isotope $\delta^{18}\text{O}$; Object Statistical Terms; Average. Abstract: Oxygen-isotope ratios of a stalagmite from Socotra Island in the Indian Ocean provide a record of changes in monsoon precipitation and climate for the time period from 42 to 55 thousand years before the present. The pattern of precipitation bears a striking resemblance to the oxygen-isotope record from Greenland ice cores, with increased tropical precipitation associated with warm periods in the high northern latitudes. The largest change, at the onset of interstadial 12, occurred very rapidly, in about 25 years. The chronology of the events found in our record requires a reevaluation of previously published time scales for climate events during this period. Database: Aquatic Sciences. ISSN: 1095-9203.

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Camberlin, P., Fontaine, B., Louvet, S., Oettli, P. and Valimba, P. 2010. "Climate Adjustments over Africa Accompanying the Indian Monsoon Onset." *J. Climate*. American Meteorological Society: 04/01; 2011/04. Volume 23, Issue 8, Pages 2047-2064. ISSN: 0894-8755. URL: <http://dx.doi.org/10.1175/2009JCLI3302.1>.

Cantor, Sidney M. United Nations Development Programme and Food and Agriculture Organization of the United Nations. 1970. Report to the Government of Southern Yemen on a Suggested Programme of Water Development Studies. Rome: Food and Agriculture Organization of the United Nations. Page(s): 65. Descriptors: Irrigation -- Yemen (Republic); Government publication; International government publication. Notes: xi; ill., maps; 28 cm; Note(s): Errata inserted; Other Titles: Suggested programme of water development studies; Responsibility: based on the work of G. Y. Jolankai. OCLC Accession Number: 85213347.

Caponera, DA. 1973. "Water Laws in Moslem Countries." Food and Agriculture Organization of the United Nations. Rome, Irrigation and Drainage Paper NO 20/1. 202 Pages, 118 Refs. FAO agricultural development paper, no. 43. Descriptors: Water Resources; Water Law; Legislation; Water Rights; Reviews; Legal Aspects; Water Resources Development; Arid Lands; Asia; Africa; Irrigation; Moslem Water Law; Afghanistan; Bahrain; Brunei; Iran; Jordan; Kuwait; Morocco; Qatar; Somalia; Tunisia; The Peoples' Democratic Republic Of Yemen; Yemen Arab Republic. Abstract: this is a revision of FAO agricultural development paper no. 43, 'water laws in Moslem countries' published in 1954. The earlier paper has been outdated by changes in water law and by the emergence of many new nations in the Moslem world. In this, volume one of a two volume update, a general introduction is given and twelve nations (Afghanistan, Bahrain, Brunei, Iran, Jordan, Kuwait, Morocco, Qatar, Somalia, Tunisia, The Peoples' Democratic Republic of Yemen, and the Yemen Arab Republic) are described. Since Moslem law is based upon revelations transmitted from Allah to man through the agency of the prophet Mohammed, its religious overtones are unmistakable and western planners must expect plans to be suspect which ignore or contradict this divine law. Moslem law has faced the practical problems of dividing a limited resource among the populace; however, it should be remembered that the scarcer the water is, the more complicated and elaborate the regulations are. Modern tendencies in Moslem water law make water a national resource under central control and ownership. This is compatible with traditional Islamic thinking which has always viewed the concept of community interest as the basis of Moslem water law. Database: Water Resources Abstracts. OCLC: 468841174; 5768722.

Carter, H. J. 1852. "Geographical Description of Certain Parts of the Southeast Coast of Arabia, and a Short Essay on the Comparative Geography of the Whole Coast." *Royal Asiatic Society, Bombay Branch Journal*. Volume 3, part 2, pages 224-317.

Caton-Thompson, G. 1938. "Geology and Archaeology of the Hadhramaut, Southwest Arabia; Preliminary Notes on Lord Wakefield Expedition." *Nature*. Volume 142, number 3586, pages 139-142.

Caton-Thompson, G. and Gardner, E.W. 1939. "Climate, Irrigation and Early Man in Hadhramaut." *Geog. Journal*. Volume 93, number 1, pages 18-38.

Carver, Michael. 1990. *War since 1945*. London: The Ashfield Press. Page(s): 322. Notes: 322 p., [8] leaves of plates: ill. 23 cm. Includes index. OCLC Accession Number: 7006633.

Cederstrom, D. J. 1971. "Ground Water in the Aden Sector of Southern Arabia." *Ground Water*. National Water Well Association, Ground-Water Technology Division, Urbana, IL.

Geology of Yemen

Volume 9, Issue 2, Pages 29-34. Descriptors: Aden Yemen; Arabian Peninsula; Asia; ground water; hydrogeology; resources; Yemen. Database: GeoRef. ISSN: 0017-467X.

Center for Naval Analyses, Alexandria, VA and Thompson Eric, Asfura-Heim Patricio. 2008. "Assessments of the Impact of 1206-Funded Projects in Selected Countries: Lebanon, Pakistan, Yemen, Sao Tome, and Principe." Jul. Page(s): 58 Report Number: CRM-D0017988.A4-REV-1 XD-GSA/DC Contract Number: N00014-05-D-0500 Monitor Series: GSA/DC. Abstract: This study examines the operational effects of 1206 global train and equip programs in Lebanon, Pakistan, Yemen, Sao Tome, and Principe. Abstract Classification: Unclassified. Technical Reports Collection. Distribution Statement: Approved for public release; distribution is unlimited. OCLC Accession Number: ADA485160. URL: <http://handle.dtic.mil/100.2/ADA485160>.

Center for Naval Analyses, Alexandria, VA and Thompson Eric, Asfura-Heim Patricio. 2008. "Assessment of the Impact of 1206 Funded Projects in Lebanon, Pakistan, Yemen, Sao Tome and Principe." May. Page(s): 57 Report Number: CRM-D0017988.A2 XD-GSA/DC Contract Number: N00014-05-D-0500 Monitor Series: GSA/DC. Abstract: This study examines the operational effects of 1206 global train and equip programs in Lebanon, Pakistan, Yemen, Sao Tome and Principe. Abstract Classification: Unclassified Technical Reports Collection. Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA482627. URL: <http://handle.dtic.mil/100.2/ADA482627>.

Chakraborty, Rajib. 2005. "Ma'rib Dam and Irrigation Project--a Wonder in the Desert." Proceedings of the Institution of Civil Engineers. Civil Engineering. 08. Volume 158, Issue 4, Pages 170-177. Descriptors: Dams -- Design & construction; Irrigation projects; Construction contracts; Agricultural engineering projects; Water -- Storage; Yemen (Republic); barrages & reservoirs; dams; drainage; floods; floodworks; irrigation. Abstract: The article focuses on the design and construction of the Ma'rib irrigation project in Yemen. Detailed designs and tender documents for the dam project were completed in 1981 and a construction contract was eventually signed between ADFD and Dogus Construction Co. of Turkey in 1984, with supervision and design by EWI. The new Ma'rib Dam impounds a 10 km long, 400 million m storage reservoir occupying 31 km of the Jabel Balaq Gorge. The dam is a 780 m long, 38 m high zoned earth-fill structure with a central impervious core providing a positive cut-off in the alluvial foundation and shell zones on either side. ISSN: 0965-089X.

Chang, Yeon S., Özgökmen, Tamay M., Peters, Hartmut and Xu, Xiaobiao. 2008. "Numerical Simulation of the Red Sea Outflow using HYCOM and Comparison with REDSOX Observations." J. Phys. Oceanogr. American Meteorological Society: 02/01; 2011/04. Volume 38, Issue 2, Pages 337-358. ISSN: 0022-3670. URL: <http://dx.doi.org/10.1175/2007JPO3697.1>.

Chaouachi, K. T. 2007. "Qat Chewing and Water Pipe (Mada'a) Smoking in Yemen: A Necessary Clarification when Studying Health Effects on Oral Mucosa." Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod. Volume 104, Issue 6, Pages 731-733. Notes: Cited By (since 1996): 2. Database: SCOPUS. ISSN: 1079-2104.

Charalambous, AN. 1982. "Problems of Groundwater Development in the Sana'a Basin, Yemen Arab Republic." Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity IAHS Publication no.136. Proceedings of a Symposium Held at the First Scientific General Assembly of the IAHS at Exeter. England, July 19-30. Pages 265-274. 5 ref. Descriptors: Groundwater mining; Groundwater potential; Aquifers; Groundwater depletion; Water demand; Yemen; Geohydrology; Groundwater level; Groundwater recharge; Wells; Boreholes; Water resources

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development; Sana'a Basin; Competing use; Sandstone. Abstract: Until recently the hydrogeology of the Sana'a was little known. Studies in 1972 to identify a source of water supply for Sana'a indicated that the Tawilah sandstone could meet the city's requirements to the year 2000 and beyond. Thus, all further work was directed in developing this aquifer. At the same time, local farmers who until recently relied on abstraction from shallow well, embarked on a program of intensive exploitation by boreholes, which has remained largely uncontrolled. This has led to declining water levels which have placed the now completed wellfields at serious risk. Examination of the aquifer in the light of the present situation indicates that previous assessments of recharge by the throughflow method have significantly overestimated the resource. Lack of data rather than hydrogeological techniques are considered to have been the major factor. Database: Water Resources Abstracts. ISSN: 0144-7815. OCLC: 9222814.

Chaudhary, Junaid Rafi and Husain, Tahir. 2007. Uncertainty Analysis of Humidity and Precipitation Changes using Data from Global Climatic Models with a Case Study. Ottawa, ON, Canada: Inst. of Elec. and Elec. Eng. Computer Society. 2006 IEEE EIC Climate Change Technology Conference, EICCCC 2006, may 10, 2006 - may 12. Conference: 2006. Descriptors: Atmospheric humidity; Climate change; Mathematical models; Precipitation (chemical); Uncertainty analysis. Abstract: The process of assessing vulnerability in agriculture, water resources, marine and terrestrial ecosystems, and coastal zone management due to climate change requires construction of predicted vision of climate scenarios under physically reasonable assumptions of greenhouse gas levels. In arid and hot climatic conditions, even minor climatic changes will have significant impact on survival of plant species, wild animals, and other desert ecosystems as well as on human health. The paper presents future changes in temperature, precipitation and humidity in Yemen, Oman, UAE and Qatar under different scenarios using IPCC database derived through GCM's. Various climatic change scenarios developed by IPCC were reviewed, A2 and B2 climatic scenarios were selected for the study. Long-term simulated records derived by the following models were retrieved from the database: 1. Hadley Model - (HADCM3) 2. Canadian Climatic Model - (CGCM2) 3. National Center for Atmospheric Research Model - (NCAR-PCM) Using 1970-2000 values as baseline, variations in 2020-2050 and 2070-2099 were estimated and statistically analyzed to determine uncertainties in prediction. Summarized impacts of climate change on human health based on empirical approach for the region is presented in the paper to make it better prepared (adapted) to the climatic changes with recommendations on future capacity building In modeling and data collection. 2006 IEEE EIC climate change technology conference, EICCCC 2006. ISBN: 1424402182.

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Photo Credit: Cheryl Rodewig. A hamadryas baboon stretches his jaws Saturday inside his cage. Found in Ethiopia, Saudi Arabia, Somalia and Yemen, this species grows up to 37 inches long and lives for around 35 years. url: <http://www.army.mil/media/83053>



Chazot, Gilles, Lowry, David, Menzies, Martin and Matthey, David P. 1997. "Oxygen Isotopic Composition of Hydrous and Anhydrous Mantle Peridotites." *Geochim. Cosmochim. Acta*. Pergamon, Oxford, International. Jan. Volume 61, Issue 1, Pages 161-169. Descriptors: Alaska; Arabian Peninsula; Asia; chain silicates; coexisting minerals; experimental studies; fluid phase; igneous rocks; inclusions; isotope ratios; isotopes; mantle; megacrysts; metasomatism; nesosilicates; Nunivak Island; O-18/O-16; olivine; olivine group; orthosilicates; oxygen; peridotites; plutonic rocks; pyroxene group; silicates; Southwestern Alaska; spinel lherzolite; stable isotopes; ultramafics; United States; water; xenoliths; Yemen. References: 41; illus. incl. 3 tables. Database: GeoRef. ISSN: 0016-7037.

Chen, M. Zuo, J. Li, P. Du, L. and Li, L. 2007. Current and Thermohaline Characteristics of the Arabian Sea during January 1998. Springer-Verlag (Heidelberg). *Journal of Ocean University of China*. Volume: 6, no. 2, page(s): 117-124. Abstract: Based on a ship survey during

January 1998, the characteristics of the flow, the thermohaline properties and the volume transport of the Arabian Sea are discussed. A strong westward flow exists between 10.5 degree N and 11 degree N, part of which turns to the south as the Somali current near the coast at about 10 degree N and the rest turns north. At the passage between the African continent and the Socotra Island, the northern branch separates into two flows: the left one enters the passage and the right one flows eastward along the southern slope of the island. Off the island the flow separates once more, most of it meandering northeast and a small fraction flowing southeast. Volume transport calculation suggests that the tidal transport is one or two orders of magnitude smaller than the total transport in this region and it becomes more important near the coast. The average velocity of the flow in the upper layer (0-150m) is about 20 cm s⁻¹, with a maximum of 53 cm s⁻¹ appearing east of the Socotra Island, and the subsurface layer (200-800m) has an average velocity of 8.6 cm s⁻¹; the velocity becomes smaller at greater depths. The depth of the seasonal thermocline is about 100m, above which there is a layer with well mixed temperature and dissolved oxygen. High-salinity and oxygen-rich water appears near the surface of the northern Arabian Sea; a salinity maximum and oxygen minimum at 100m depth along 8 degree N testifies the subduction of surface water from the northern Arabian Sea. Waters from the Red Sea and the Persian Gulf also influence the salinity of the area. ISSN: 1672-5182. Database: Technology Research Database.

Cheng, Michael L., Leal, Marco A. and McNaughton, David. 1999. "Productivity Prediction from Well Logs in Variable Grain Size Reservoirs Cretaceous Qishn Formation, Republic of Yemen." *The Log Analyst*. Society of Professional Well Log Analysts, Houston, TX, United States: United States. Feb. Volume 40, Issue 1, Pages 24-32. Descriptors: Arabian Peninsula; Asia; calibration; clastic rocks; cores; Cretaceous; geophysical surveys; grain size; Masila Block; Mesozoic; models; natural gas; permeability; petroleum; petroleum engineering; production; Qishn Formation; quantitative analysis; reservoir properties; reservoir rocks;

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resistivity; sedimentary rocks; surveys; well logs; Yemen. References: 5; illus. incl. chart, 2 tables, sketch map. Abstract: The Upper Qishn Clastics of Cretaceous age are the primary producing reservoirs in the Masila Block Development area. The underpressured, low gas-oil ratio reserves require artificial lift from initial completion. Electric submersible pumps are used to produce these reservoirs; consequently, knowledge of initial reservoir productivity is essential to the well completion designs and pump sizing. Conventional core and log evaluation methods used to predict reservoir productivity have not been reliable because of variation in reservoir quality and facies changes between pools. A simple and cost effective prediction technique using commonly available open-hole log data has been developed. The method uses log-derived normalized resistivity ratios ($R(\text{sub } n) = \log \{ (R(\text{sub } t) / R(\text{sub } w)) / (R(\text{sub } xo) / R(\text{sub } mf)) \}$), that characterize reservoir fluid mobility, and predict well productivity indices (PIs). The correlation was developed using well test data from 20 oil bearing zones in 9 wells, and is routinely applied to predict initial PIs in new development wells. The method has been proven effective over four years of field development and production in the Masila Block. The $R(\text{sub } n)$ technique is a natural extension of the conventional moved-oil plot method in log analysis that is used to infer zones of maximum permeability and movable hydrocarbon. The model is simple and appears to be grain size independent. Further, the technique does not require complex petrophysical and geological analysis; it utilizes data sets (i.e., dual laterolog with microspherically focused resistivity devices) that are consistent between wells. Database: GeoRef. ISSN: 0024-581X.

Chizhikova, N P, N A Goncharova, M P Verba, and Awad Said Al'-Kasiri. 1995. "Mineralogy of Desert Soils in the Hadramawt Valley (Yemen) and Changes Following Irrigation". *Eurasian Soil Science*. 27, no. 3: 91. ISSN: 1064-2293. OCLC: 89283162.

Chorin, Ethan Daniel. "Von Clausewitz Meets Sea-Air: Examining the Link between Internal Transportation Infrastructure, Transshipment and Income Growth in the Republic of Yemen." 30-01792 UMI. Pages 169 pages. Descriptors: Container terminals; Design; Economic development; Economics; Impact; Impacts; Infrastructure; Ports; Roads; Shipments; Yemen; Aden. Notes: Thesis--University of California, Berkeley, 2000. Microfiche. Ann Arbor, Mich.: Bell & Howell Information and Learning Company, 2001 2 microfiches; 11 x 15 cm. vi, 169 leaves; Bibliography; Illustrations. Abstract: Examining the link between internal transportation infrastructure, transshipment and income growth in the Republic of Yemen. Database: TRIS. OCLC: 47633673.

Chowdary, JS, Gnanaseelan, C., Thompson, B. and Salvekar, PS. 2005. "Water Mass Properties and Transports in the Arabian Sea from Argo Observations." *J. Atmos. Ocean Sci.* Sep. Volume 10, Issue 3, Pages 235-260. Descriptors: Advection; Climatological means; High salinity waters; Isopycnals; Isotherms; Marginal seas; Monsoons; Ocean circulation; Ocean-atmosphere system; Oceanographic data; Potential density; Salinity decrease; Salinity profiles; Salinity structure; Salinity variations; Seasonal variability; Southwest monsoon; Strong winds; Summer monsoon; Upper ocean; Water mass properties; Water mass structure; Water masses; Article Taxonomic Terms: Socotra; Article Geographic Terms: Arabian Sea; Arabian Sea, Persian Gulf; Red Sea; Yemen, Socotra; World Ocean; Marine. Abstract: The information acquired from Argo floats such as temperature and salinity profiles is used to study water mass properties in the Arabian Sea from 2002 to 2004. An examination of water mass structure at different locations reveals the presence of high salinity water of marginal seas in the Arabian Sea. During the southwest monsoon season, the impact of the early onset of southwesterlies is noticed in the upper ocean temperature and salinity structure over the Western Arabian Sea

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(WAS) during 2002. Surface density variations are found to be more during the southwest monsoon season due to strong wind forcing. Argo temperature and salinity profiles showed that the winter cooling and the formation of Arabian Sea High Salinity Water (ASHSW) over the Northern Arabian Sea (NAS) began during the second half of November within the upper 100 m depth. In the NAS, the Persian Gulf Water (PGW) salinity is above 36, as PGW moves towards the south along isopycnal layer of 26.6 sigma sub(theta) (sigma sub(theta) is potential density) salinity decreases. It is observed that the PGW high salinity water is not continuously prominent over the WAS in 2002 and in 2003. In the WAS the 27.2 sigma sub(theta) isopycnal layer depth, corresponding to Red Sea Water (RSW), did not exactly follow the pattern of isotherms as is seen in the northern and eastern Arabian Sea. The variability related to RSW salinity is due to the underwater currents. The present study also confirms that RSW is prominent in the southeast Arabian Sea at the potential density of 27.2 with a maximum in summer monsoon compared to other seasons. The observed peak in the salinity at 27.2 density level during the spring intermonsoon is due to the influence of winter time spreading of RSW to the south of Socotra in 2002. Westward movement of Argo floats in the region east of Socotra during the winter is evident in both the observations and model studies. Water mass properties change when they move away from their source region due to the consistent horizontal advection. The changes in the water mass properties along the Argo float trajectory are confirmed by comparing with the climatological mean monthly values from the World Ocean Atlas 2001 data set. Database: Meteorological & Geostrophysical Abstracts. ISSN: 1741-7538.

Christie, Susan J.. 2005. "Socotra's road to Ruin." Geographical (Campion Interactive Publishing); May 2005, Vol. 77 Issue 5, p60-64, 5p, 6 Color Photographs, 1 Map. Keywords: roads -- Design & construction; public works; Transportation; Socotra (Yemen). Abstract: Discusses the possible effects of road infrastructure development on the archipelago of Socotra in **Yemen**. Information on the road infrastructure project in the island; Problems concerning erosion of road beds in the island; Inset: The weird and wonderful world of Socotran flora. ISSN: 0016-741X.

Clark, Janine A. 2004. Islam, Charity, and Activism: Middle-Class Networks and Social Welfare in Egypt, Jordan, and Yemen. Bloomington, IN, Indiana University Press, 2004. 236 p. ISBN: 0253343062; 9780253343062; 0253216265; 9780253216267. OCLC: 52086027.

Clark, PB and Davies, SMA. 1988. "Application of Regime Theory to Wadi Channels in Desert Conditions." International Conference on River Regime. Hydraulics Research Limited, Wallingford, Oxon UK. 1988. Pages 67-82, 5 Fig, 3 Tab. 18 ref. Descriptors: Hydrological regime; Yemen; Ephemeral streams; Alluvial channels; Sediment transport; Channel morphology; Flow characteristics; Steep slopes; Mathematical equations; Discharge hydrographs. Abstract: In South Yemen slopes are extremely steep, channel sections cannot be considered stable and the ephemeral nature of flows and their infrequency raises problems as to the nature of any regime condition and even to the concept itself. In addition, the activities of man have had a significant effect on the channel section. Therefore, an attempt has been made to establish general hydraulic parameters for each reach in order to allow for the design of a future program for individual training and bank protection programs. The evidence suggests that Bray 's regime relationship for channel width gives reasonable values when used with representative flows of greater rarity than are usually considered applicable. Such flows have been estimated to have return periods of between about 5 and 20 years and there is some indication that the return period is a function of the frequency of spate flows. Other available regime relationships relating depth of flow and slope to a representative flow appear not to be applicable for these very steep

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channels. Equations for the slope/discharge relationships have been developed from the data set but, particularly in view of the difficulty in defining the dominant discharge, these must be viewed as tentative. A relationship between the channel wavelength and dominant discharge has also been developed as this wavelength appears to be a measurable parameter that might provide an independent check on the dominant discharge for further work on this type of channel.

Database: Water Resources Abstracts. ISBN: 0471919551; 9780471919551. OCLC: 17550893.

Claudon, M., Viillard, Y. and Elmerich, A. 1982. "Hydrotelluric Fluorotic Intoxication in North Yemen. First Results." *Med. Trop.* Volume 42, Issue 3, Pages 327-337. Notes: Cited By (since 1996): 2. Database: SCOPUS. ISSN: 0025-682X.

Cna Analysis and Solutions, Alexandria, VA and Kaufman, Alison A. 2009. "China's Participation in Anti-Piracy Operations Off the Horn of Africa: Drivers and Implications." Jul. Page(s): 19 Report Number: MISC-D0020834. A1 XD-XD Monitor Series: XD. Abstract: In December 2008, the navy of the People's Republic of China (People's Liberation Army Navy, or PLAN) deployed a task force, made up of two guided missile destroyers and a supply ship, to participate in international antipiracy operations off the coast of Somalia, in the Gulf of Aden/Horn of Africa (HoA) region. This deployment marked the first time in modern history that China's navy has engaged in an operational mission outside of its claimed territorial waters. The PLAN's participation in international anti-piracy operations has been viewed by many in the United States and elsewhere as an indication of China's apparent willingness to take on a larger military role on the global stage. Unclassified Technical Reports Collection. Distribution Statement: Approved for public release; distribution is unlimited. OCLC Accession Number: ADA503697. URL: <http://handle.dtic.mil/100.2/ADA503697>.

Coleman, R. G., DeBari, S. and Peterman, Z. 1992. "A-Type Granite and the Red Sea Opening." *Tectonophysics*. Volume 204, Issue 1-2, Pages 27-40. Notes: Cited By (since 1996): 13. Abstract: Miocene-Oligocene A-type granite intrudes the eastern side of the Red Sea margin within the zone of extension from Jiddah, Saudi Arabia south to Yemen. The intrusions developed in the early stages of continental extension as Arabia began to move slowly away from Africa (around 30-20 Ma). Within the narrow zone of extension silicic magmas formed dikes, sills, small plutons and extrusive equivalents. In the Jabal Tirf area of Saudi Arabia these rocks occur in an elongate zone consisting of late Precambrian basement to the east, which is gradually invaded by mafic dikes. The number of dikes increases westward until an igneous complex is produced parallel to the present Red Sea axis. The Jabal Tirf igneous complex consists of diabase and rhyolite-granophyre sills (20-24 Ma). Although these are intrusive rocks their textures indicate shallow depths of intrusion (< 1 km). To the south, in the Yemen, contemporaneous with alkali basaltic eruptions (26-30 Ma) and later silicic eruptions, small plutons, dikes, and stocks of alkali granite invaded thick (1500 m) volcanic series, at various levels and times. Erosion within the uplifted margin of Yemen suggests that the maximum depth of intrusion was less than 1-2 km. Granophyric intrusions (20-30 Ma) within mafic dike swarms similar to the Jabal Tirf complex are present along the western edge of the Yemen volcanic plateau, marking a north-south zone of continental extension. The alkali granites of Yemen consist primarily of perthitic feldspar and quartz with some minor alkali amphiboles and acmite. These granites represent water-poor, hypersolvus magmas generated from parent alkali basalt magmas. The granophyric, two-feldspar granites associated with the mafic dike swarms and layered gabbros formed by fractional crystallization from tholeiitic basalt parent developed in the early stages of extension. Initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratios of these rocks and their bulk chemistry indicate that production of peralkaline and metaluminous granitic magmas involved

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both fractionation and partial melting as they ascended through the late Precambrian crust of the Arabian plate. Database: SCOPUS. ISSN: 0040-1951.

Combes, H., Pierre Caulet, J. and Tribovillard, N. 2005. "Monitoring the Variations of the Socotra Upwelling System during the Last 250 Kyr: A Biogenic and Geochemical Approach." *Palaeogeography, Palaeoclimatology, Palaeoecology*. 1 Aug. 2005. Volume 223, Issue 3-4, Pages 243-259. Descriptors: Article Subject Terms: Community composition; Fronts; Geochemistry; Organic carbon; Palaeoceanography; Palaeoecology; Paleooceanography; Seasonal variability; Sediment chemistry; Thermocline; Trace elements; Trace elements in seawater; Upwelling; Article Taxonomic Terms: Radiolaria; Article Geographic Terms: Indian Ocean; Indian Ocean, Socotra Gyre; Yemen, Socotra. Abstract: A combination of changes in the species composition of the radiolarian populations, and in the sediment chemical composition (content and mass accumulation rates of carbonate, organic carbon, and selected major and trace elements, with special attention paid to Ba) is used to reconstruct the variations in upwelling activity over the last 250 kyr in the Socotra gyre area (Somali-Socotra upwelling system, NW Indian Ocean). In the Socotra gyre (Core MD 962073 at 10 super(o)N), the variations in upwelling intensity are reconstructed by the upwelling radiolarian index (URI) while the thermocline/surface radiolarian index (TSRI) testifies to productivity variations during non-upwelling intervals. Despite an origin related both to marine and terrigenous inputs, the geochemical records of organic carbon, silica, and trace elements (Ba, P, Cu, and Zn) normalized to Al are controlled by the variations in surface paleoproductivity. The data indicate a continuous increase in upwelling intensity during the last 250 kyr with a maximum activity within the MIS 3, while high productivity periods in between the upwelling seasons occurred both during glacial and interglacial intervals. A comparison of our data with published observations from another gyre of the Somalian upwelling area located at 5 super(o)N in the Somali gyre area shows differences regarding periods of upwelling activity and their geochemical imprint. Three hypotheses are proposed to explain these differences: (1) changes in the planktonic community, resulting in more silica-rich deposits in the Socotra gyre, and more carbonate-rich deposits in the Somali gyre, that are controlled by differences in the source water of the upwelling; (2) a more important terrigenous input in the southern gyre; and (3) a different location of the sites relative to the geographic distribution of the upwelling gyres and hydrologic fronts. Database: Meteorological & Geostrophysical Abstracts. ISSN: 0031-0182.

COMSICCA. 2005. "Fleeing One War, Finding another: Support for Somali Refugees in Yemen." *Community Dev. J.* April 1. Volume 40, Issue 2, Pages 201-204. Abstract: This case study describes the work of COMSICCA, a Yemeni NGO working with refugees. ISSN: 0010-3802.

Commission for the Geological Map of the World/Commission for the Geological Maps of the Middle East (CGM/CGMME). 2010. "Yemen." The CGMW, the oldest international organization in geosciences after the International Geological Congress (IGC), was created in 1881 during the 2nd IGC in Bologna. It is a non-profit-making scientific and educational body governed by French law. The CGMW is responsible for designing, promoting, coordinating, preparing and publishing small-scale thematic (geology, tectonics, ore deposits, natural resources, climate, etc.) Earth Science maps of continents, major regions, and oceans. In the context of its mission, the CGMW intends to play a leading role in the use and diffusion of digital cartographic techniques, as well as in the development of international standards. See: <http://www.cgmme.com/Article.aspx?CId=Yemen&Txt=1>

Geology of Yemen

Conference on Alternative Strategies for Desert Development and Management. 1982. United Nations, Inst. for Training and Research. 1977, Sacramento, Calif. *Alternative Strategies for Desert Development and Management 3, Water*. New York: Pergamon Press, 1982. Environmental sciences and applications, 3, 3. UN document symbol recorded as UNITAR/CR/16 on all 4 vols. Includes bibliographical references. Material type: Conferences, etc. (proceedings/final reports). Proceedings of the Conference on Alternative Strategies for Desert Development and Management co-sponsored by United Nations Institute for Training and Research and the State of California. ISBN 0-08-022404-0. OCLC: 8114955.

Connor, Ken. 1998. *Ghost Force: The Secret History of the SAS*. London: Weidenfeld & Nicolson. Page(s): 375. Abstract: Desert warriors 1941-45 -- Malaya 1950-58 -- Jebel Akhdar 1958-59 -- Return to the West 1958-63 -- Brunei and Borneo 1962-66 -- The Kennedy assassination 1963 -- Aden 1964-67 -- Operation Storm, Dhofar 1970-77 -- Northern Ireland 1968-97 -- Terrorism 1968-98 -- Iranian Embassy 1980 -- The Falklands 1982 -- Afghanistan 1982-89 -- Cold War 1945-90 -- Gulf War 1990-91 -- The future -- Appendix: Extracts from the Founding principles of the SAS, laid down by David Stirling. "Buy this book and you are getting more than SAS history and lore, but geo-political facts. Long and winding, but well worth it." Notes: xiii, 375 p., [16] p. of plates: ill., ports. 26 cm. ISBN: 0297840800. OCLC Accession Number: 40876666.

"Conservation of Old Sana'a, Yemen." 1995. *Architectural Review*. 11. Volume 198, Issue 1185, Pages 78-78. Descriptors: Architecture -- Conservation & restoration; Water utilities; Streets; Alleys; Buildings -- Repair & reconstruction; Yemen (Republic). Abstract: The article describes the conservation project in Sana'a, Yemen. Using technical studies, the Yemeni government has been organizing water supplies and sewerage and a paving program which has already covered half the city's streets and alleys with black basalt and white limestone. Some of the old buildings have been converted into women's technical school, art and galleries and hotels. ISSN: 0003-861X.

Coque-Delhuille, Brigitte and Gentelle, Pierre. 1992. "Sedimentations et Erosions Historiques Dans La Vallée Du Wadi Bayhan (Yemen). Historic Erosion and Sedimentation in the Wadi Bayhan Valley, Yemen; 27th International Geographical Congress; Technical Program Abstracts." *Technical Program Abstracts - International Geographical Congress. International Geographical Congress, [location varies], International. Volume 27, Pages 119-120*. Descriptors: Arabian Peninsula; Asia; Cenozoic; desertification; erosion; fluvial features; fluvial sedimentation; Quaternary; sedimentation; valleys; Wadi Bayhan; wadis; water erosion; Yemen. Database: GeoRef.

Coque-Delhuille, Brigitte. 2011. « Paléoenvironnements historiques et géoarchéologie dans la région du Wadi Dura' », *Chroniques yéménites* [En ligne], 6 | 1997, mis en ligne le 21 octobre 2002, Consulté le 26 septembre 2011. URL: <http://cy.revues.org/82>.

Coque-Delhuille, B. 1994. "Caractéristiques, genèse et signification des vernis désertiques: l'exemple du Yémen", *Les milieux arides et semi-arides. Héritages et dynamiques actuelles*, Colloque en l'honneur de R. Coque, publications ENS Fontenay-Saint-Cloud, (1994), pp. 259-287.

Coque-Delhuille, B. et P. Gentelle. 1994. "Erosion historique et actuelle et environnement humain dans le sud du désert arabe (Yémen du Sud)", *Publications de l'ORSTOM, Colloque ORSTOM sur l'environnement humain de l'érosion, Paris-Bondy, (1994)*, pp. 345-360.

Geology of Yemen

Coque-Delhuille, B. et P. Gentelle. 1995. "Crues et sédimentation contrôlée au Yémen antique", publications du Colloque *Crues, versants et lits fluviaux. Processus naturels et impacts des activités humaines*, Colloque du Laboratoire de Géographie physique, URA 141 CNRS Meudon, Paris, (mars 1995).

Coque-Delhuille, B. et P. Gentelle. 1995. "Aeolian dust and superficial formations in the Arid part of Yemen", conférence internationale Al Ain (Emirats Arabes Unis), (décembre 1995), Quaternary Deserts and Climatic Change, à paraître in *Balkema Press*, Pays-Bas.

Coque-Delhuille, B. et P. Gentelle. 1995. "Ancient irrigation (sayl) and south-arabian anthrosols in the wadi Dura' valley (Yemen)", *Publications of the Ministry of Water Resources, Sultanate of Oman*, (1995), pp. 122-128.

Coque-Delhuille, B. et P. Gentelle 1995. "Le Yémen aride: environnements quaternaires, historiques et actuels", *Sécheresse*, (1995), numéro spécial sur les sécheresses dans le monde, pp. 67-75.

Corstange, Daniel M. 2008. *Institutions and Ethnic Politics in Lebanon and Yemen*. United States -- Michigan: University of Michigan. ProQuest Dissertations and Theses. Abstract: This dissertation presents three essays based on the theme of ethnicity and institutions, utilizing insights and data collected from Lebanon and Yemen, two Arab societies within which ethnicity (sect, tribe, and region) is salient socially and politically, but which use different institutions to channel these cleavages through the political system. The first essay uses a methodological innovation to study illiterate voting rights in Lebanon, which has normative, sectarian and distributional consequences. It first addresses the difficulties of studying sensitive topics with surveys, in which systematic response bias severely limits the reliability of self-reported data. I present an augmented version of the list experiment and a new statistical estimator called listit to mitigate incentives for respondents to misrepresent themselves. I show that responses to a direct question on illiterate voting rights produce sectarian answers: community membership drives attitudes, whereas material conditions do not. The opposite obtains when the question is asked indirectly via the list experiment: community membership has no influence on attitudes, which instead are driven strongly by material conditions. The second essay studies institutional preferences in Lebanon. Given the salience of sectarianism in Lebanon, it argues that preferences should vary by community membership. Although religion provides the nominal boundaries between the sectarian communities, the Lebanese are also able to invoke shared religious ideals to imagine a larger community beyond the sect: religion unites as well as divides. I show that religiosity reduces favorable assessments of autocratic institutions in all sects, suggesting that religious individuals conceive of the polity in more inclusive terms than do sectarian individuals. The third essay compares Lebanon and Yemen and argues that the descent principle makes ethnic constituencies captive audiences to their own elites, reducing the cost of political support. The price of votes depends on the institutionally-influenced intraethnic competitive environment: oligopsony, in which elites compete for their coethnics' votes, or monopsony, in which a single vote-buyer is dominant and constituents compete for patronage. I provide evidence that constituents in monopsonized communities--Lebanese Sunnis and Yemeni Shiites--make overt displays of political support for leaders with patronage considerations in mind, a dynamic unseen in the more internally competitive communities in either country. Notes: University of Michigan; Ph.D. Database: ProQuest Dissertations & Theses (PQDT).

Corum, James S. & Johnson, Wray R. 2003. *Airpower in Small Wars: Fighting Insurgents and Terrorists*. , 2003, 507. Lawrence, KS: University Press of Kansas. Page(s): 507. Abstract: Biplanes and bandits -- Colonial air control -- The Greek civil war and the Philippine

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anti-Huk campaign -- The French colonial wars, 1946-1962 -- The British colonial wars, 1945-1975 -- Airpower in South Vietnam, 1954-1965 -- Airpower and counterinsurgency in Southern Africa -- Protracted insurgencies -- Intervention in the Mideast, 1962-2000. Notes: xiv, 507 pages: ill. 24 cm. ISSN/ISBN: 0700612394. OCLC Accession Number: 51477066.

Costin, E. et al. 1973. "Establishment of windbreaks and shelterbelts in arid regions with special reference to P.D.R. of Yemen." FAO/DANIDA Inter-Regional Training Centre on Heathland and Sand Dune Afforestation, Field Excursions (Denmark); Field Excursions (Lybian Arab R.), 26 Aug 1973. FAO, Rome (Italy). Report on the FAO/DANIDA Inter-Regional Training Centre on Heathland and Sand Dune Afforestation, Denmark and Libya, 26 August - 21 September 1973. p. 151-165. Report No: FOR--DEN/TF-123; FOR—T. Keywords: Erosion Control; Arid Zones; Windbreak Trees; Species; Planting; Silviculture; Forest Ecology; Crops; Democratic Yemen. FAO Acc. No: 127069.

Costin, E., et al. 1973. "Sand dune fixation and afforestation in some semi-desert countries of the Middle East area." FAO/DANIDA Inter-Regional Training Centre on Heathland and Sand Dune Afforestation, Field Excursions (Denmark); Field Excursions (Lybian Arab R.), 26 Aug 1973. FAO, Rome (Italy). Report on the FAO/DANIDA Inter-Regional Training Centre on Heathland and Sand Dune Afforestation, Denmark and Libya, 26 August - 21 September 1973. p. 66-79. Keywords: Deserts; Afforestation; Dunes; Soil Stabilization; Sand; Ecology; Fencing; Planting; Species; Democratic Yemen; Egypt. Report No:FOR--DEN/TF-123; FOR—T. FAO Acc. No: 127060.

Costin, E. 1972. "People's Democratic Republic of Yemen: forestry with special reference to sand dune fixation and establishment of windbreaks." SOY/3. Agricultural Demonstration and Training, El-Kod and Giar. Research Series no 5. 59 pages. 3 tab., 1 map, 13 phot., 7 app. with 5 tab., 1 org. chart & 2 large maps attached. Keywords: Dunes; Soil Stabilization; Sand; Forestry; Forests; Species; Forest Plantations; Windbreak Trees; Afforestation; Democratic Yemen. UNDP SF PROJECT. Report No:ESR-UNDP/SF SOY/3. FAO Accession Number: 117641

Coulié, E., Quidelleur, X., Gillot, P. -Y, Courtillot, V., Lefèvre, J. -C and Chiesa, S. 2003. "Comparative K–Ar and Ar/Ar Dating of Ethiopian and Yemenite Oligocene Volcanism: Implications for Timing and Duration of the Ethiopian Traps." *Earth Planet. Sci. Lett.* 2/15. Volume 206, Issue 3-4, Pages 477-492. Descriptors: flood basalts; Oligocene; Ethiopia; Yemen; Ar-40/Ar-39; K–Ar; GPTS. ISSN/ISBN: 0012-821X.

Coulter, P. 1974. "Mother and Child Health Care in the Yemen." *Nurs. Times*. Volume 70, Issue 46, Pages 1764-1765. Abstract: Yemen, a country in which 1/2 of the children die before their 15th birthday, is just beginning to develop rural health services. After the revolution in 1962, Yemen was left with only a few poorly equipped city hospitals, a handful of trained medical personnel, and a complete lack of health facilities at the village level. Village health centers, which emphasize both preventive and curative aspects of maternal and child health, are now being established. The personnel at these centers are stressing the value of breast-feeding in an attempt to counter the growing practice of bottle feeding. Bottle feeding is completely inappropriate in the rural areas since the water, fuel, and utensils needed to sterilize the bottles are lacking. In addition, illiteracy prevents the mothers from mixing and administering powdered products safely. For those women unable to breast-feed, the health centers are providing the mothers with instructions for spoon and bottle feeding. There is a pressing need to train more individuals to serve as auxiliary health personnel. The health programs must be designed to take into account the traditional beliefs of the villagers. For example, any attempt to treat rickets must take into account the belief that sunlight is harmful to children. Programs must also recognize the

lack of resources in the community. Promoting a diet of meat, eggs, and fruit is pointless since these items are either not available or are too expensive for most of the villagers to purchase. Men who do most of the shopping must also be educated on health and nutrition matters. Due to the traditional segregation of the sexes, this training will have to be provided in separate settings. Database: SCOPUS. ISSN: 0954-7762.

Cox, K. G., Gass, I. G. And Mallick, D. I. J. 1970. "The Peralkaline Volcanic Suite of Aden and Little Aden, South Arabia." *J. Petrology*. October 1. Volume 11, Issue 3, Pages 433-462. Abstract: The volcanic rocks of Aden, Little Aden, and Ras Imran, here designated as belonging to the Aden Volcanic Series, were erupted through central-vent, strato-volcanoes about 5 m.y. ago. In its major element chemistry the Aden Volcanic Series is intermediate between the alkaline and tholeiitic associations, and this is demonstrated by comparing it with the alkaline suite of Hawaii and the tholeiitic series of Thingmuli, Iceland. It is proposed that the most acceptable parental' magma is a mildly alkaline olivine basalt which, on fractionation, produced a series ranging from trachybasalts through trachyandesites and trachytes to rhyolites. These rhyolites are peralkaline as the molecular proportion of alumina is less than that of the combined alkalis, and are comenditic as the series is poor in normative femic constituents. Trace element data suggest that the peralkaline silicic eruptives are chemically comparable with those of Mayor Island, New Zealand, where a mildly alkaline olivine basalt parent has also been postulated. Although the age of eruption of c. 5 m.y., given by K-Ar measurements, is entirely consistent with an age deduced from geomorphological criteria, an $^{87}\text{Sr}/^{86}\text{Sr}$ versus $^{87}\text{Rb}/^{86}\text{Sr}$ isochron plot suggests that the series is related to a thermal event some 20-30 m.y. older than the age of eruption. As this earlier age corresponds directly to the age of the previous magmatic episode, the eruption of the Yemen Trap Series, the upper part of which is petrologically similar to the Aden Volcanic Series, and as the initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratios suggest that the magma originated in the mantle, it is proposed that the most acceptable petrogenetic scheme, which would also explain the anomalously old Rb-Sr age, is: (a) Partial fusion in the upper mantle giving rise to the alkaline Yemen Trap Series, (b) After the cessation of surface activity, a large body of magma existed in the upper mantle and this magma, on crystallizing, fractionated to produce a layered sequence, (c) About 5 m.y. ago some event, either pressure relief or further thermal activity, resulted in the partial remelting of this fractionated plutonic sequence and the liquids so formed reached the surface without significant mixing or chemical fractionation.

Crassard, Rémy. 2009. "Modalities and Characteristics of Human Occupations in Yemen during the Early/Mid-Holocene." *Comptes Rendus Geosciences*. 9. Volume 341, Issue 8-9, Pages 713-725. Descriptors: Holocene; Yemen; Neolithic; Lithic technology; Arabian Humid Period; Holocène; Yémen; Néolithique; Technologie lithique; Période humide arabe. Abstract: Although few reference sites are known in Yemen, those found to date give good, although preliminary, chronostratigraphic sequences that demonstrate different types of lithic industries. The Hadramawt region of eastern Yemen is particularly rich in Early to Mid-Holocene sites. These sites are characterized by the appearance of laminar and especially bifacial lithic industries. The latter includes the production of flat as well as symmetrical arrowheads, and likely later manufacture of arrowheads with triangular section. The distribution of the trihedral points through southern Arabia suggests a technical tradition anchored at the beginning of the Middle Holocene. Presence of the fluting technique reinforces the impression that a true local Arabian "endemic development area" was constituted through time, without any particular external influences. Climate and geography probably contributed to settling modalities and

Geology of Yemen

consequently influenced diffusions, relations and movements of populations. ISSN/ISBN: 1631-0713.

Cross, W. K. and Stephens, R. M. 1986. "Road Maintenance In Bangladesh And In North Yemen." Planning and Transport Research And Computation. Pages 1-10. Descriptors: Maintenance and repair; Maintenance and repair; Maintenance; Repairing; Roads; Bangladesh; Yemen. Notes: W.K. CROSS AND R.M. Stephens Rendel Palmer & Tritton Planning And Transport Research And Computation International Co Meeting Proceedings Of Seminar J Held At The Ptrc Summer Annual Meeting. Database: TRIS. Availability: Available from UC Berkeley Transportation Library through interlibrary loan or document delivery.

Current Water Policies and Practices in Selected ESCWA Countries. 1999. New York: UN. Page(s): 104. Descriptors: Water Management; Water Policy; Egypt; Jordan; Lebanon; Syrian Arab Republic; Yemen; Government publication; International government publication. Notes: iv; charts, graphs, tables. UN Job no.: I991024 E. Material type: Reports/studies. OCLC Accession Number: 78120379.

Geology of Yemen

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Davey, J. C. 1990. "Wellfield Development for Urban Water Supplies in Yemen." Arab Water World Int. Volume 14, Issue 4 July-August, 1990. Pages 9-11. Abstract: Internationally-funded groundwater projects have recently been completed for the main urban areas of PDR Yemen. The necessary resources to secure potable supplies into the next century have been proved in Cretaceous sandstone, Eocene limestone and Quaternary clastic aquifers, and their investigation has highlighted the importance of comprehensive hydrogeological studies prior to permanent works design and construction. The projects discussed will improve the quantity, quality and accessibility of potable water to nearly one third of the country's population. (A). Database: SCOPUS. ISSN: 1015-8332.

Davey, JC. 1989. "Wellfield Development for Urban Water Supplies in PDR Yemen." Journal of the Institution of Water Engineers and Scientists JIWSDI Vol. 3, No. 4, p 413-422. August 1989. Pages 9 ref. Descriptors: Water supply; Water supply development; Groundwater potential; Yemen; Urban areas; Geohydrology; Potable water; Wells. Abstract: Internationally-funded groundwater projects have recently been completed for the main urban areas of People's Democratic Republic of Yemen: (1) Improvements at Bir Nasir and the commissioning of the Upper Abyan well field have led to enhanced supplies throughout Greater Aden; (2) after years of shortages Al Mukalla can look forward to adequate water supplies when the An Nagah wellfield is commissioned and remedial works to optimize existing investment at Wadi Buwaysh are completed; and (3) further developments at Seiyun and farther east will help to spread the benefits of a new water supply system throughout the Hadramaut valley. The necessary resources to secure potable supplies into the next century have been proved in Cretaceous sandstone, Eocene limestone and Quaternary clastic aquifers, and their investigation has highlighted the importance of comprehensive hydrogeological studies prior to permanent works design and construction. The projects discussed will improve the quantity, quality and accessibility of potable water to nearly one third of the country's population. Database: Water Resources Abstracts. ISSN: 0309-1600.

Davey, J., and T. Harris. 1987. "Seeking New Sources on the Incense Route." World Water 10.10 (1987): 51,51,53. Abstract: Traditional sources of water in the Wadi Hadramaut region of Yemen are described and the effects of increasing salinity reported. Searches for further water sources commenced in 1977 and investigations in the area of Seiyun are described briefly. The first stage scheme comprised a new well field, disinfection facilities, storage and distribution. Seven wells were drilled and groundwater abstracted from 40 m deep at over 37.5 litres per second from each hole. The first stage development will satisfy the water demand for a projected population of 76,000 by 1995. Future developments are briefly discussed.

Davey, John. 1986. "Where East Meets West; PDR Yemen." The British Geologist. Geological Society, London, UK. Volume 12, Issue 2, Pages 64-65. Descriptors: Al Mukalla; Arabian Peninsula; Asia; drawdown; ground water; Hadramont Valley; hydrogeology; Mukalla Sandstone; surveys; water resources; water table; Yemen. Notes: illus. incl. sketch map. Database: GeoRef. ISSN: 0144-0063.

David, Clifford B. and David, Patricia Hallett. 1984. "Bottle-Feeding and Malnutrition in a Developing Country: The 'Bottle-Starved' Baby." Journal of Tropical Pediatrics. June 1. Volume 30, Issue 3, Pages 159-164. Abstract: To measure the impact of bottle-feeding on nutrition, we studied 510 consecutive mothers and their infants under 3 attending an urban health center in North Yemen. Infants were weighed and their mothers interviewed on use of cow's milk and other foods and on demographic, educational and economic status. Of those who bottle-

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fed, most (74 per cent) used powdered whole-milk products and not special infant formulas. Bottle-fed infants under 6 months had a markedly increased risk of severe malnutrition over those fully breast-fed (16.2 per cent vs. 2.2 per cent, P60 kcal/kg body weight daily from milk. Use of dilute milk (<50 kcal/dl) appeared to double the risk of severe malnutrition in bottle-fed infants. Milk concentration was correlated with size of the measuring scoop supplied in the tin. Concentration and daily intake were both related more strongly to family income than to parental literacy or other socio-demographic measures. Interim strategies to prevent the syndrome of the bottle-starved' infant should focus on early provision of additional calories from all possible sources, particularly breast milk and suitable solids. To affect feeding patterns, regulation of the infant-formula industry must control producers of other milk products as well. ISSN: 1465-3664.

David, Patricia H., Bisharat, Leila and Kawar, Sana. 1991. "Using Routine Surveys to Measure Mortality: A Tool for Programme Managers." Soc. Sci. Med. Volume 33, Issue 3, Pages 309-319. Descriptors: childhood mortality; maternal mortality; EPI surveys; Jordan; Syria; Yemen; Djibouti. Abstract: Aid donors and recipients have begun to demand timely, population-based information for programme planning and for measuring health programme performance. Results from trials in Jordan, Syria, Djibouti and People's Democratic Republic of Yemen show that widely-used routine surveys for estimating vaccination coverage can be adapted to collect data on health indicators such as child and maternal mortality. Estimation methods must be robust and fieldwork well-supervised. adding questions about total children ever born and surviving, the survival of the preceding birth, and the survival of sisters to such surveys, population-based estimates of the trend and recent level of childhood mortality and of the lifetime risk of maternal death can be obtained. These trials indicate that the need to monitor selected health indicators could be met through inexpensive, low-technology surveys. ISSN: 0277-9536.

Davidson, D. et al. 1975. Preparation of a Geologic Photo Map and Hydrologic Study of the Yemen Arab Republic [Quarterly Report, Dec. 1975]. Volume: E76-10246, page(s): 3P-3P. Abstract: There are no author-identified significant results in this report. Reports-Open file series - United States Geological Survey, 78-770; Project report: Yemen Arab Republic investigations - U.S. Geological Survey, (IR)Y-13. Report prepared for Goddard Space Flight Center, Greenbelt, Maryland. Type III final report, September 1977. Description: ii, 15 pages: maps; 28 cm. Database: Technology Research Database. OCLC: 7035464.

Davidson I., Al-Kadasi M., Al-Khribash S., Al-Subbary A.K., Baker J., Blakey S., Bosence D., Dart C., Heaton R., McClay K., Menzies M., Nichols G., Owen L., Yelland A. 1994 Geological evolution of the southeastern Red Sea rift margin, Republic of Yemen. Bull Geol Soc Am 106: 1471 to 1493.

Davies, Caroline. 2003. "Sedimentary and Geochemical Investigation of Lacustrine Sediments from the Yemen Highlands and Implications for Climate Change; Geological Society of America, North-Central Section, 37th Annual Meeting." Abstracts with Programs - Geological Society of America. Geological Society of America, Boulder, CO. Feb. 2003. Volume 35, Issue 2, Pages 53. Descriptors: Arabian Peninsula; arid environment; Asia; basins; Cenozoic; climate; climate change; Dhamar Highlands; environmental effects; fluctuations; geochemistry; highlands; Holocene; intermontane basins; lacustrine environment; lacustrine sedimentation; lake sediments; lake-level changes; monsoons; paleoclimatology; paleoenvironment; Quaternary; Rub'al Khali; sedimentation; sedimentology; sediments; terrestrial environment; topography; Yemen. Abstract: Lacustrine deposits from the semiarid Dhamar Highlands of Yemen record significant changes in paleoclimate. This paper presents sedimentary and geochemical analyses

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of lacustrine sediments and their implications for climate change in southwestern Arabia. The study area, on the southeastern tip of the Arabian Peninsula, is located in a climatic transition zone. It is bounded by the Rub al-Khali Desert to the north, and to the south and east, the Indian Ocean, which subjects the highlands to the influence of the Indian Ocean monsoon. The Dhamar Highlands of Yemen consist of high intermontane valleys surrounded by the highest mountains (3000 m asl) on the Arabian Peninsula. The intermontane basins contain very long sediment histories. Lacustrine deposits occur within the basins where, today, the area is semi-arid without major reservoirs of surface water. Lakes with restricted outlets are evidence of periods in the past, characterized by climates significantly moister than the present. A peat deposit with a radiocarbon age of 9,820 + 60 yrs B.P. is also evidence of moister conditions in the early Holocene. Sedimentary and geochemical analysis of paleo-lake sediments record fluctuations in sedimentation and chemical regimes that extend into the Pleistocene. These fluctuations provide signatures in the sediment profile that identify episodes of soil development and episodes of lacustrine deposition. The occurrence of multiple paleosols indicates periods of stable land surface. Paleosols are separated by thick lacustrine deposits indicative of increased surface water and moister overall conditions. Fluctuations in the sediment record of the Dhamar Highlands reflect a regional record of climatic conditions for Southwest Arabia. Database: GeoRef. ISSN: 0016-7592.

Davies, Caroline P. 2003. "Paleohydrology and Paleoclimates from Lacustrine Environments of the Dhamar Highlands, Yemen; XVI INQUA Congress; Shaping the Earth; a Quaternary Perspective." Congress of the International Union for Quaternary Research. [International Union for Quaternary Research], International. Volume 16, Pages 183. 252 pages: ill., map; 28 cm. Descriptors: absolute age; Arabian Peninsula; Asia; basins; C-14; carbon; Cenozoic; dates; depositional environment; Dhamar Highlands; fluctuations; Holocene; intermontane basins; isotopes; lacustrine environment; lower Holocene; monsoons; neotectonics; paleoclimatology; paleohydrology; paleolimnology; Quaternary; radioactive isotopes; reconstruction; sedimentation; sedimentation rates; tectonics; Yemen. Abstract: The Dhamar highlands of Yemen is a tectonically active region characterized by high intermontane valleys surrounded by the highest mountains (3000 masl) on the Arabian Peninsula. These highlands are bounded by the Rub al-Khali desert to the north, and the Indian Ocean to the south and east, which subjects them to the influence of the Indian Ocean monsoon. Lacustrine deposits from these highlands record significant changes in Quaternary paleohydrology. This poster presents sedimentary, geochemical, and chronological data analyses of the lacustrine sediments and their implications for paleohydrology and paleoclimate change in southwestern Arabia. The intermontane basins record very long histories of paleohydrologic change. Currently the region is semi-arid without major reservoirs of surface water. However, thick lacustrine sequences suggest periods of significantly moister past environments. Additionally, a peat deposit with a radiocarbon age of 9,820 + 60 yrs B.P. also documents moister conditions during the early Holocene. The occurrence of multiple paleosols indicate periods of land surface stability, while carbonate-rich horizons are evidence of increasing aridity and again signal significant changes in the paleohydrology. The relationships of paleohydrologic change associated with active tectonics and paleoclimate changes such as influences of the Indian Ocean monsoon are examined through sedimentary and geochemical analysis. Fluctuations in sedimentation and chemical regimes extend into the Pleistocene and provide signatures in the sediment profile that identify episodes of lacustrine deposition, soil development, and periods of greater aridity. Fluctuations in the lacustrine record of the Dhamar highlands reflect both local changes in paleohydrology and a

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regional record of paleoclimatic conditions in southwest Arabia. Database: GeoRef. ISBN: 0945920512; 9780945920519. OCLC: 53828077.

Davies, Caroline Pickens. 2006. "Holocene Paleoclimates of Southern Arabia from Lacustrine Deposits of the Dhamar Highlands, Yemen." *Quatern. Res.* 11. Volume 66, Issue 3, Pages 454-464. Descriptors: Paleohydrology; Paleoclimate; Lacustrine; Peat; Paleosol; Holocene; Dhamar highlands; Yemen. Abstract: This paper presents new evidence from the Dhamar highlands, Yemen, of paleohydrologic response to fluctuations in Holocene climate. Stratigraphic, geochemical, and chronological analyses of highland peat and lacustrine deposits contribute to knowledge of the timing of early Holocene moisture changes on the Arabian Peninsula, providing a backdrop to understanding early cultural development in the Arabian highlands. The location of the Dhamar highlands, characterized by intermontane valleys surrounded by the highest mountains on the Arabian Peninsula and adjacent to the Indian Ocean is ideal for examining the influence of the Indian Ocean Monsoon (IOM) on the moisture history of this region. Fluctuations in the lacustrine and paleosol records of the Dhamar highlands reflect both local changes in paleohydrology and regional influences on the Holocene paleoclimatic conditions in southwest Arabia. In addition, a peat deposit with a radiocarbon age of 10,253 – 10,560 cal yr BP documents some of the earliest Holocene high moisture conditions on the Arabian Peninsula. ISSN: 0033-5894.

Davison, Ian, Al-Kadasi, Mohamed, Al-Khirbash, Salah, et al. 1994. "Geological Evolution of the Southeastern Red Sea Rift Margin, Republic of Yemen." *Bull. Geol. Soc. Am. Geological Society of America.* Nov. 1994. Volume 106, Issue 11, Pages 1474-1493. Descriptors: Article Subject Terms: Coastal zone; Elevation; Floods; Geologic Fractures; Heating; Lithosphere; Magma; Palaeo studies; Plumes; Rifting; Stress; Subsidence; Tectonics; Thermal Expansion; Timing; Volcanic rocks; Volcanism; Article Geographic Terms: Red Sea; Yemen. Abstract: The tectonic evolution of the southeastern margin of the Red Sea Rift in western Yemen has been investigated using a multi-disciplinary field study of an east-west transect between Al Hudaydah and Sana'a. Slow subsidence of up to 1 km occurred over the area during a 100 m.y. period before rifting. There was a major episode of flood volcanism between ca. 30 and 20 Ma, and important extensional faulting began after the eruption of the volcanic rocks and ceased before middle to late Miocene sediments and volcanic rocks were deposited unconformably on top of rotated fault blocks on the coastal Tihama Plain. Surface uplift has produced the Yemen highlands, whose highest peak reaches an elevation of 3660 m. This is attributed to plume heating and eruption of >3000 m of volcanic rocks. Apatite fission-track ages indicate early to middle Miocene exhumational cooling ages, postdating the major volcanic phase and contemporaneous with rifting. Volcanism was accompanied by emplacement of subvertical dike swarms, which generally strike north-northwest to northwest, broadly parallel to the Red Sea coastline. Major faults indicate northeast-southwest-directed extension. Large granitic sheets and plutons (up to 25 km wide) intruded the volcanic rocks. Approximately 30 km of extension has taken place across a 75-km-wide zone ($\beta = 1.7$) in 6-8 m.y. The relative timing of volcanism followed by extension and uplift does not fit conventional models of passive or active rifting. We suggest that the proto-Red Sea Rift was caused by regional plate stresses that exploited lithospheric weakening caused by the Afar plume. Appreciable doming only occurred after the main episode of volcanism, which suggests that magmas extruded before maximum thermal expansion of the lithosphere took place. Database: Water Resources Abstracts. ISSN: 0016-7606.

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De Geest, P. Verheyden, S. Cheng, H. Edwards, L. and Keppens, E. Indian Ocean Monsoon Variability Recorded in Holocene High-Resolution Speleothem Records from Soqatra Island (Yemen). Descriptors: Article Subject Terms: Aquifer recharge; Caves; Convergence zones; Correlations; Groundwater recharge; Karst; Meteor research; Meteorological data; Monsoon rainfall; Monsoons; Rainfall variability; Seasonal variations; Article Geographic Terms: Arabian Peninsula; Indian Ocean; Yemen. Abstract: Situated in the Indian Ocean between the Horn of Africa and the Arabian Peninsula, Soqatra island captures meteoric rainfall twice a year, due to the migrating inter-tropical convergence zone (ITCZ), offering continental proxies -in the form of speleothems- to register Indian Ocean Monsoon (IOM) variability. Due to the recent availability of meteorological data (rainfall and temperature) of 11 manual stations recorded over the last 5 years, we calculated that approximately 85% of the rainfall is related to the NE Monsoon period, while only 15% is related to the SW Monsoon period with an important irregular geographical distribution over the island. As seasonal fluctuations of rainwater oxygen isotopic composition are related to the amount of rainfall, differences in the oxygen isotopic compositions of meteoric waters versus groundwater are used to estimate amount and timing of karst aquifer recharge. At the NE limestone plateau karstic recharge only takes place during the NE Monsoon rainy period when a rainfall threshold of 80 to 90 mm is exceeded, explaining the more negative cave drip waters and groundwater in general. Two caves in this area were chosen as research location and the isotopic composition of nowadays forming speleothem calcite was monitored by sampling drip waters and collecting freshly deposited calcite on glass slabs. A sampled speleothem from Hoq Cave (SSTM1) and one from Casecas Cave (S-STM5) have formed over the past 6 ka BP and the past 1 ka BP (TIMS U/Th dating) respectively. Both speleothems display alternations of dark compact and white porous layers, which are interpreted as seasonal variations because they coincide with carbon and oxygen isotopic variations as observed by measurements at a 50 μ m resolution. At the two sampling locations, distant of 6 km, both speleothems present similar isotopic changes over the last 1 ka, controlled by the NE Monsoon rainfall variability. Correlations with other proxies in the same region will contribute to a better understanding of the IOM system. Notes: Geophysical Research Abstracts. [np]. NU: 08393. ISSN: 1029-7006. Database: Meteorological & Geostrophical Abstracts. OCLC: 11196065.

De Geest, Pierre. 2007. "High-Resolution Speleothem Records from Soqatra Island (Yemen), as Recorders of Indian Ocean Monsoon Variability." *Acta Carsologica = Karsoslovni Zbornik. Slovenska Akademija Znanosti in Umetnosti, Ljubljana, Slovenia*. Volume 36, Issue 1, Pages 211. Descriptors: absolute age; aquifers; Arabian Peninsula; Asia; calcite; carbon; carbonate rocks; carbonates; Casecas Cave; caves; Cenozoic; dates; ground water; Holocene; Hoq Cave; hydrology; Indian Ocean; inter-tropical convergence zone; isotopes; karst; limestone; monitoring; monsoons; oxygen; plateaus; Quaternary; rainfall; recharge; research; seasonal variations; sedimentary rocks; solution features; Soqatra Island; speleothems; temperature; Yemen. Database: GeoRef in Process. ISSN: 0583-6050.

Delany, M. J. 1989. "The Zoogeography of the Mammal Fauna of Southern Arabia." *Mamm. Rev.* Volume 19, Issue 4, Pages 133-152. Notes: Cited By (since 1996): 7. Abstract: The southern Arabian fauna occupies a montane coastal strip of Saudi Arabia parallel to the Red Sea from Taif southwards, the Yemens and Oman. Brief descriptions of the physical, climatic and vegetational features of the region are provided. Most mammal species in the area are assigned to one of the following zoogeographical categories: Palaearctic, Saharo-Sindian, Afrotropical plus Palaearctic, Aftropical and Oriental. Most species are Afrotropical with a substantial number

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Saharo-Sindian. There is appreciable endemism within the region. World sea levels have fluctuated, probably between -105 and -175 m below present levels. Such falls would have facilitated narrow water barriers or land connections between Africa and Arabia. Database: SCOPUS. ISSN: 0305-1838.

Delhuille, B. and Gentelle, P. 2000. Ancient Irrigation (SAYL) and South Arabian Anthrosols in the Wadi Dura Valley (Yemen). *Publications of the Ministry of Water Resources, Sultanate of Oman*, (1995), pp. 122-128.

Dent, D. and Murtland, R. 1990. "Land Evaluation for Afforestation in a Semi-Arid Environment: The Montane Plains of the Central Highlands of North Yemen." *Catena*. Volume 17, Issue 6, Pages 509-523. Notes: Cited By (since 1996): 5. Abstract: In semi-arid environments, much land use depends on water harvesting from the upper members of soil catenas to support crops on the lower members. In the Central Highlands of North Yemen, an initial evaluation of land for forestry on the basis of a general-purpose resource inventory highlighted drought and frost as the main constraints, and identified over 150 potential forest species. Subsequent species elimination and proving trials revealed that, in the absence of data, the frost hazard had been underestimated; and under a water-harvesting regime the very stony, coarser-textured midslope soils are more suited to more species than the fine loamy soils of the footslopes because of their better infiltration and rooting characteristics. Conventional soil survey and land evaluation does not cope easily with small, scattered land units; especially where site performance is dependent upon the behaviour and management of upslope members of the catena. For field use, a site type key has been devised with a supplementary table to match suitable tree species with site type. This expert system makes use of cultural, vegetation, soil and landform features, some of which are unique to North Yemen. However, the principles involved should have general application. Database: SCOPUS. ISSN: 0341-8162.

Department of Defense, Washington, DC. 2002. "2002 Year in Review." 31 Dec. Page(s): 17. Report Number: XD-DOD Monitor Series: DOD. Abstract: This annual report from the Department of Defense (DoD) provides an update on the DoD's accomplishments during 2002. Section 1, Global War Against Terrorism, describes the multinational coalition that was assembled to support Operation Enduring Freedom; humanitarian and civil affairs aid that was provided to the Afghan population; long-term stability in Afghanistan; financial, law enforcement, and other operations relating to terrorism in the Philippines, Republic of Georgia, and Yemen; and Homeland Security. Abstract Classification: Unclassified Technical Reports Collection. Distribution Statement: Approved for public release; distribution is unlimited. OCLC Accession Number: ADA475302. URL: <http://handle.dtic.mil/100.2/ADA475302>.

Department of State, Washington, DC, Office of External Research and Quandt, William B. 1981. "Saudi Perceptions of the International Environment," 22 Sep. 1981. Page(s): 4 Report Number: FAR-211-GP Monitor Series: 211-GP. Abstract: Saudi Arabia enters the 1980s with unprecedented wealth and international prestige. This does not, however, produce a sense of real power or security on the part of Saudi rulers. The reasons are several: In terms of population and military might, Saudi Arabia remains a small power by Middle East standards. Regional instability threatens Saudi Arabia directly and indirectly. The US-Saudi relationship, long relied upon by Saudi leaders to enhance the Kingdom's security, is being called into question. The Soviet Union is developing positions of strength around Saudi Arabia--Afghanistan, South Yemen, Ethiopia, as well as Libya and Syria. Abstract Classification: Unclassified Technical Reports Collection. OCLC Accession Number: ADA106927.

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Deuser, W. G., Ross, E. H. and Waterman, L. S. 1976. "Glacial and Pluvial Periods: Their Relationship Revealed by Pleistocene Sediments of the Red Sea and Gulf of Aden." *Science*. March 19. Volume 191, Issue 4232, Pages 1168-1170. Abstract: Oxygen isotope analyses of planktonic foraminifera from the Red Sea and Gulf of Aden indicate that during periods of maximum continental and polar glaciation in the late Pleistocene, the Red Sea was subject to strong evaporation. Between glacial maximums the salinity of the Red Sea was equal to or below that of the open ocean. This suggests that high-latitude glacial periods corresponded in time to interpluvial stages in the present-day desert belt of northern Africa, whereas high-latitude interglacial periods coincided with pluvial stages.

Dewar, Michael. 1984. *Brush Fire Wars: Minor Campaigns of the British Army since 1945*. London: Robert Hale. Page(s): 208. Notes: 208 p., [16] p. of plates: ill., maps; 23 cm. With a foreword by Sir Frank Kitson. ISBN: 0312106742. OCLC Accession Number: 10913533.

DHV Raadgevend Ingenieursbureau; Yemen; Ministry of Municipalities and Housing; Netherlands; Ministerie van Buitenlandse Zaken and Directorate General for International Cooperation. 1983. *Rada Urban Development Project: Final Project*. Amersfoort, the Netherlands: DHV Consulting Engineers. Descriptors: City planning -- Yemen (Republic) -- Rida`; Urban policy -- Yemen (Republic) -- Rida`; Government publication; National government publication. Abstract: v. 1. The Rada urban area development plan: executive summary of the project.--v. 2. Social and economic aspects.--v. 3. Physical planning/masterplan.--v. 4. Water supply.--v. 5. Waste water disposal.--v. 6. Solid wastes management.--v. 7. Area drainage.--v. 8. Roads.--v. 9a. Electricity supply.--v. 10. Slaughtering facilities.--v. 11. Institutional and legal framework. Notes: 11 v.: ill., maps; ans (some folded in pockets); 30 cm. Note(s): Prepared for Yemen Arab Republic, Ministry of Municipalities and Housing and Kingdom of the Netherlands, Ministry of Foreign Affairs, Directorate General for International Cooperation (DGIS). Includes Arabic summaries. OCLC: 18029617.

Diansky, NA, Zalesny, VB, Moshonkin, SN and Rusakov, AS. 2006. "High Resolution Simulation of the Indian Ocean Monsoon Current Variability." *Okeanologiya*. Volume 46, Issue 5, Pages 650-671. Descriptors: Article Subject Terms: Annual variations; Atmospheric forcing; Bottom topography; Brackishwater environment; Climatology; Current charts; Current meandering; Current rings; Current velocity; Estuaries; Mathematical models; Monsoons; Numerical analysis; Ocean-atmosphere system; Water balance; Water currents; Article Taxonomic Terms: Socotra; Article Geographic Terms: Asia, Ganga R. Arabian Sea, Somali Current; Bangladesh, Bengal Bay; India, Lakshadweep; Indian Ocean; Indian Ocean, Great Whirl; Yemen, Socotra; Marine. Abstract: Some results of the Indian Ocean monsoon circulation simulated with a sigma -coordinate ocean model developed at the Institute of Numerical Mathematics RAS are presented. The model has a horizontal resolution of (1/8) degree *(1/12) degree and 21 unevenly sigma -layers. Realistic bottom topography and land geometry are used. The numerical experiment was carried out for 15 years started from Levitus climatology for January and using monthly mean climatic atmospheric forcing from NCEP reanalysis. The annual cycle of surface and subsurface currents, temperature and salinity fields are analyzed for the 15-th model year. The model reproduces well the Summer Monsoon and the Winter Monsoon Currents, their annual cycles and space structures. The modeled Somali Current has a good agreement with the observations with model velocities exceeding 2 m/s and the transport about 70 Sv in Summer Monsoon time. The model results show that a turn of Somali Current from summer to winter direction is accompanied by generation of anticyclonic eddies that drift westward by beta -effect and dissipate in Somali shore and Gulf of Aden. The monsoon

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variability of equatorial surface current and equatorial subsurface undercurrent is analyzed. It is shown that these currents are mainly generated by zonal wind stress, which is dominated by a semi-annual harmonic. The equatorial surface current and compensating Equatorial subsurface counter-current are also dominated by semi-annual harmonics. The subsurface counter-current has a time lag by approximately one month. It is found that the gradient currents caused by river run-off make an important contribution to the circulation in the Bay of Bengal. This effect manifests itself especially in summer when the Ganges River brings fresh turbid waters. Main features of quasi-stationary gyres like Great Whirl, Socotra high, Lakshadweep high and low are well reproduced. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0030-1574.

Dias, Alexandra M. 2007. "Battling Terrorism in the Horn of Africa, Edited by Robert I. Rotberg * US Foreign Policy and the Horn of Africa, by Peter Woodward." *Afr. Aff. (Lond)*. July 1. Volume 106, Issue 424, Pages 539-541. ISSN: 0001-9909. OCLC: 61361539.

Directorate of Overseas Surveys. *Yemen Arab Republic, Montane Plains: Soils and Land Suitability*. Surbiton: Land Resources Development Centre, Overseas Development Administration, 1981. Rec 52/YEM/BDA/1-5. With: Yemen Arab Republic montane plains and Wadi Rima project. (Project record 62). 5 maps. prepared by the Directorate of Overseas Surveys. OCLC: 316517547.

Dockrill, Saki R. 2008. "British Policy in Aden and the Protectorates, 1955-67: Last Outpost of a Middle East Empire." *English Historical Review*. June 1. Volume CXXIII, Issue 502, Pages 808-809. ISSN: 0013-8266.

Dold, E. P., Moser, R. and Kiehne, E. "An Economy Airport for Sana'a." *Airport Forum*. Bauverlag GmbH: Volume 4, Issue 1, Pages 49. Descriptors: Airports; Construction; Costs; Finance; Structural design; Airport design; Construction costs. Abstract: Since September 1973, Sana'a the chief City of the Arab Republic of Yemen, has boasted an international airport worthy of the name. After some years of construction work, a complete airport had taken shape where only a more or less paved airstrip had existed before. Total cost was only DM 16.5 million. The project was financed in part by the Federal Republic of Germany. Database: TRIS. Availability: Massachusetts Institute of Technology. ISSN: 0002-2802.

Dolfing, B. 2001. "Water and History." *Water Policy*. Volume 3, Issue Suppl., Pages S201-S204. Descriptors: Article Subject Terms: Arid environments; Case Studies; Conferences; Drainage; Environmental Protection; Floods; Historical account; History; Hydraulic Structures; Irrigation; Irrigation water; River basins; Storms; Water Demand; Water Management; Water Policy; Water Supply Development; Water supply; drainage water; scarcity; sustainability; Article Geographic Terms: Bolivia; Greece; Italy, Roma; Japan; Peru; Yemen. Abstract: Problems like water scarcity and droughts as well as inundations, floods and storm surges are as old as mankind. Water management, therefore, has existed for thousands of years. In the absence of advanced technology, the efforts undertaken by people in the past to supply themselves with sufficient water to meet the various demands of society were based on thorough observation of nature. At the same time, people managed to build, maintain and manage hydraulic structures in harmony with their natural environment as well as in close co-ordination with state-hood building. The sustainability of traditional systems in general is substantially better than that of today's systems. The need to improve the performance of many modern systems can benefit from historical experiences. Speakers showed surprising evidences of humankind overcoming the constraints of nature in constructing systems for irrigation, drainage and water supply from Antiquity until the end of the nineteenth century and ranging from Japan, through Jemen, Greece

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and Rome to Peru and Bolivia. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 1366-7017.

Donaldson, William J. 2000. *Sharecropping in the Yemen a study of Islamic theory, custom, and pragmatism*. Leiden, Netherlands: Brill. Abstract: This text discusses sharecropping in the Yemen against the background of Islamic law and customary law. Sharecropping is interesting in Islam since its basis is ostensibly inconsistent with the Islamic prohibition against transactions involving gharar (risk or uncertainty). OCLC: 228119260. URL: <http://site.ebrary.com/id/10090635>.

Dop, J. 2000. Domestic Rural Water Supply in Al Bayda Province Yemen Arab Republic. In: Kosinsky, Victor de; Somer, Marc de. Water resources for rural areas and their communities: proceedings of the Vth World Congress on Water Resources. Ghent, Crystal Drop Publications, 1985. p.629-39. World Congress on Water Resources, 5, Brussels, 9-15 June 1985. Organized by the IWRA, International Water Resources Association = AIRE, Association internationale des ressources en eau = AIREH, Asociación Internacional de Recursos Hidricos; under the high patronage of His Majesty Baudouin, King of the Belgians; with the participation of the United Nations and UNESCO. ISBN: 9071974014; 9789071974014. OCLC: 13029993.

Dorrell, David (ed). 1965. "Air Forces Middle East: The RAF at Work from Kuwait to Africa." Air Pictorial. May 1965. Volume Vol. 27, Issue No. 5, Pages 144-148. ISSN: 0002-2462.

Dorsey, James. 2010. "Corruption Fuels Crisis in Water-Poor Yemen." Eureka Street. Eureka Street Magazine Pty Ltd: 02/12. Volume 20, Issue 2, Pages 34-35. Descriptors: Water shortages; Fuel; Smuggling; Resource management; Climatic changes; Yemen (Republic). Abstract: The article reports on the cause of water crisis in Yemen as it struggles to defeat Al Qa'ida. It mentions that the water supply crisis results from the climate change, poor or resource management, and wasteful irrigation as well as corruption and uncontrolled digging of wells. It notes that the country resists donors demand to abolish diesel subsidies that would cut into profits from diesel smuggling as well as to need for economic and political reform. ISSN: 1833-7724.

DouAbul, A. A. -Z and Al-Shiwafi, N. A. 1998. "Dissolved/dispersed Hydrocarbons in the Arabian Region." Mar. Pollut. Bull. Volume 36, Issue 10, Pages 844-850. Notes: Cited By (since 1996): 4. Database: SCOPUS. ISSN: 0025-326X.

DouAbul, AA-Z, Heba, HMA and Fareed, KH. 1997. "Polynuclear Aromatic Hydrocarbons (PAHs) in Fish from the Red Sea Coast of Yemen." Hydrobiologia. Kluwer Academic Publishers: 5 Sep. Volume 352, Issue 1-3, Pages 251-262. Descriptors: Article Subject Terms: Aromatic hydrocarbons; Bioaccumulation; Carcinogens; Chromatography; Coastal Waters; Coastal zone; Fish; Fish kill; Hydrocarbons; Marine fish; Marine organisms; Marine pollution; Mass Spectrometry; Muscle; Oil; Oil pollution; Pollution effects; Pollution monitoring; Polycyclic aromatic hydrocarbons; Polynuclear aromatic hydrocarbons; Public Health; Water Pollution Effects; Article Taxonomic Terms: Pisces; Article Geographic Terms: Red Sea; Yemen; PAH; Red Sea; Yemen. Abstract: A detailed analytical study using combined normal phase high pressure liquid chromatography (HPLC), gas chromatography (GC) and gas chromatography/mass spectrometry (GC/MS) of Polynuclear Aromatic Hydrocarbons (PAHs) in fish from the Red Sea was undertaken. This investigation involves a preliminary assessment of the sixteen parent compounds issued by the U.S. Environmental Protection Agency (EPA). The study revealed measurable levels of capital sigma E PAHs (the sum of three to five or six ring parent compounds) (49.2 ng g super(-1) dry weight) and total PAHs (all PAH detected) (422.1

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ng g super(-1) dry weight) in edible muscle of fishes collected from the Red Sea. These concentrations are within the range of values reported for other comparable regions of the world. Mean concentrations for individual parent PAH in fish muscles were; naphthalene 19.5, biphenyl 4.6, acenaphthylene 1.0, acenaphthene 1.2, fluorene 5.5, phenanthrene 14.0, anthracene 0.8, fluoranthene 1.5, pyrene 1.8, benz(a)anthracene 0.4, chrysene 1.9, benzo(b)fluoranthene 0.5, benzo(k)fluoranthene 0.5, benzo(e)pyrene 0.9, benzo(a)pyrene 0.5, perylene 0.2, and indeno(1,2,3-cd)pyrene 0.1 ng g super(-1) dry weight respectively. The Red Sea fish extracts exhibit the low molecular weight aromatics as well as the discernible alkyl-substituted species of naphthalene, fluorene, phenanthrene and dibenzothiophene. Thus, it was suggested that the most probable source of PAHs is oil contamination originating from spillages and/or heavy ship traffic. It is concluded that the presence of PAHs in the fish muscles is not responsible for the reported fish kill phenomenon. However, the high concentrations of carcinogenic chrysene encountered in these fishes should be considered seriously as it is hazardous to human health. Based on fish consumption by Yemeni's population it was calculated that the daily intake of total carcinogens were 0.15 μ g/person/day. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0018-8158.

Dowgiallo, J. 1988. "Thermal Waters in Granitic Terrains, Case Histories from Poland and North Yemen." Karst Hydrogeology and Karst Environment Protection. Volume 2. Proceedings of the 21st Congress of the International Association of Hydrogeologists. Guilin, China October 10-15. (1988). p 1253-. Volume 1988. IAHS Publication No. 176, Pages 9 ref. Descriptors: Geohydrology; Geothermal water; Granites; Poland; Case studies; Yemen; Uranium; Thorium; Hot springs. Abstract: Thermal waters occur in the Upper Carboniferous Karkonosze granite (Western Sudetes) of Poland, as well as in its Precambrian and Lower Paleozoic cover. Their temperature, up to 68 C, is not only due to the depth of circulation, but also to radiogenic heat production resulting in the decay of uranium and thorium present in the granites in considerable amounts. Horizontal fissure systems found in boreholes up to a depth of 750 m, yield considerable quantities of thermal water. Hot springs occurring near the Upper Tertiary granitic bodies of Manakha-Lihab, Milhan-Hufash and Bura-Raymah Western Escarpment of North Yemen, probably owe their temperature, to radiogenic heat produced in the granites. Drilling may reveal horizontal relaxation fissures yielding thermal water of economic importance. Database: Water Resources Abstracts. ISBN: 0947571663; 9780947571665. OCLC: 20597407.

Dowling, Wg Cdr John. 1992. RAF Helicopters: The First Twenty Years. London: Air Historical Branch/HMSO. Page(s): 489. Abstract: At head of title: Ministry of Defence, Air Historical Branch (RAF). Dowling's detailed and comprehensive study highlights the contribution of the RAF support helicopters to the Radfan campaign, especially the Westland Belvedere which could carry larger loads than any other type. Notes: xv, 488 p., [70] p. of plates: ill., maps; 26 cm. ISBN: 0117727253. OCLC Accession Number: 27268972.

Downes, Chris. 2004. "'Targeted Killings' in an Age of Terror: The Legality of the Yemen Strike." J Conflict Security Law. June 1. Volume 9, Issue 2, Pages 277-294. Abstract: In November 2002, a US Unmanned Aerial Vehicle launched a missile at a car in Yemen suspected to be carrying terrorists. The lethal strike arguably represented a targeted killing', a policy that had previously been widely renounced by the international community including the US. However, the incident remained largely unchallenged by other states. This article analyses the legality of the Yemen strike, taking into account alternative legal rationales that could be presented in defence of US action. It characterises and assesses the incident in turn, as a Yemen

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request for forceful intervention, an engagement in an ongoing armed conflict, an anti-terrorist operation mandated by Security Council Resolution 1373 and an act of anticipatory self-defence. It finds that the Yemen strike in particular, and targeted killings' in general, can only tenuously be reconciled with the existing international legal framework. In this context, the article questions the uncritical international response to the Yemen incident. It speculates that the tacit acceptance of US action reflects two emerging norms governing the use of force, namely a toleration of military actions that do not threaten the existence of the state and the gradual legitimisation of state action perpetrated against unidentified individuals. ISSN: 1467-7962.

Dresch, Paul. 1993. *Tribes, Government and History in Yemen*. Oxford: Clarendon Press. Abstract: Paul Dresch here combines ethnography with history to describe the system of sedentary tribes in South Arabia--a strategically sensitive part of the world--over the past thousand years. He examines the values and traditions the tribal people bring to the contemporary world of nation-states, and discusses the relation of the major tribes to pre-modern Islamic learning, the Zaydi Imamate, ideas of contemporary statehood, and the area as a whole. Dresch's unique and provocative insights are of increasing value given the increased Western involvement with Yemen since 1989, the union of the two Yemens in 1990, and the country's first free election in 1993. ISBN: 0-19-827790-3.

Dresch, Paul and Haykel, Bernard. *Stereotypes and Political Styles: Islamists and Tribesfolk in Yemen*. *International Journal of Middle East Studies*. 27:405-431 November 1995. Examines the political party of Islah, its historical progress, public identity, and its general adviser. ISSN: 1471-6380.

Droubi, A. 1998. For a Sustainable use of Groundwater in Agriculture in the Arab Region; Agricultural Threats to Groundwater Quality; Workshop Proceedings. France: Agricultural Threats to Groundwater Quality, Saragossa. Spain Conference: Oct. 27-30, 1996. Descriptors: Africa; agriculture; aquifer vulnerability; aquifers; Arabian Peninsula; arid environment; Asia; brackish water; drawdown; East Africa; Egypt; fertilizers; ground water; international cooperation; Jordan; leaching; legislation; Mauritania; Middle East; Morocco; North Africa; policy; pollution; preventive measures; salinization; salt-water intrusion; Saudi Arabia; soils; Somali Republic; Sudan; sustainability; Syria; terrestrial environment; Tunisia; water quality; water resources; water scarcity; water supply; water use; West Africa; Yemen. Abstract: Arab countries are facing critical problems of environmental degradation. Population increase and economic growth have spurred higher demands for the limited water resources. Groundwater is often the best and sometimes the only source of water supply. The region faces a future of increasingly acute water scarcity. Intensification of agriculture, often by means of irrigation, has produced groundwater quality problems, particularly with respect to nitrate pollution, pesticides, fertilizers, salinisation, logging and over exploitation of aquifers. Water quality degradation is quickly joining water scarcity as a major issue in the region. A sustainable use of groundwater in agriculture require's preventive measures to deal with groundwater quality degradation. It also requires informing the public of environmental risk, increased awareness of environmental problems. An integral management policy taking into account cost-benefit issues is also required based on the estimation of the real cost of the water allocated, fees to be paid in the case of pollution, and monitoring. Strengthening the capacity of the environmental institutions is also one of the priorities. Notes: References: 23; illus. incl. 3 tables. ISBN: 8484979563. Database: GeoRef. OCLC Accession Number: 43374308.

Dumm, Andrew. 2010. *Understanding the Houthi Conflict in Northern Yemen: A Social Movement Approach*. United States -- District of Columbia: The American University. Abstract:

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Since 2004, the Yemeni government has been fighting a bloody civil war with local Zaydi Shia forces known as the Houthis in the country's north. Conventional explanations rooted in the recent history of the civil war fail to adequately account for the rise of the rebels and their fundamental grievances, however. A social movement approach, which can contextualize the Houthi rebellion within a historical evolution of Zaydi movements, is used here to explain the transition of the Houthis from non-violent social movement to armed insurrectionary group. The Yemeni regime's anti-Zaydi policies and nationalist narrative, along with a competing Wahhabi religious movement, led to a series of inter- and intra-movement disputes that fostered the rise of increasingly oppositional Zaydi factions like the Houthi. The interplay between the Houthi leadership's complex framing of Zaydi grievances and escalating regime-challenger interactions over a public protest movement explains the Houthis' recourse to violence in 2004. The American University; M.A. Typescript; v, 132 leaves : ill. ; 29 cm. American University, School of International Service. Thesis advisor: Kristin Smith Diwan. OCLC: 744633681.

Dumont, HJ and Al-Safadi, MM. 1993. Further Additions to the Dragonfly Fauna of the Republic of Yemen (Odonata). Descriptors: Article Subject Terms: aquatic insects; check lists; distribution records; dominant species; geographical distribution; new records; Article Taxonomic Terms: Odonata; Article Geographic Terms: Yemen; Macrodiplax cora; Orthetrum abbotti; aquatic insects. Abstract: 24 spp. were collected during a cool and rainy period in Feb., 1993. Winter spp. were dominant, with *Aeshna yemenensis* Waterston a prominent example, while summer spp. had not (or were only beginning) to emerge. In addition to *Anax parthenope* Sel. and *Tramea limbata* (Desj.), the oriental, brackish-water *Macrodiplax cora* (Br.) and the afrotropical *Orthetrum abbotti* Calv. are new to Yemen. ISSN: 1010-5220. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. OCLC Accession Number: 3588199.

Đuriš, Z. 2007. "New Occurrence of *Vercoia Socotrana* Đuriš, 1992 (Crustacea, Decapoda, Crangonidae) in the Gulf of Aden, Western Indian Ocean." *Senckenb. Maritima*. Volume 37, Issue 1, Pages 1-4. Descriptors: Crangonidae; Decapoda; Gulf of Aden; Indian Ocean; Socotra; *Vercoia socotrana*. Abstract: Five juvenile specimens of the rare crangonid shrimp *Vercoia socotrana* Đuriš 1992 were collected in the western Gulf of Aden, West Indian Ocean during FS Meteor cruise (MINDIK) in 1987. The specimens agree well morphologically with the original description, based on a single ovigerous female from the Socotra Island. Some minor differences are due to the small size of the present specimens. Some additional data on the morphology of the species are provided. Database: SCOPUS. ISSN: 0080-889X.

2007. Dyer, Caroline. "Working Children and Educational Inclusion in Yemen." *International Journal of Educational Development*. 9. Volume 27, Issue 5, Pages 512-524. Descriptors: Yemen; Working children; IPEC; Educational inclusion. Abstract: The Republic of Yemen has a very high number of working children, employed in a variety of occupations, ranging from street vending to guards on farms, and domestic labour. Including these children in formal education is a major challenge facing the Republic, which has one of the lowest rates of female participation in primary education in the world, and a very underdeveloped non-formal sector. In a context where poverty levels are very high, particularly in rural areas, families remain under significant financial pressure to rely on children's work to supplement, or indeed provide, their income and survival. This broader context challenges school-based efforts to include working children, particularly where initiatives aiming to improve the quality of the formal system are only just beginning to make an impact. This paper discusses key challenges of providing education to working children in Yemen, focusing on the work of the International Labour Organisation's International Programme for the Elimination of Child Labour (IPEC) and

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some of the issues that it faces in using schooling as a strategy to prevent child labour. ISSN: 0738-0593.

E. D. W. 1887. "Barren Rocks of Aden." Notes and Queries. December 24. Volume s7-IV, Issue 104, Pages 509-c. Royal Asiatic Society. OCLC: 220728715.

Eales, K. J. 1986. Power Supplies to Potable Water Wellfield in South Yemen. London, Engl: IEE. 272, page(s): 180-184. First International Conference on Industrial Power Engineering. Descriptors: Well Pumps; Electric Power Distribution; Electric Power Systems - Pumps. Abstract: The population of Greater Aden is likely to continue to increase well into the next century and although the rate of increase in domestic per capita consumption appears to be falling, a new supply will be required by approximately 1990. A reliable long term yield of some 10 Mm³/year can be obtained from a wellfield development in the upper part of the Tuban Delta which should satisfy the demand until approximately 1995. This paper deals with the design of the electrical system required to supply power to 20 borehole pumps spread over an area 5 km long by 0.5 km wide with borehole depths of approximately 120 m. ISBN: 0852963432.

Earth Satellite Corporation. 1983. "Southwest Region of the People's Democratic Republic of Yemen, Landsat Mosaic-General Map." Chevy Chase, MD: The Corporation. Descriptors: Yemen, South -- Remote-sensing maps. Notes: Description: 1 map: col. 85 x 112 cm. Map Info: Scale ca. 1:500,000. Note(s): Includes index map and 2 location maps. Responsibility: this mosaic of edge-enhanced Landsat imagery was produced by Earth Satellite Corp., 1983, for the World Bank's WADI TUBAN Project-Hydrologic/Geologic Evaluation-IDA credit-768 YDR. LCCN: 2001-620740. OCLC Accession Number: 47238097.

Economist Intelligence Unit: Country Profile: Yemen; References. (Bibliography) (Brief Article) (Geographic Overview). 2008. 07/02. Page(s): NA. Descriptors: Yemen. Abstract: National statistical sources. ISSN: 1367-6156. URL: http://find.galegroup.com/gtx/infomark.do?&contentSet=IAC-Documents&type=retrieve&tabID=T001&prodId=AONE&docId=A180876888&source=gale&rprod=AONE&userGroupName=loc_main&version=1.0.

Edwards, Capt F. W. 1964. Report on FRA Operations in Radfan April/May 1964. British Army. Page(s): 32. Abstract: An interesting contemporary account of Federal Regular Army (FRA) participation in Operations Nutcracker and Rustum in 1964 is given by Edwards (*Report on FRA Operations*) in a paper that has survived from the Army Staff College archives. Although restricted to two specific campaigns the report gives a unique British view of the capabilities of the FRA in the Radfan as a whole. JSCSC Library.

Edwards, Frank. 2004. The Gaysh: A History of the Aden Protectorate Levies 1927-61 and the Federal Regular Army of South Arabia 1961-67. Solihull: Helion. Page(s): 204. Abstract: Information on the friendly local forces in Aden is quite scarce with the history by Edwards (*The Gaysh* which reprises parts of his earlier official report) being the most useful as it covers the creation and operation of the Federal Regular Army, albeit in one slim chapter as most of the book is devoted to more distant history. Notes: ix, 180 pages: ill., maps; 21 cm. ISBN: 1874622965. OCLC Accession Number: 57002594.

Eger, Helmut. 1987. "Runoff Agriculture: A Case Study about the Yemeni Highlands." Jemen-Studien. Wiesbaden: L. Reichert, 1987: Volume Bd. 7, Descriptors: Soil conservation -- Terracing -- Yemen; Terracing -- Yemen; Contour farming; Irrigation water -- Yemen. Notes: xvi, 238 pages: ill., maps; 28 cm. Bibliography: p. 161-169. Abstract: Summary in English and German. ISBN: 3882264268. OCLC Accession Number: 700783702.

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Eger, Helmut. 1987. *Runoff Agriculture: A Case Study about the Yemeni Highlands*. Wiesbaden: L. Reichert. Page(s): 238. Descriptors: Terracing -- Yemen (Republic); Contour farming; Irrigation water -- Yemen (Republic). Notes: xvi; ill., maps; 28 cm. Note(s): Summary in English and German. Includes bibliographical references (p. 161-169). Responsibility: Helmut Eger. ISBN: 3882264268; 9783882264265. OCLC Accession Number: 18462187.

Eger, Helmut and Universität Tübingen. 1986. *Runoff Agriculture: A Case Study about the Yemeni Highlands*. Tübingen: Descriptors: Agriculture -- Yemen (Republic); Arid regions agriculture -- Yemen (Republic); Water in agriculture -- Yemen (Republic); Water-supply, Agricultural -- Yemen (Republic); Thesis/dissertation. Notes: xix, 258, [80] p., [4] folded leaves of plates: ill., maps. Dissertation: Thesis (Doctoral)--Universität Tübingen, 1986. Note(s): Dissertation title, abstract and curriculum vitae in German. Includes bibliographical references (p. 233-258). OCLC Accession Number: 427825209.

El Anbaawy, Mohamed I. H. and Fara, Mohamed. 1993. "Geology of Damt Travertine Deposits and Thermomineral Springs, Yemen Republic." *Acta Geologica Universitatis Comenianae* (Bratislava). Univerzita Komenskeho, Bratislava, Slovak Republic. Volume 49, Pages 97-109. Descriptors: Amran Group; Arabian Peninsula; areal geology; Asia; carbonate rocks; Damt Yemen; ground water; hot springs; limestone; sedimentary rocks; springs; Tawilah Sandstone; thermal waters; travertine; Yemen. References: 10; illus. incl. 1 table, geol. sketch map. Abstract: The hydrothermal system in the Damt area, Republic of Yemen, is mainly controlled by Quaternary tectonic and volcanic activities as well as the presence of the Tawilah Sandstone and limestone of Amran Group as aquifers, and circulation of meteoric and in part juvenile waters. These controlling factors have definite implications regarding the development of geysers and thermomineral springs which consequently deposited different genetic types of travertines. The older type is the "crater" vesicular banded travertine formed episodically from the geysers at ancient time. The younger type is the "hanged" algal laminated travertine formed by incrustation and evaporation of the mineralized springs waters through fissures around the sides of the volcanic cones up to the present time. Each of these types is recognized in the field and characterized by its own fabric and composition. Database: GeoRef. ISSN: 1335-2830.

El-Said, A. H. M. 1994. "Keratinophilic Fungi in Soils of Yemen Arabic Republic". *Journal of Basic Microbiology*. 34, no. 5: 311. ISSN: 0233-111X. OCLC: 106962396.

El Sharabi, Essam. 2004. "Water Resources Management in the Ta'iz City, Yemen; a Comprehensive Overview; Italia 2004; 32nd International Geological Congress; Abstracts." *International Geological Congress, Abstracts = Congres Geologique International, Resumes*. [International Geological Congress], [location varies], International; Abstracts = Congres Geologique International, Resumes. Aug. Volume 32, Pages 459. Descriptors: Arabian Peninsula; Asia; drainage basins; hydrology; Taiz Yemen; water management; water resources; watersheds; Yemen. Notes: SP: IGC, International Geological Congress. Database: GeoRef. OCLC: 56945241.

El Sharabi, Essam. 2004. "The Negative Impacts upon the Environmental Aspects in Taiz City and Surroundings, Yemen; Italia 2004; 32nd International Geological Congress; Abstracts." *International Geological Congress, Abstracts = Congres Geologique International, Resumes*. [International Geological Congress], [location varies], International; Abstracts = Congres Geologique International, Resumes. Aug. Volume 32, Part 1, Pages 591. Descriptors: Arabian Peninsula; Asia; degradation; environmental effects; erosion; floods; geologic hazards; land use; pollution; sewage; soil erosion; soils; sustainable development; Taiz Yemen; urban environment;

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urbanization; waste disposal; water pollution; Yemen. Notes: IGC, International Geological Congress. Database: GeoRef. OCLC: 56945241.

El Sherbini, A. A. 1980. "The Need for Rural Development in the Southern Sub-Region of the Arabian Peninsula." *Dirasast Natural Sciences*. Volume 7, Issue 1, Pages 65-74. Abstract: What should be the main emphasis in development programmes to improve the lot of the rural poor in Oman and the 2 Yemens? Should the stress be on increased productivity, or on improving the health of the rural poor - or their education? Or should the emphasis be rural infrastructure - water supply, electricity, etc.? To date, Democratic (South) Yemen has encouraged agrarian reform coupled with decentralization of decision-making, while (North) Yemen has maintained a predominantly private enterprise system. Oman, in contrast, now has an oil-influenced market economy. Gives indicators on characteristics of the rural poor in the 3 countries - despite the difficulties in assembling data. Database: SCOPUS. ISSN: 0253-424X.

El-Anbaawy, M. I. H., Al-Aawah, M. A. H., Al-Thour, K. A. and Tucker, M. E. 1992. "Miocene Evaporites of the Red Sea Rift, Yemen Republic: Sedimentology of the Salif Halite." *Sediment. Geol.* Volume 81, Issue 1-2, Pages 61-71. Notes: Cited By (since 1996): 3. Abstract: Miocene evaporites are spectacularly exposed along the Red Sea coastal plain of Yemen, especially in the region of Salif. Over one thousand metres of bedded halite containing regular millimetre-thick laminae of anhydrite were precipitated below wave base (which need not have been very deep) in a relatively quiet and protected basin, virtually cut-off from the open sea of the Mediterranean and Indian Ocean. A metre-thick unit of laminated and rippled anhydrite within the halite is the result of a major decrease in salinity within the basin. Gypsum overlying the halite is bedded and laminated, but does contain vague vertical structures suggestive of an original selenitic mineralogy. This sulphate was probably precipitated as bottom-growth gypsum and decanted crystals. More open circulation in the basin was established in the Early Pliocene when carbonate muds and siliciclastics were deposited. These Miocene evaporites were precipitated during the continental rifting and opening of the Red Sea-Gulf of Aden when half-graben structures were formed and fed by occasional influxes of marine water. Subsequent sedimentation and tectonic deformation led to major halokinesis, the development of diapirs and exposure of the halite along the coastal plain. Database: SCOPUS. ISSN: 0037-0738.

El-Anbaawy, Mohamed I. H. and Fara, Mohamed. 1993. "The Travertine Deposits and Thermomineral Springs of Damt Area, Yemen Republic." *Annals of the Geological Survey of Egypt*. Egyptian Geological Survey and Mining Authority, Cairo, Egypt. Volume 19, Pages 125-141. Descriptors: aquifers; Arabian Peninsula; Asia; carbonate rocks; Cenozoic; chemical composition; cones; Damt Yemen; evaporation; genesis; geothermal systems; geysers; ground water; hydrology; hydrothermal conditions; juvenile water; laminations; meteoric water; petrography; planar bedding structures; Quaternary; sedimentary rocks; sedimentary structures; sedimentation; springs; travertine; volcanism; Yemen. Notes: AGSECC; References: 13; illus. incl. 2 plates, 1 table, geol. sketch map. Database: GeoRef. ISSN: 0365-2777.

Elderhorst, W. I. M. van der Gun, J A M; Kruseman, G. P. and Anonymous. 1991. *Spatial Allocation of Pumping to Reduce the Negative Impacts of Groundwater Overexploitation in Wadi Surduel, the Republic of Yemen*; XXIII Congreso Internacional Sobreexplotacion De Acuiferos; Actas; Ponencias, Comunicaciones y Resumenes De Posters. XXIII International Congress on Aquifer Overexploitation; Proceedings; General Papers, Extended Abstracts and Posters. Spain: Asociacion Internacional de Hidrogeologos, Grupo Espanol, Spain. XXIII Congreso Internacional Sobreexplotacion De Acuiferos. Canary Islands, Spain Conference: 1991. Descriptors: aquifers; Arabian Peninsula; Asia; clastic rocks; drawdown; exploitation;

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ground water; Indian Ocean; interfaces; mitigation; models; pumping; Red Sea; salt-water intrusion; sedimentary rocks; spatial distribution; Wadi Surduel; Yemen. References: 3; geol. sketch maps. ISBN: 8440491328. Database: GeoRef. OCLC: 23921391.

El-Gamili, Mahmoud M. and Fara, Mohamed. 1996. "Hydrogeology of Wadi Hamman Ali Hot Springs, Anis, Yemen Republic; 30th International Geological Congress; Abstracts." International Geological Congress, Abstracts--Congres Geologique Internationale, Resumes. [International Geological Congress], [location varies], International; Abstracts--Congres Geologique Internationale, Resumes. Volume 30, Pages 556. Descriptors: Anis Yemen; aquifers; Arabian Peninsula; Asia; energy sources; faults; fractures; geothermal energy; geothermal fields; ground water; hot springs; recharge; springs; thermal waters; volcanism; Wadi Hamman Ali Hot Springs; Yemen. Notes: IGC, International Geological Congress. Database: GeoRef. OCLC: 51383829.

El-Hazmi, MAF and Warsy, AS. 2000. "Xmn I Polymorphic Site in Yemeni Sickle Cell Disease Patients." *J. Trop. Pediatr.* February 1. Volume 46, Issue 1, Pages 25-29. Abstract: To investigate the molecular basis of severe clinical presentation in sickle cell disease (SCD) patients in Yemen, this study was conducted on 30 Yemeni SCD patients living in Riyadh and attending King Khalid University Hospital. Seven individuals without SCD were used as controls. Haematological parameters, red cell indices, HB A2 and Hb F levels were estimated and haemoglobin variant were identified on electrophoresis profiling. DNA was extracted from the buffy coat separated from fresh blood samples and was treated with the restriction endonuclease: Xmn I. The fragments generated were separated on electrophoresis, transferred to nitrocellulose and hybridized to a 32P-labelled probe of {gamma}-globin gene. After extensive washing, two bands, 8.1 kb and 7.0 kb in size, were obtained. The frequency of occurrence of the presence of Xmn I polymorphic site (7.0 kb fragment) and its absence (8.1 kb fragment) were documented. The results in Yemeni SCD patients were compared with the results obtained previously in Saudi Arabs. Of the 30 SCD patients from Yemen 29 had only the 8.1 kb fragment and one had only the 7.0 kb fragment. This gave the frequency of 0.966 for the absence (-) and 0.033 (+) for the presence of Xmn I polymorphic site. This is the same result as that reported earlier for SCD patient from southwestern Saudi Arabia [(-)=0.966; (+)=0.033] but is significantly different from that reported in the eastern province [(-)=0.068; (+) 0.932] of Saudi Arabia. This paper presents the nature of molecular linkage in SCD patients from Yemen. ISSN: 1465-3664.

El-Hazmi, MAF and Warsy, AS. 1999. "Brief Report. Alpha Thalassaemia in Yemeni Children with Sickle Cell Disease." *Journal of Tropical Pediatrics.* December 1. Volume 45, Issue 6, Pages 370-374. Abstract: Alpha thalassaemia frequently occurs in several of the Middle Eastern populations. This study was conducted on 26 sickle cell disease (SCD) patients from Yemen and 19 normal children (Hb AA) living in Riyadh, Saudi Arabia. Blood samples were extracted by venepuncture, and haematological and biochemical parameters were estimated. ISSN: 1465-3664.

Elie, Serge D. 2007. *The Waning of a Pastoralist Community: An Ethnographic Exploration of Soqatra as a Transitional Social Formation.* England: University of Sussex (United Kingdom). Abstract: Soqatra is the main island of a four-island Archipelago, and is undergoing an accelerated change process driven by a dual incorporation process: First, the Yemeni government's modernization of its infrastructure and consolidation of its political incorporation into the national community. Second, a United Nations led internationalization of its economy through the implementation of an environmental protection and ecotourism

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development programme. Consequently, its approximately 50,000 inhabitants, who constituted a predominantly pastoralist community with a unique language and a mixed ethnic composition, are now being enlisted in a state-sponsored and internationally assisted community development process, which has spawned an internal social transformation and communal transition. The cardinal problematic of this dissertation is to elucidate the current dynamics of Soqatra's politically mediated and development induced communal transition within a historical continuum. It employs a "processual ethnography" approach that straddles the contemporary and historical dimensions to identify the critical processes of transition, the vectors of change, and their effects. These effects are traced through four domains of social interaction between Soqotrans and external actors, namely politics, economy, culture and environment. The thesis that informs and structures this dissertation is that political incorporation has historically constituted the primary determinant of Soqatra's communal order, and is now the main impetus of its transition. Accordingly, the dissertation situates the island's transition through an overview of the four phases of its recent history of political encompassment, as forms of sovereignty arrogated by outsiders (i.e., sultanate fiefdom, socialist administration, unity government, and post-unity regime), which introduced four divergent types of administrative regimes, as forms of governmentality (i.e., tributary patrimonialism, democratic centralism, tribal libertarianism, and an internationally-mediated local governance), and highlights their reconfigurative impacts on local institutions and practices. Subsequently, it discusses separately the vectors of change (i.e., communal mutation, national acculturation, and transcultural annexation) generated, especially but not exclusively, by the last phase of political encompassment, and explores their adjustment effects on the island's communal life. Finally, it considers the cultural and developmental dilemmas generated by this on-going process of change. University of Sussex (United Kingdom); Ph.D. Database: ProQuest Dissertations & Theses. OCLC: 500366783.

El-Nakhal, H.A. 2005. Review of stratigraphy of the outcropping Cretaceous system in the Republic of Yemen. *Journal of King Saud University. Science.* Volume 17, No 2.

El-Nakhal, Hamed A. 1987. Comparison Between The Groundwater Quality In An Intermountainous And A Coastal Plain In Yemen Arab Republic. Wallingford, Engl: Int Assoc of Hydrological Sciences. IAHS Publication (International Association of Hydrological Sciences) 169, page(s): 73-80. Irrigation and Water Allocation. Symposium Held during the 19th General Assembly of the International Union of Geodesy and Geophysics. Vancouver, BC, Can. Abstract: Groundwater quality of the Sana's and Hudaydah areas, which represent an intermountainous and a coastal plain, respectively, is compared. The quality of the groundwater of both areas has been evaluated for irrigation and domestic use by applying the Wilcox (1955) and the Doneen (1961) methods as well as the standards accepted by the World Health Organization (1971). The results of the evaluation show that the quality of Sana's water is much better than that of Hudaydah. The poor quality of Hudaydah groundwater is attributed to its contamination with sea water and to the low rate of the Hudaydah annual rainfall. Database: SCOPUS. ISBN: 01447815; 9780947571313. ISSN: 0144-7815. OCLC: 16913671.

El-Nakhal, H. A. 1997. "Review of the Stratigraphy of the Paleozoic Erathem in the Republic of Yemen." *Arab Gulf Sci. Res.* Volume 15, Issue 3, Pages 583-598. Notes: Cited By (since 1996): 2. Abstract: In Yemen, the Paleozoic Erathem includes the Wajid Formation which consists of continental sandstone (Carboniferous-Early Permian) and the Kooli Formation which consists of glacial siltstone and silt-shale (Permian). The Kooli is the lower formation of the Kohlan Group (Permian-Early Jurassic) and it is subdivided into the Sharas Siltstone Member and the overlying Khalaqah Shale Member. Database: SCOPUS. ISSN: 1015-4442.

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El-Nakhal, Hamed A. 1992. "Quality of the Groundwater of the Amran Basin, Republic of Yemen; 29th International Geological Congress; Abstracts." International Geological Congress, Abstracts = Congres Geologique International, Resumes. [International Geological Congress], [location varies], International; Abstracts = Congres Geologique International, Resumes. Volume 29, Pages 898. Descriptors: Amran Basin; Arabian Peninsula; Asia; ground water; water quality; Yemen. Notes: IGC, International Geological Congress. Database: GeoRef. OCLC: 26750046.

El-Nakhal, Hamed A. 1987. "Comparison between the Groundwater Quality in an Intermountainous and a Coastal Plain in Yemen Arab Republic; Irrigation and Water Allocation." IAHS-AISH Publication. International Association of Hydrological Sciences, [Louvain], International. Volume 169, Pages 73-80. Descriptors: Affar Formation; Amran Formation; aquifers; Arabian Peninsula; Asia; coastal plains; Ghiras Formation; ground water; Hudaydah region; hydrogeology; Sana'a region; surveys; water quality; Yemen. References: 4; illus. incl. 4 tables, sketch maps. Database: GeoRef. ISBN: 0947571310.

El-Nakhal, Hamed A. 1987. "Comparison of Groundwater Quality in an Intermountainous Plain and a Coastal Plain in the Yemen Arab Republic; International Union of Geodesy and Geophysics (IUGG), XIX General Assembly; Abstracts--Union Geodesique Et Geophysique Internationale (UGGI), XIX Assemblee Generale; Resumes." International Union of Geodesy and Geophysics, General Assembly. International Union of Geodesy and Geophysics (IUGG), Vancouver, BC, Canada. Volume 19, Pages 1000. Descriptors: Arabian Peninsula; Asia; coastal plains; ground water; Hudaydah; hydrogeology; Sana'a; water quality; Yemen. Database: GeoRef. OCLC: 17103326; 29416399.

El-Zaemey, A. 2000. Water Conservation in Yemen: A Case Study. Database: COS Conference Papers Index.

El-Zaemey, A. 2000. Solid Waste Management in Developing Countries - Yemen as a Case Study. Database: COS Conference Papers Index.

Esenkov, OE and Olson, DB. 2002. "A Numerical Study of the Somali Coastal Undercurrents." Deep-Sea Res. (II Top. Stud. Oceanogr.). Volume 49, Issue 7-8, Pages 1253-1277. Descriptors: Article Subject Terms: Coastal currents; Modelling; Nearshore dynamics; Ocean circulation; Undercurrents; Article Geographic Terms: Yemen, Socotra; Marine. Abstract: Subsurface circulation in the western Arabian Sea is studied with an open boundary version of the Miami Isopycnic Coordinate Ocean Model (MICOM). The model solution demonstrates a strong annual cycle and significant alongshore variability of subsurface circulation. Based on the dynamics and water properties, three regions are identified along the coast. A cross-equatorial current, which exists throughout the year, carries low-salinity water northwards. Comparison of the model results with observations in the equatorial region demonstrates that the model reproduces the annual cycle and transport of the currents remarkably well. Although it underestimates the speed of the undercurrent core by about a factor of two, increasing the horizontal resolution from 0.35 degree to 0.225 degree improves agreement with the measurements. A spring southward undercurrent between 5 degree N and the equator owes its existence to the wind forcing in the Arabian Sea. Water with higher salinity values, found in the coastal region north of 5 degree N, is advected by a southward undercurrent that is present between October and March. The existence of the undercurrent is caused by flows from the east and northeast. The latter originates in the Persian Gulf and provides about 75% of water for the coastal undercurrent. The annual Rossby wave generated in the interior of the domain contributes to the formation of the current in the fall. The third region is an area near 4 degree N, where the

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southward undercurrent separates, as velocity and salinity fields suggest. Subsurface circulation north of 5 degree N is disconnected from flows near the equator during most of the year. The model circulation is not sensitive to the details of coastal bottom topography. In contrast, the presence of the Socotra Island, which is absent in the model, leads to a more realistic solution in that the southward undercurrent north of 5 degree N is present throughout the spring. Interannual variability of the model subsurface fields increases significantly when observed, rather than climatological, wind forcing is used. The most dramatic changes occur in the coastal and equatorial regions. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0967-0645.

Geology of Yemen

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Fabey, Michael. 2000. "Attack Waiting To Happen." Traffic World. Commonwealth Business Media: Volume 264, Issue 4, Pages 40. Descriptors: Ports; Security; Yemen. Abstract: Subtitle: Lax Port Security, Regional Tension Presage Bombing OF USS Cole. ISSN: 0041-073X. Availability: Available from Northwestern University Transportation Library through interlibrary loan or document delivery. URL: <http://www.library.northwestern.edu/transportation/services.html>; <http://worldcat.org/oclc/4563352>.

Fabik, Miroslav. 1981. "Geologicka Expedice v Jemenske Lidove Demokraticke Republice. Geologic Expedition in Southern Yemen." Geologicky Pruzkum. Zamestnavatelsky Svaz Dulniho a Naftovho Prumyslu, Prague, Czechoslovakia. Volume 23, Issue 12, Pages 350-352. Descriptors: Arabian Peninsula; areal geology; Asia; cartography; economic geology; exploration; geochemistry; geophysical surveys; ground water; guidebook; hydrogeology; maps; mining review; nonmetal deposits; reserves; Southern Yemen; surveys. Notes: GEYPAN. Database: GeoRef. ISSN: 0016-772X.

Falhorn, M. 1986. "Geographische Charakteristik Des Wadi Hadramaut. Geographic Characteristics of Wadi Hadramaut." Wissenschaftliche Beitrage - Martin-Luther-Universitaet Halle-Wittenberg. Martin Luther Universitaet Halle-Wittenberg, Halle, Federal Republic of Germany Federal Republic of Germany. Volume 19, Pages 77-107. Descriptors: agriculture; Arabian Peninsula; Asia; basins; dams; environmental geology; geography; ground water; hydrogeology; hydrology; intermontane basins; irrigation; land use; soils; Southern Yemen; springs; surface water; surveys; vegetation; Wadi Hadramaut; water supply; Yemen. Notes: References: 6; sects., geol. sketch maps. Database: GeoRef. ISSN: 0440-1298.

Fara, Mohamed. 1993. "Sewage Water Disposal and Aquifer Pollution in Arid Lands; a Case Study; Sana'a Waste Water Discharge; Memoires of the XXIVth Congress of the International Association of Hydrogeologists; Hydrogeology of Hard Rocks." Memoires - Association Internationale Des Hydrogeologues = Memoires - International Association of Hydrogeologists. Association Internationale des Hydrogeologues; Committee of U.S.A. Members of the International Association of Hydrogeologists, Montpellier, International. Volume 24, Pages 813-823. Descriptors: Al-Rawdah Yemen; aquifers; Arabian Peninsula; arid environment; Asia; discharge; ground water; pollutants; pollution; Sana'a Yemen; sewage; terrestrial environment; waste water; Yemen. Notes: CD: IAHMAP; References: 7; illus. incl. 2 tables. Database: GeoRef. ISSN: 0579-6733.

Fara, Mohamed. 1993. "Sewage Water Disposal and Aquifer Pollution in Arid Lands (Case Study; Sana'a Waste Water Discharging)." Annals of the Geological Survey of Egypt. Egyptian Geological Survey and Mining Authority, Cairo, Egypt. Volume 19, Pages 425-434. Descriptors: aquifers; Arabian Peninsula; arid environment; Asia; discharge; geochemistry; ground water; human waste; hydrochemistry; monitoring; pollutants; pollution; remediation; Sanaa Yemen; sewage; terrestrial environment; waste disposal; water quality; water treatment; water wells; wells; Yemen. Notes: AGSECC; References: 2; illus. incl. 1 table, geol. sketch map. Database: GeoRef. ISSN: 0365-2777.

Fara, Mohamed, Chandrasekharam, Dornadula and Minissale, Angelo. 1999. "Hydrogeochemistry of Damt Thermal Springs, Yemen Republic." Geothermics. Elsevier Ltd: Volume 28, Issue 2, Pages 241-252. Descriptors: Natural water geochemistry; Analytical geochemistry; Composition; Deposits; Dissolution; Geothermal springs; Limestone; Sandstone; Temperature measurement. Abstract: The Damt thermal springs (40-45C), flowing through

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travertine deposits, belong to the Na-HCO₃ type of water, and have higher pCO₂ (from -1.18 to -0.58 = PCO₂ from 0.07 to 0.26 atm) relative to cold Ca-SO₄-(Cl) groundwaters. The cold waters have pCO₂ ranging from -1.86 to -2.50 (= PCO₂ from 0.014 to 0.0035 atm). The chemical composition of the cold springs is controlled by evaporite deposits present in the Tawilah sandstone and Amran limestone formations, while simple crustal dissolution, coupled with CO₂-rich fluid-rock interaction control the chemical signature of the hot spring waters. The temperature of the feeding system, based on the K₂/Mg geothermometer, varies between 80 and 120C. Damt thermal springs appear to be related to a 10,000 year-old volcanic activity that led to the appearance of several craters in the area. ISSN: 0375-6505. URL: [http://dx.doi.org/10.1016/S0375-6505\(99\)00006-1](http://dx.doi.org/10.1016/S0375-6505(99)00006-1).

Farquharson, FAK, J. R. Meigh, and J. V. Sutcliffe. 1992. "Regional Flood Frequency Analysis in Arid and Semi-Arid Areas." *Journal of Hydrology (Amsterdam)* 138.3 (1992): 487-501. Abstract: The relationship between maximal annual flood (MAF) and catchment characteristics in arid and semi-arid regions, where flood measurement was difficult, was studied by analysing 3637 station-years of data from 162 basins with annual rainfall less than 600 mm in 12 countries. Regional and interregional flood frequency curves constructed by combining dimensionless flood frequency curves for individual stations within each region (using the probability weighted moments method) showed strong similarity, with extreme slope and skewness indicating similar storm characteristics. MAF regressions on catchment area and mean annual rainfall showed that MAF might be estimated from regression equations for Iran, Saudi Arabia and Yemen, Queensland (Australia), South Africa and Botswana, although data from some countries was currently insufficient to give reliable results. Overall grouped regression provided a good general predictor of MAP in most areas studied even where local flood data were unavailable. ISSN: 0022-1694.

Farquharson, F. A. K., Plinston, D. T. and Sutcliffe, J. V. 1996. "Rainfall and Runoff in Yemen." *Hydrological Sciences Journal- Journal- des Sciences Hydrologiques*. IAHS Press: Wallingford, United Kingdom. Volume 41, Issue 5, Pages 797-811. Descriptors: Rain; Arid regions; Computer aided analysis; Mathematical models; Runoff; Statistical methods. Abstract: This paper makes use of a water balance study of a mountainous area with a wide range of average annual rainfall in an arid and semiarid region to illustrate the development of both a statistical model of daily rainfall and a rainfall-runoff model. The models are appropriate for these conditions and may be relevant to similar areas. Comparisons of mean rainfall and runoff at the arid end of the scale suggest that runoff coefficients do not conform to common assumptions. ISSN: 0262-6667.

Faruqi, Naser I. Biswas, Asit K. and Bino, Murad J. 2001. *Water Management in Islam*. IDRC. Page(s): 149 pages. Descriptors: Water resources development; Water-supply; Water-supply Africa, North; Water-supply Middle East. Notes: Islam and the environment; ownership and transfer of water and land in Islam ISBN: 0889369240. URL: http://books.google.com/books?id=Goljt39k-RoC&printsec=frontcover&source=gbv_v2_summary_r&cad=0#v=onepage&q=&f=false

Favrel, P. 1961. Aden - Ground control for aerial mapping of lahej area - Report to the government. FAO 1961 - EPTA Report no 1310 - 17 p. Keywords: Cartography; Aerial Surveying; Photography; Photogrammetry; Management; Land Levelling; Height; Training; Democratic Yemen. Epta Project. Report Number: LA-EPTA 1310. FAO Library Accession Number: 051310.

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Fediuk, Ferry and Sebesta, Jiri. 2006. "Proces Vymyvani Pri Vzniku Sutovych Forem Jemenskeho Ostrova Sokotry. Selective Sorting Processes Forming Slope-Debris Patterns in Socotra Island, Yemen." *Zpravy o Geologických Vyzkumech v Roce. Cesky Geologický Ustav, Prague, Czech Republic. Volume 2005, Pages 148-149.* Descriptors: Arabian Peninsula; Asia; bedrock; Cenozoic; climate; debris; erosion; gabbros; geomorphology; Haggerher Mountains; igneous rocks; landforms; patterns; plutonic rocks; processes; Quaternary; rainfall; relief; slopes; Socotra Island; soils; vegetation; Yemen. References: 4. Abstract: Spectacular forms of blocky debris on the slopes built by gabbroic rocks have been found in western part of Haggeher Mts. (Socotra Island). They occur as dark irregular patches 100 to 500 m (super 2) in areal extent, entirely free of vegetation in contrast to the green surroundings covered with plants. At first sight, these forms resemble polygonal soils known from sub-nival areas. Here however, in tropical environment (12 degrees from the equator), their origin requires a quite different explanation. The gabbro in the substrate of the debris is dissected by two systems of subvertical and mutually perpendicular joints. In the places of especially intensive jointing and at the junction of the two systems, the rain-water flushes fine particles of the debris into open joints and only coarse stony material unsuitable for vegetation remains on the surface. The designation "selective winnowing" can be used for this process. Low coastal plains of the island have a typical arid character with average rainfall 120 mm/y only, but this value raises ten times in the mountains making the winnowing of debris effective. Database: GeoRef in Process. ISSN: 0514-8057. URL: <http://www.geology.cz/zpravy/obsah/2005/zpravy-o-vyzkumech-2005-str-148-149.pdf>.

Fennema, F. and Briede, J. W. 1990. "The Effect of Clipping and Water Stress on the Production of Selected Grass Species in the Yemen Arab Republic." *J. Arid Environ. Volume 19, Issue 1, Pages 119-124.* Notes: Cited By (since 1996): 2. Abstract: *Andropogon distachyos*, *Tetrapogon villosus*, *Themeda triandra* and *Agropyron desertorum* were clipped to 1.5 cm at 3 or 6 wk intervals and soil moisture was kept near field capacity. *T. villosus* tolerated defoliation in combination with water stress better than the other native grass species. *T. triandra* seemed to be the least tolerant to clipping, whereas *A. distachyos* was intermediate. -from Authors. Database: SCOPUS. ISSN: 0140-1963.

Ferguson, M. E., Al-Hadrami, G., Al-Rowaily, S. L. R., Al Hajoj, A. and Peacock, J. M. 1999. "Desert Forages of the Arabian Peninsula; a Solution for Enhancing Conservation and Combating Desertification; the Third Conference on Desertification and Environmental Studies; Beyond the Year 2000; Proceedings." *Proceedings - Conference on Desertification and Environmental Studies. United Nations Environment Programme and King Saud University, Prince Sultan Center for Environmental, Water and Desert Research, International. Volume 3, Pages 209-217.* Descriptors: Arabian Peninsula; Asia; biota; data bases; data processing; degradation; desertification; deserts; drought; ecology; eolian features; global change; global warming; grasses; ground water; habitat; irrigation; land use; nutrients; Oman; Plantae; rangelands; recharge; salinization; United Arab Emirates; vegetation; water quality; Yemen. References: 11; illus. incl. 4 tables, sketch maps. Abstract: The native plant biodiversity of the Arabian Peninsula, which comprises over 3500 species, is being rapidly depleted. The primary cause is overgrazing, particularly by the large population of small ruminants (24 million and growing steadily). increasing amounts of supplementary feed in the form of alfalfa and Rhodes grass is being produced to accommodate the shortfall from the rangeland. These species, introduced to the region, consume huge volumes of water, mainly applied through irrigation from groundwater. Groundwater reserves have fallen dramatically, thus salinity levels have risen.

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The combined effects have meant that the potential productivity of the land has fallen, desertification is accelerated and, in some cases, the land has had to be abandoned. Some of the National Agricultural Research Systems of the Arabian Peninsula, working with the International Center for Agricultural Research in the Dry Areas (ICARDA), have taken steps to address the resulting degradation. This paper describes step-by-step an holistic approach that was begun in 1997 to address the problems. It started with the collection of indigenous knowledge and interviews with local Bedouin farmers in the United Arab Emirates; continued through a series of training programs for human resource development, germplasm collection missions in the UAE, the Sultanate of Oman and the Republic of Yemen; the development of herbaria, databases, and one large genebank in the Republic of Yemen as well as a working collection in the UAE. Seed has been multiplied and evaluations for water-use efficiency and nutritive value are underway. Initial data shows that not only do the desert forages use less water than the introduced forages, but also their nutritive value is as good. In addition to determining a sustainable forage production system, research is underway to define appropriate restoration and rehabilitation methodologies, and small enclosures have been selected, in some countries, viz., Kingdom of Saudi Arabia, Kuwait and UAE, for this purpose. Some of the collaborative research at the Range & Development Research Center at Al-Jouf in Saudi Arabia is briefly described. This research will not only benefit the Arabian Peninsula countries, but also all countries that are likely to face the increasing impacts of global warming, salinity, drought and desertification in the 21st century. Database: GeoRef. ISBN: 9960373800; 9789960373805. OCLC: 191914549.

First Country Programme for the Republic of Yemen. 1992. New York: UN. Page(s): 18. Descriptors: Indicative Planning Figures; Country Programmes; Development Strategies; Development Assistance; Statistical Services; Resources Mobilization; Management Development; Administrative Reform; Manpower Development; Health Services; Education; Employment; Sustainable Development; Natural Resources Development; Water Resources Development; Mineral Resources Development; Yemen; Project Finance; Aid Coordination; Programme Management; UNDP -- Programme management; Government publication; International government publication; Internet resource. Notes: tables. Development projects. Issued under agenda item 6, agenda document DP/1992/L.14. Issued under agenda item 6a, agenda document DP/1992/L.14. General Info: Distribution: General. Other Titles: 1st country programme for the Republic of Yemen. OCLC Accession Number: 123432900; 84293218.

Fischer, J., Schott, F. and Stramma, L. 1996. "Currents and Transports of the Great Whirl-Socotra Gyre System during the Summer Monsoon, August 1993." *J. Geophys. Res. (C Oceans)*. Volume 101, Issue C2, Pages 3573-3587. Descriptors: Article Subject Terms: current observations; current velocity; dynamical oceanography; monsoons; ocean circulation; ocean currents; oceanic eddies; Article Geographic Terms: Indian Ocean, Great Whirl; Indian Ocean, Socotra Gyre; Somali Dem. Rep. Yemen, Socotra; Marine. Abstract: From August 11 to 22, 1993, a conductivity-temperature-depth/acoustic Doppler current profiler survey was carried out in the Somali-Socotra region to investigate currents and transports associated with the Great Whirl and Socotra Gyre circulation during the height of the summer monsoon. The monsoon circulation was confined to the upper 300 m depth, with intense surface currents up to 2.2 m s⁻¹ in the Great Whirl and up to 1.4 m s⁻¹ in the Socotra Gyre. Deeper-reaching flow was found in the northwestern part of the Somali Basin and in the passage between the shelf of Somalia and Abd al Kuri. The Great Whirl transport was 58 Sv, of which nearly 25% were due to ageostrophic flow components. The northern part of the Great Whirl thereby appeared as a closed circulation cell in which the offshore transport was balanced by a southward transport of

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the same magnitude. Upwelled water was advected from the cold wedge of the upwelling regime at the Somali coast along the edge of the gyre. The water in the center of the gyre had the characteristics of Indian Equatorial Water (IEW). The Socotra Gyre carried 23 Sv of modified Arabian Sea Water (ASW). Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0148-0227.

Flanders, Lowell and Institute for Development Anthropology (Binghamton, N.Y.). 1987. Mission Report. Descriptors: Natural resources -- Yemen; Water supply -- Yemen, South; Rural development projects -- Yemen; Applied anthropology -- Yemen; Manuscript. Abstract: Yemeni joint project for natural resources;: Kuwait, 27 June - 1 July --; Rural water supply Bedouin communities; Denmark, 1 July - 4 July. Notes: 21 pages; 28 cm. Note(s): Title from cover. "7 July 1987." "TCD - 3269". Responsibility: Lowell Flanders. OCLC Accession Number: 708077444.

Fleitmann, D., Burns, S. J., Mangini, A., et al. 2007. "Holocene ITCZ and Indian Monsoon Dynamics Recorded in Stalagmites from Oman and Yemen (Socotra)." *Quat. Sci. Rev.* Volume 26, Issue 1-2, Pages 170-188. Notes: Cited By (since 1996): 44. Abstract: High-resolution oxygen isotope ($\delta^{18}O$) profiles of Holocene stalagmites from four caves in Northern and Southern Oman and Yemen (Socotra) provide detailed information on fluctuations in precipitation along a latitudinal transect from 12°N to 23°N. $\delta^{18}O$ values reflect the amount of precipitation which is primarily controlled by the mean latitudinal position of the ITCZ and dynamics of the Indian summer monsoon (ISM). During the early Holocene rapidly decreasing $\delta^{18}O$ values indicate a rapid northward displacement in the mean latitudinal position of the summer ITCZ and the associated ISM rainfall belt, with decadal- to centennial-scale changes in monsoon precipitation correlating well with high-latitude temperature variations recorded in Greenland ice cores. During the middle to late Holocene the summer ITCZ continuously migrated southward and monsoon precipitation decreased gradually in response to decreasing solar insolation, a trend, which is also recorded in other monsoon records from the Indian and East Asian monsoon domains. Importantly, there is no evidence for an abrupt middle Holocene weakening in monsoon precipitation. Although abrupt monsoon events are apparent in all monsoon records, they are short-lived and clearly superimposed on the long-term trend of decreasing monsoon precipitation. For the late Holocene there is an anti-correlation between ISM precipitation in Oman and inter-monsoon (spring/autumn) precipitation on Socotra, revealing a possible long-term change in the duration of the summer monsoon season since at least 4.5 ka BP. Together with the progressive shortening of the ISM season, gradual southward retreat of the mean summer ITCZ and weakening of the ISM, the total amount of precipitation decreased in those areas located at the northern fringe of the Indian and Asian monsoon domains, but increased in areas closer to the equator. Database: SCOPUS. ISSN: 0277-3791.

Florida State Univ, Tallahassee, Mesoscale Air-Sea Interaction Group and Simmons, Ray C; Luther, Mark E; O'Brien, James J; Legler, David M. 1987. "Verification of a Numerical Ocean Model of the Arabian Sea." August 1987. Page(s): 82 Contract Number: N00014-82-C-0404. Abstract: A case study evaluating the predictive capability of an upper layer circulation model of the northwest Indian Ocean is presented. The ocean model is a nonlinear, reduced gravity model incorporating realistic boundary geometry and is forced by actual wind observations. Model results for the fall of 1985 are compared to, and evaluated against, U S Navy bathythermograph and NOAA satellite data collected during Aug-Nov 1985. An assessment of the model's ability to predict correctly the circulation structure is made. Wind observations were converted to wind stress for model forcing by a procedure developed by

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Leglar and Navon (1987). While the model is only moderately successful in reproducing the structure of the large, rather homogeneous pool of water located off the Arabian Peninsula in September, it behaves remarkably well in the dynamically active region around Socotra. Major oceanographic fronts and eddies frequently observed in the region during the transition period between the southwest and the northwest monsoon appear in the 1985 model results and compare well, both temporally and spatially, with the observational data. Thus, given accurate wind information, the model appears highly effective in dynamically active regions, and demonstrates potential as a useful prognostic tool for evaluation of the Arabian Sea when real time winds become available. Keywords: Air sea interactions. Abstract Classification: Unclassified Technical Reports Collection. Notes: Technical rept., DTIC Accession Number: ADA185777.

Food and Agriculture Organization (FAO). 1979. Survey and evaluation of available data on shared water resources in the Gulf States and the Arabian Peninsula. Volume I. Food and Agriculture Organization of the United Nations, Rome

Food and Agriculture Organization (FAO); Marty Matlock (Topic Editor). 2008. "Water profile of Yemen." In: Encyclopedia of Earth. Eds. Cutler J. Cleveland (Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment). [First published in the Encyclopedia of Earth December 13, 2006; Last revised May 8, 2008; Retrieved April 1, 2010]. URL: http://www.eoearth.org/article/Water_profile_of_Yemen

Food and Agriculture Organization of the United Nations. 1997. "Yemen." Food and Agriculture Organization of the United Nations. Page(s): 271-278. Descriptors: Water resources development; Water-supply; Water-supply, Rural. Abstract: The AQUASTAT programme has been initiated with the view of presenting a comprehensive picture of water resources and irrigation in developing countries. This report presents the results of a survey of the Near East Region taken in 1995 and 1996. The survey relied mostly on country-based statistics and information contained in sector studies and master plans. A general summary presents a regional analysis of water resources and irrigation in the Near East Region, and 29 profiles describe the situation in each country in more detail. ISBN: 9251039690. URL:

http://books.google.com/books?id=AeXFwPYC8jwC&pg=PA271&dq=yemen&lr=&as_drrb_is=b&as_minm_is=0&as_miny_is=1990&as_maxm_is=0&as_maxy_is=2010&num=100&as_brr=1&as_pt=BOOKS&ei=KpdDS7npApGsNsGM4eEH&cd=68#v=onepage&q=yemen&f=false.

Foppen, J. W. A., Naaman, M. and Schijven, J. F. 2005. "Managing Water Under Stress in Sana'a, Yemen." Arabian Journal for Science & Engineering, Section C: Theme Issues. Arabian Journal for Science & Engineering: 12. Volume 30, Issue 2, Pages 69-83. Descriptors: Water quality management; Groundwater; Sewerage; Aquifers; Water -- Analysis; Sanitation; Yemen (Republic); ground water pollution; groundwater modeling; pollution control; sustainable water use; Urban groundwater; waste water management. Abstract: Lack of water management in the Sana'a Basin in Yemen has led to mining of groundwater and massive groundwater quality deterioration. In the last four years, management of waste water has changed dramatically and entire city neighborhoods have been connected to a conventional sewer system. In this paper, the effects of this measure on long-term groundwater quality development of the aquifers underlying Sana'a and, more specifically, on water quality of the public supply peri-urban wellfields are analyzed. The results, obtained with a transient groundwater model, indicated that by 2020 the construction of the sewerage will have considerably reduced the area polluted by groundwater, but the process is slow. Furthermore, construction of the sewerage will hardly affect the groundwater quality of the wellfields, since flow is not directed towards most of the production wells. The Yemeni authorities should realize that less expensive sanitation alternatives are

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available, but they need user participation, which, in turn, would raise public awareness that water supplies and sanitation are not to be seen as solely a government responsibility. ISSN: 0377-9211.

Foppen, JWA. 2002. "Impact of High-Strength Wastewater Infiltration on Groundwater Quality and Drinking Water Supply: The Case of Sana'a, Yemen." *J. Hydrol. (Amst.)*. 10 June 2002. Volume 263, Issue 1-4, Pages 198-216. Descriptors: Acidification; Anions; Calcium; Cation Exchange; Cations; Cesspool; Cesspools; Chlorides; Drinking water; Environmental Effects; Ground water; Groundwater Pollution; Infiltration; Ion exchange; Model Studies; Nitrates; Path of Pollutants; Pollution (Environmental); Pollution (Groundwater); Prediction; Survey; Surveys; Waste water; Wastewater; Wastewater Disposal; Water Quality; Water quality (Natural waters); Water supplies; Water supply; Water wells; pH; Article Geographic Terms: Yemen; Yemen, Sana'a; Freshwater. Notes: TR: CS0507491. Abstract: In Sana'a, the capital of the Yemen Arab Republic, a major well inventory was compiled in 1995 during which samples were analysed for major cations and anions. Five years later the opportunity was taken to repeat the exercise on a sub-set of the original wells. The results showed that groundwater in the urban area was characterised by high concentrations of almost all major cations and anions due to the continuous infiltration of wastewater into the aquifers via cesspits. The dominant watertype appeared to be CaCl sub(2). The Cl super(-)-concentration ranged from 3 to 10 mmol/l and NO sub(3) super(-)-concentration ranged from 1 to 3 mmol/l while NH sub(4) super(+) was absent in all samples. It is concluded that cation exchange has taken place. Ca super(2+) in groundwater has been enriched, while Na super(+), K super(+) and NH sub(4) super(+) have been depleted. Groundwater affected by wastewater had pH values of 0.5-1 unit lower than groundwater not affected by wastewater, indicating that acidification has taken place. Over the period between the two surveys, concentrations of almost all major anions and cations increased, while pH decreased, both owing to the continuous infiltration of wastewater. An exploratory one-dimensional transport model of a 200 m column of the aquifer underlying Sana'a showed that, over a 15-year period of continuous wastewater infiltration, a quarter of the NH sub(4) super(+) present in raw sewage would oxidise to NO sub(3) super(-) thereby producing acidity and some 60% would be adsorbed. The model indicates that after 50 years of wastewater infiltration, exchange of NH sub(4) super(+) has become limited due to the limited cation exchange capacity (CEC) of the soil. Therefore more NH sub(4) super(+) will be oxidised to NO sub(3) super(-) and [NO sub(3) super(-)] in groundwater will rise. At the same time, groundwater in the zone of NH sub(4) super(+) oxidation will become very acid due to a lack of buffering minerals. The modelling studies, together with the results from the surveys, tend to indicate that up to 12% of the current population of the city could be dependent on contaminated groundwater for their drinking water supply. Database: Water Resources Abstracts. ISSN: 0022-1694.

Foppen, JWA; Naaman, M. and Schijven, JF. 2005. *Managing Urban Water Under Stress: The Case of Sana'a, Yemen*. *Water Resources Management III*. Page(s): 101-110. Descriptors: Groundwater; Groundwater Pollution; Sanitation; Water Resources Management; Construction; Groundwater Basins; Water Management; Geohydrology; Stress; water quality; Aquifers; Basins; Water supplies; Wastewater; public awareness; responsibility; Mining; Sewers; Urban areas; Article Geographic Terms: Yemen. Abstract: Lack of water management in the Sana'a Basin in Yemen has led to mining of groundwater and massive groundwater quality deterioration. In the last four years, management of wastewater has changed dramatically and entire city neighborhoods have been connected to a conventional sewer system. In this paper, the effects of this measure on long-term groundwater quality development of the aquifers underlying

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Sana'a and, more specifically, on water quality of the public supply peri-urban wellfields are analyzed. The results, obtained with a transient groundwater model, indicated that by 2020 the construction of the sewerage will have considerably reduced the area polluted by groundwater, but the process is slow. Furthermore, construction of the sewerage will hardly affect the groundwater quality of the wellfields, since flow is not directed towards most of the production wells. The Yemeni authorities should realize that less expensive sanitation alternatives are available, but they need user participation, which, in turn, would raise public awareness that water supplies and sanitation are not to be seen as solely a government responsibility. ISBN: 1845640071. Database: Water Resources Abstracts. OCLC Accession Number: 7327802.

Foster, Stephen. 2003. Yemen: rationalizing groundwater resource utilization in the Sana'a Basin. Sustainable Groundwater Management- Lessons from practice. Case Profile Collection Number 3. World Bank. OCLC: 62071935. URL: <http://www.docstoc.com/docs/48548353/Yemen-Rationalizing-Groundwater-Resource-Utilization-in-the-Sanaa>.

Francaviglia, V. M. and Cessari, L. 1995. "Due Citta Fragili; Samarcanda (Uzbekistan) e Shibam (Jemen). Two Fragile Towns; Samarkand, Uzbekistan and Shibam, Yemen; La Citta Fragile in Italia. The Fragile City in Italy." *Geologia Applicata e Idrogeologia*. Universita di Bari, Istituto di Geologia Applicata, Facolta di Ingegneria, Bari, Italy. Volume 30, Pages 509-525. Descriptors: Arabian Peninsula; archaeological sites; Asia; buildings; case studies; Commonwealth of Independent States; damage; foundations; geologic hazards; ground water; land subsidence; land use; planning; reclamation; Samarkand Uzbekistan; Shibam Yemen; site exploration; urban environment; Uzbekistan; water table; Yemen. References: 12; illus. incl. sketch maps. Abstract: It is a question of two opposite extremes, of two different kinds of fragility. The first, that of Samarkand, a steppe town, can be considered as the final stage of the evolution of an architectural and town-planning heritage in which the course of time, the numerous social, political, economical and cultural changes have led to a situation of such decay that the Municipality has been compelled to launch a Plan for the Revitalisation of Samarkand. This town, its historical centre at least, is no longer in equilibrium with the social, economical and cultural context in which exists, and more recently not even with the environmental one. The second, that of Shibam, a desert town, on the contrary represents a typical case of a town which has remained perfectly in equilibrium with the social, economical, cultural and environmental context which has created it, this latter having changed only slightly. Notwithstanding this, its fragility does not originate from the circumstance of being made up of sun-dried mud bricks, but is implicit in the seducing prospects of an economical growth fuelled by oil revenues and so rapid that the architectural heritage in its whole cannot react through adequate modifications. In the case for Uzbekistan, the historical centre of Samarkand, with its famous monuments by Tamerlane covered with polychrome faïences, has become "de jure et de facto" an open-air museum, a totally passive entity whose contribution to the creation of national wealth is negligible, which runs the risk of being destroyed totally due to the water-bearing layer raising and restoration works carried out by using inadequate materials. This threatening water level raising has been caused by unconstrained town-planning techniques. As a matter of fact, as restoration works of timurid and post-timurid monuments, tending to give them back their original splendour, are going on since some decades, a water-level raising of 8 metres in the last 18 years has helped in a differential subsidence of all monuments, both ancient and modern. As a consequence, structural damages, as well as collapses as in the recent case of the Chor-Minar of Buchara, have occurred. The problems affecting Samarkand and its monuments are of technical

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origin only, not political, and thus of easy--though expensive--solution. On the contrary, in the near future Shibam will face different problems, of less easier solution but in which we should avail ourselves of any previous experience learned from similar cases in Europe and in Sana' itself, the Yemen capital city. Due to the lack of any local good stone, the only building materials since ever used in Shibam, as well in the whole Wadi Hadhramaut, have been sun-dried mud-bricks for structures, wood for architraves and plaster for adorning facades. All this architectural heritage, which not only includes habitations but also religious and military buildings, due to its specific nature deserves a greater amount of skilled manpower, easy to get thanks to its low costs. The foreseeable economical growth, and its impact on local culture, will unavoidable lead to a progressive neglecting of traditional buildings in favour of less expensive and more durable models, made up of reinforced concrete and concrete-bricks. Shibam, together with all the marvels of Wadi Hadhramaut, is condemned to a slow and physical disappearance unless any adequate safeguard plan is proposed and carried out. Database: GeoRef. ISSN: 0435-3870.

Francaviglia, Vincenzo M. 2000. "Dating the Ancient Dam of Ma'rib (Yemen)." *Journal of Archaeological Science*. 7. Volume 27, Issue 7, Pages 645-653. Descriptors: Yemen, Sabaeans, Ma'rib Dam, 14c Dating, Sediments, Irrigation, Arid Lands, Desert Farming. ISSN: 0305-4403.

Fratantoni, D. M., Bower, A. S., Johns, W. E. and Peters, H. 2006. "Somali Current Rings in the Eastern Gulf of Aden." *J. Geophys. Res. C Oceans*. Volume 111, Issue 9, Notes: Cited By (since 1996): 2. Abstract: New satellite-based observations reveal that westward translating anticyclonic rings are generated as a portion of the Somali Current accelerates northward through the Socotra Passage near the mouth of the Gulf of Aden. Rings thus formed exhibit azimuthal geostrophic velocities exceeding 50 cm/s, are comparable in overall diameter to the width of the Gulf of Aden (250 km), and translate westward into the gulf at 5-8 cm/s. Ring generation is most notable in satellite ocean color imagery in November immediately following the transition between southwest (boreal summer) and northeast (winter) monsoon regimes. The observed rings contain anomalous fluid within their core which reflects their origin in the equator-crossing Somali Current system. Estimates of Socotra Passage flow variability derived from satellite altimetry provide evidence for a similar ring generation process in May following the winter-to-summer monsoon transition. Cyclonic recirculation eddies are observed to spin up on the eastern flank of newly formed rings with the resulting vortex pair translating westward together. Recent shipboard and Lagrangian observations indicate that vortices of both sign have substantial vertical extent and may dominate the lateral circulation at all depths in the eastern Gulf of Aden. Database: SCOPUS. ISSN: 0148-0227.

Freytag, Berndt und Artaria. 2002. "Jemen, Autokarte 1:1 500 000: Ortsverzeichnis, Mit planen Von Sanaa Und Aden." Wien: Freytag-Berndt u. Artaria. Freytag-Berndt Autokarte; Variation: Freytag, Berndt und Artaria. Freytag-Berndt Autokarte. Descriptors: Roads -- Yemen (Republic) -- Maps; Yemen (Republic) -- Maps, Tourist. Notes: Description: 1 map: col. 63 x 92 cm., folded in cover 24 x 13 cm. Map Info: Scale 1:1,500,000. 1 cm. = 15 km. Note(s): Road maps with tourist features. Relief shown by shading and spot heights. Includes notes, inset city maps of Sanaa and Aden. Other Titles: Alternate cover title: Yemen, road map 1:1 500 000; index, with city maps of Sanaa & Aden; Title in upper margin: Jemen; Parallel title in upper margin: Yemen; Freytag & Berndt Jemen; Responsibility: Freytag & Berndt; Kartographie, Druck u. Verlag--Freytag-Berndt u. Artaria. ISBN: 3850843068; 9783850843065; LCCN: 2008-625229. OCLC Accession Number: 39815895.

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Gabaly, M. M. 1977. Problems and Effects of Irrigation in the Near East Region; Arid Land Irrigation in Developing Countries; Environmental Problems and Effects. United Kingdom: Pergamon Press, Oxford. International Symposium on Arid Land Irrigation in Developing Countries, Alexandria. Egypt Conference: Feb. 16-21, 1976. Descriptors: Afghanistan; Africa; agriculture; Arabian Peninsula; arid environment; Asia; Bahrain; Cyprus; developing countries; East Africa; Egypt; environmental geology; field crops; ground water; Indian Peninsula; Iran; Iraq; irrigation; Jordan; Kuwait; land use; Lebanon; levels; Libya; Middle East; North Africa; Oman; Pakistan; Qatar; salinity; Saudi Arabia; seepage; soils; Somali Republic; Sudan; Syria; terrestrial environment; United Arab Emirates; water quality; Yemen; yields. References: 8; tables. Database: GeoRef. OCLC Accession Number: 2957694.

Galhena, Ravindra. "Braced for Challenge." Containerisation International. T&F Informa UK, Limited: Pages 53-. Descriptors: Freight forwarders; Shipping. Abstract: Ravindra Galhena reports on the opportunities and challenges facing ship agency and logistics company Barwil Unitor as it seeks to raise its profile in Yemen. Database: TRIS. ISSN/ISBN: 0010-7379. Availability: Available from Northwestern University Transportation Library through interlibrary loan or document delivery. TRIS Accession Number: 01097728. URL: <http://www.library.northwestern.edu/transportation/services.html>.

Ganchikov, VG and Munavvarov, ZI. 1991. "The Marib Dam (History and the Present Time)." Hydrotechnical Construction HYCOAR. Vol. 25, No. 4. October. Volume p 242-248, Pages 1991. (Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, pp. 50-55, April, 1991.) Descriptors: Archaeology; History; Irrigation programs; Marib Dam; Water resources development; Yemen; Developing countries; International agreements; Tourism; United Nations. Abstract: Historically, Yemen has been recognized for the magnificence of its ancient water engineering. From the Red Sea coast to the limits of the Rub' al Khali desert are numerous ruins of small and large dams made of earth and stone. The summit of hydraulic construction in ancient times is the Marib dam, the ruins of which give evidence of the broad engineering knowledge and construction abilities of the Yemenis of about the 6th century B.C. Downstream from the Marib dam two irrigation systems were built to supply water to about 10,000 ha of land. The dam, with various additions and reconstructions, lasted for 1300 yr before falling into disrepair following a war. Recently a dam was built upstream of the ruins of the Marib dam. However, the wadi bed at the new dam site consists of alluvial sand and gravel material 30-50 m thick. Seepage emanates from this dam that does not threaten its structure. As a way of capturing the seepage, consideration is being given to rebuilding the ancient Marib dam, both as functioning structure, but as a historic monument to be visited by tourists interested in other monuments of ancient civilizations of the Marib plains. The complexity and volume of work involved in this project make it necessary that several organizations work together under the aegis of UNESCO, using financial contributions from international organizations. Database: Water Resources Abstracts. ISSN: 1930-630X.

Garbrecht, Jurgen D. and Garbrecht, Guenther K. H. 2004. Siltation Behind Dams in Antiquity. ASCE. ASCE Conference Proceedings. Water Resources and Environmental History; Proceedings of EWRI Annual Meeting 2004. Volume: 140, 40738, page(s): 6. Conference: June 27, 2004. Descriptors: Dams; History; Silts; Middle East; Iran; Yemen. Abstract: The siltation behind dams in antiquity and measures to extend the operational life of reservoirs is illustrated for the Marib and Kebar dams in Yemen and Iran, respectively. For both dams siltation played a major role. The Marib dam impounded floodwaters to enable irrigation of downstream oases.

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Over several centuries, silts entrained in the irrigation water accumulated on the irrigated fields up to 15 m high, and the dam was raised to compensate for the loss of slope and conveyance due to the sedimentation. The Kebar dam was an arch dam designed as a small storage reservoir. In addition to small operational openings for irrigation water withdrawals, large openings on the upstream side of the dam were probably used during construction to pass the water of the river, but may also have been used for periodical flushing of accumulated sediments. Both examples show that the engineers of the time were keenly aware of reservoir siltation problems and were able to successfully extend the operational lifetime of the reservoirs by structural enhancements and probable sediment flushing. URL: <http://link.aip.org/link/?ASC/140/6/1>.

Garzanti, E., Vezzoli, G., Andò, S. and Castiglioni, G. 2001. "Petrology of Rifted-Margin Sand (Red Sea and Gulf of Aden, Yemen)." *J. Geol.* Volume 109, Issue 3, Pages 277-297. Notes: Cited By (since 1996): 14. Abstract: The Red Sea-Gulf of Aden rift system, displaying a complete record of magmatic activity and characterized by arid climate and negligible anthropic modifications, provides an ideal natural laboratory for studies aimed at defining actualistic references for both volcanic and nonvolcanic rifted-margin provenances. Rifted-margin sands are derived in various proportions from volcanic to plutonic rocks emplaced before, during, or after the climax of tectonic extension (volcanic rifted-margin provenance) and from prerift sedimentary successions and underlying crystalline basements progressively unroofed during uplift of rift blocks (rift-shoulder provenance). Volcaniclastic rifted-margin sands are feldspatholithic, as are those shed by Pacific-type magmatic arcs, but are characterized by bimodal (basalt/rhyolite) lithics, abundant granophyte grains, and low plagioclase/total feldspar (P/F) ratios due to supply from synrift hypersolvus alkali granites, representing the upper levels of rift-generated juvenile crust. Augite dominates among dense minerals; detritus from postrift alkali-basalt fields includes olivine and, locally, enstatite and spinel. Sedimentary detritus from undissected rift shoulders consists of recycled quartz and carbonate sedimentary lithics; dense mineral assemblages include largely rounded to subrounded, recycled durable grains, zircon, and rutile being concentrated locally due to their higher density. Arkosic sands from basement rocks exposed on dissected rift shoulders display remarkably consistent compositions, with excess quartz with respect to "ideal arkose"; hornblende-rich assemblages from amphibolite-facies gneiss terranes contrast with epidote-dominated assemblages from greenschist-facies arc terranes. Diagnostic signatures and compositional trends recorded by modern Yemen sands may help in interpreting provenance of ancient rift-related sandstone suites. Database: SCOPUS. ISSN: 0022-1376.

Gavin, R. J. 1975. *Aden Under British Rule 1839-1967*. . London: C Hurst. Page(s): 472. Abstract: A comprehensive and well researched history of Aden is provided by Gavin who covers the whole period of British involvement from 1839 to the military evacuation in 1967. Notes: x, 472 pages: ill. 23 cm. ISBN: 0064923371. OCLC Accession Number: 1990965.

Gear, Donald and Food and Agriculture Organization of the United Nations. 1962. *Report to the Government of Aden on Recommendations Concerning the Investigation and Solution of the Problems of Developing the Underground Water Supplies of the Aden Arab Protectorates*. Descriptors: Groundwater -- Arab countries; Water resources development -- Arab countries; Aden (Protectorate); Government publication; International; government publication. Notes: 27 p. 28 cm. Note(s): "Proj. ADEN/TE/LA." Other Titles: Recommendations concerning the investigation and solution of the problems of developing the underground water supplies of the Aden Arab Protectorates; Responsibility: by Donald Gear. OCLC Accession Number: 32816632.

Geology of Yemen

Gear, Donald; United Nations Development Programme and Food and Agriculture Organization of the United Nations. 1970. Report to the Government of Southern Yemen on the Underground Water Resources of the Region to the North of the Wadi Hadhramaut and the Jebel Mahrat and their Development. Rome: Food and Agriculture Organization of the United Nations. Page(s): 43. Descriptors: Groundwater -- Yemen (People's Democratic Republic); Water-supply -- Yemen (People's Democratic Republic); Livestock -- Yemen (People's Democratic Republic); Government publication; International government publication. Notes: vi; 28 cm. Note(s): "MR/A0675/4.70/E/1/250"--P. 4 of cover. Includes bibliographical references (p. 43). Other Titles: Underground water resources of the region to the north of the Wadi Hadhramaut and the Jebel Mahrat and their development; Responsibility: based on the work of Donald Gear. OCLC Accession Number: 40930758.

Gear, Donald. 1970. "Southern Yemen: the underground water resources of the Aden Arab Protectorate and their development: report to the government." Technical Report no 8. 63 pages. 13 tab., 3 maps. Water Resources; Resource Management; Groundwater; Topography; Drainage; Precipitation; Flooding; Hydrogeology; Geomorphology; Wells; Geology; Cartography; Water Supply; Water Levels; Engineering; Pipes; Energy; Supply; Water Drilling; Information Needs; Water Quality; Hydrodynamics; Pumping; Democratic Yemen. Report No: AGL-TECH. REP. NO 8. FAO: Acc.No: 112259.

Gear, Donald. 1962. Aden - Recommendations concerning the investigation and solution of the problems of developing the underground water supplies of the Aden Arab protectorates - Report to the government. FAO 196i - EPTA Report no 1481 - 29 p., 1 tab. Keywords: Training; Workers; Scientists; Water Supply; Groundwater; Water Resources; Resource Management; Water Management; Democratic Yemen. EPTA PROJECT. Report Number: LA-EPTA 1481. FAO Library Accession Number: 051481.

Gear, Donald. 1961. The underground water resources of the Aden Arab protectorates and their development. Aden, 1961 - Epta Project 1481, Underground Water Resources Report No 8 - 60 P., 16 Tab., 4 Maps - For Final Report See /51481. Keywords: Water Resources; Resource Management; Groundwater; Surveys; Precipitation; Hydrology; Hydrogeology; Water Supply; Wells; Water Drilling; Measurement; Economic Situation; Engineering; Pipes; Energy; Supply; Data Collection; Pumping; Pumps; Democratic Yemen. UNDP TA PROJECT. Report Number: LA-EPTA 1481. FAO Library Accession Number: 066349.

Gear, Donald. 1961. "The underground water resources of the Wadi Beihan." Aden, 1961 - Epta Report 1481, Underground Water Resources Report No 7 - 24 P., 2 Tab., 3 Maps, 26 Ref., 4 App. With 6 Tab. - For Final Report See /51481. Keywords: Water Resources; Groundwater; Surveys; Democratic Yemen; Hydrology; Hydrogeology; Water Supply; Wells; Pumps; Water Drilling; Pipes. UNDP TA PROJECT. Report Number: LA-EPTA 1481. FAO Library Accession Number: 066348.

Gear, Donald. 1961. "The underground water resources of the delta part of the Wadi Tiban catchment area." Aden, 1961 - Epta Project 1481, Underground Water Resources Report No 6 - 82 P., 12 Tab., 10 Graphs, 6 Maps, 3 Plans, 54 Ref., 5 App. With 16 Tab. - For Final Report See /51481. Keywords: Watersheds; Deltas; Water Resources; Groundwater; Surveys; Hydrology; Hydrogeology; Depth; Water Levels; Permeability; Temperature; Water Supply; Wells; Water Drilling; Measurement; Democratic Yemen; Tiban River. UNDP TA PROJECT. Report Number: LA-EPTA 1481. FAO Library Accession Number: 066347.

Gear, Donald. 1961. The underground water resources of part of the Abyan delta catchment area. Aden, 1961 - Epta Project 1481, Underground Water Resources Report No 5 -

Geology of Yemen

63 P., 11 Tab., 5 Maps, 2 Plans, 31 Ref., 5 App. With 10 Tab. - For Final Report See /51481.

Keywords: Watersheds; Water Resources; Groundwater;

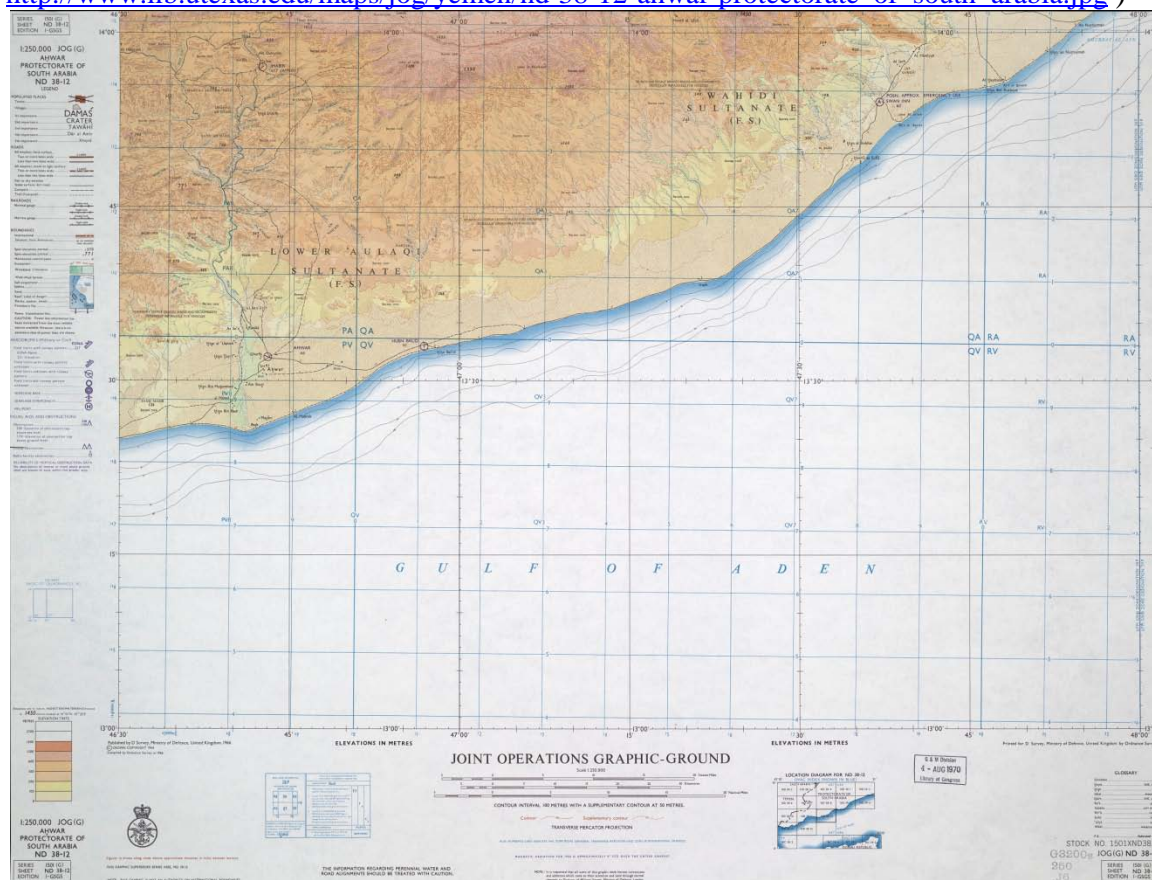
Surveys; Hydrology; Hydrogeology; Depth; Water Levels; Fluid Mechanics; Water Supply; Permeability; Temperature; Groundwater Recharge; Groundwater Table; Water Drilling; Wells; Measurement; Democratic Yemen; Abyan Delta. UNDP TA PROJECT. Report Number: LA-EPTA 1481. FAO Library Accession Number: 066346.

Gear, Donald. 1961. The underground water resources of the Mukeiras agricultural area. Aden, 1961 - Epta Project 1481, Underground Water Resources Report No 4 - 21 P., 1 Map, 10 Ref., 2 App. - For Final Report See /51481. Keywords: Farmland; Water Resources; Groundwater; Surveys; Hydrogeology; Hydrology; Water Supply; Wells; Pumping; Resource Management; Democratic Yemen. UNDP TA PROJECT. Report Number: LA-EPTA 1481. FAO Library Accession Number: 066345.

Geology of Yemen

Gear, Donald. 1961. The underground water resources of parts of the Wadi Ahwar catchment area. Aden, 1961 - Epta Project 1481, Underground Water Resources Report No 3 - 54 P., 2 Tab., 3 Maps, 17 Ref., 7 App. With 3 Tab. - For Final Report See /51481. Keywords: Watersheds; Water Resources; Groundwater; Surveys; Hydrology; Hydrogeology; Topography; Depth; Water Levels; Permeability; Temperature; Water Supply; Wells; Pumping; Deltas; Plains; Democratic Yemen; Ahwar River. UNDP TA PROJECT. Report Number: LA-EPTA 1481. FAO Library Accession Number: 066344.

(Joint Operations Graphic-Ground, Ahwar Region, Ordnance Survey, UK. 1966. See: http://www.lib.utexas.edu/maps/jog/yemen/nd-38-12-ahwar-protectorate_of_south_arabia.jpg)



Gear, Donald. 1961. The underground water resources of parts of the wadi Meifa ah catchment area. Aden, 1961 - Epta Project 1481, Underground Water Resources Report No 2 - 45 P., 1 Map, 35 Ref., 6 App. With 4 Tab. - For Final Report See /51481. Keywords: Watersheds; Water Resources; Groundwater; Surveys; Hydrology; Hydrogeology; Depth; Water Levels; Permeability; Temperature; Water Supply; Resource Management; Democratic Yemen; Meifa Ah River. UNDP TA PROJECT. Report Number: LA-EPTA 1481. FAO Library Accession Number: 066343.

Gear, Donald. 1961. The underground water resources of the Wadi Hadhramaut. Aden, 1961 - Epta Project 1481, Underground Water Resources Report No 1 - 72 P., 4 Tab., 5 Maps, 12 Plans, 46 Ref., 16 App. With 11 Tab. - For Final Report See /51481. Keywords: Groundwater; Water Resources; Hydrology; Hydrogeology; Depth; Water Levels; Water Supply; Saline Water; Freshwater; Wells; Pumping; Measurement; Research; Water Quality; Water Conservation;

Geology of Yemen

Democratic Yemen; Hadhramaut River. EPTA PROJECT. Report Number: LA-EPTA 1481. FAO Library Accession Number: 066342.

“Geographic Map of the Yemen Arab Republic (San`a).” 1978. Reston, VA: USGS. IMAP. IMAP Yemen, page(s): 1 sheet. Notes: 1 map: color; 116 x 86 cm. folded to 27 x 22 cm. in envelope 30 x 24 cm. At head of title: Yemen Arab Republic = al-Jumhu`riyah al-`Arabiyyah al-Yamaniyyah. "Prepared by the U.S. Geological Survey from NASA Land Satellite imagery." Includes index map and text. "G78484." IMAP 1143-A. Miscellaneous investigations series (Geological Survey (U.S.)), map I-1143-A. OCLC: 35103574.

Geological Consulting Company (GEOCON) Ltd; Mezhdunarodnaia akademiia nauk; Yemen and Wizarat al-Naft wa-al-Tharawat al-ma`diniyah. . 1995. “Republic of Yemen: Potential Exploitation Groundwater Resources Map.” St. Petersburg: Geological Consulting Company (GEOCON) Ltd. Descriptors: Water-supply -- Yemen (Republic) -- Maps; Groundwater -- Yemen (Republic) -- Maps; Geology -- Yemen (Republic) -- Maps; Yemen (Republic) -- Maps. Notes: Description: 1 map: col. on 8 sheets 84 x 71 cm or smaller. Map Info: Scale 1:500,000. Note(s): At head of title: Geological Consulting Company (GEOCON) Ltd., International Academy of Sciences on Nature and Society, Russia; Ministry of Oil and Mineral Resources, Geological Survey and Mineral Exploitations Board Authority, Yemen. Includes inset map of Socotra. Responsibility: editors Ali Jabr Alawi, Nickolay Mezhelovsky... cartographer Aliftina P. Philippova. OCLC Accession Number: 253203068.

Geological Survey (U.S.). 1980. “Landsat 1 Mosaic Showing the Four Catchment Areas, Major Drainage Basins, and Drainage Network of the Yemen Arab Republic (San`a.” Reston: The Survey. Descriptors: Remote sensing -- Yemen (Republic) -- Specimens; Watersheds -- Yemen (Republic) -- Maps; Yemen (Republic) -- Remote-sensing maps. Notes: Description: 1 remote sensing image: col. 117 x 87 cm. Map Info: Scale 1:500,000. Note(s): “Water-supply paper 1757-P, plate 1.” OCLC: 21788163.

George, A. Date not given. "Yemeni Water Plans Await Merger Boost." World Water and Environmental Engineer: 30-. Abstract: Despite the economic benefits of the merger between north and south Yemen in May 1990, the unified state was still vulnerable to the fluctuation of foreign aid for water projects. Problems faced by the countrys National Water and Sewerage Authority in the implementation of water supply and sewerage schemes are discussed. During economic restrictions, priority was being given to interim projects in major cities such as Sanaa and Taiz and provincial towns of Ibb and Dhamar. Finance for these projects is considered. ISSN: 0963-584X.

George, R. W. 1963. Aden - Crawfish resources of eastern Aden protectorate - Report to the government. FAO 1963 - EPTA Report no 1696 - 26 p., 5 tab., 1 Graph, 4 phot., 1 map, 9 References. Keywords: Crawfish; Fishery Resources; Fishery Biology; Crustacea; Mollusca; Panulirus; Fishery Management; Geographical Distribution; Indo Pacific Ocean; Fisheries; Regulations; Yields; Democratic Yemen. EPTA PROJECT. Report Number: FI-EPTA 1696. FAO Library Accession Number: 051696.

Gerbier, N.E., Roffey, J.; Roy, J.H.L. 1963. Report on aerial surveys in the Arabian Peninsula - Jun-Jul 1963 - Operational research. Rapport Sur les leves aeriens effectues dans la Peninsule arabique - Juin-juillet 1963 - Recherche operationnelle. FAO 1963 - UNDP/SF Desert Locust Project - Progress Report no Unsf/DI/Op/3 - 23 p., 2 tab., 1 app. with 3 graphs, 12 maps. Languages: English, French. Keywords: Aerial Surveying; Insect Control; Acrididae; Operations Research; Locusta; Animal Population; Methods; Meteorology; United Arab Emirates;

Geology of Yemen

Democratic Yemen; Saudi Arabia. UNDP SF PROJECT. Report Number: PL-UNSF/DL/OP/3. FAO Library Accession Number: 057704.

Gerhager, Barbara and Sahooley, Anwer. 2009. "Reforming the Urban Water Supply and Sanitation (UWSS) Sector in Yemen." *Int. J. Water Resour. Dev.* Routledge: 03. Volume 25, Issue 1, Pages 29-46. Descriptors: Water use; Tariff; Water-supply; Expenditures, Public; Public-private sector cooperation; Decentralization in management; Stakeholders; Yemen (Republic) -- Economic conditions; Yemen (Republic). Article. Abstract: In the early 1990s, Yemen suffered from low service coverage and national tariffs that were too low to cover public expenditure, as well as an inadequate level of service provided by the centralized National Water and Sanitation Authority. In 1996, a reform study recommended that the UWSS sector should embrace a policy of decentralization, corporatization, commercialization, the separation of service delivery and regulatory functions, as well as public-private partnerships. The government approved this reform agenda as a Council of Ministers Decree in 1997. Awareness campaigns and consensus-building among stakeholders and political leaders and local demand supported the reform process. Currently, 95% of the total urban population related to utility towns is attended by independent utilities. ISSN: 0790-0627.

Gerhager, B.; Sahooley, A.; Salan, S. 2009. Yemen Urban Water Supply and Sanitation Sector Reform. Yemen Ministry of Water and Environment and Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ). URL: <http://www.tc-wateryemen.org/documents/downloads/uwss%20booklet.pdf>

Germany, Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover, Federal Republic of Germany. 1991. Water Master Plan Al Mahwit Province; Water Distribution; Geology; Spring Location. Federal Republic of Germany Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover, Federal Republic of Germany. Descriptors: Al Mahwit Yemen; aquifers; Arabian Peninsula; Asia; discharge; geologic maps; ground water; hydrogeologic maps; hydrographic maps; lithostratigraphy; maps; springs; stratigraphic columns; surface water; water harnessing; water resources; water supply; Yemen. Scale: 1:100,000. Type: hydrogeologic map; geologic map; hydrographic map. Database: GeoRef. GeoRef Accession Number: 2002-007368.

Geukens, F. 1966. "Geology of the Arabian Peninsula - Yemen." Professional Paper. Volume 560-B, Pages B1-B23. Abstract: A review of the geology of Yemen as shown on USGS Miscellaneous Geological Investigations Map I-270-A, "Geological Map of the Arabian Peninsula," 1963. Translated from the French by S. D. Bowers. Availability: USGS Library.

Geukens, Fernand. 1960. "Contributions à la Géologie du Yemen." *Inst. Géol. France de l'Univ. Louvain, Mém.* Volume 21, pages 116-180, plates 7-8. Louvain: Institut géologique de l'Université, librairie universitaire. Memoires De L'institut Geologique de l'Université de Louvain. OCLC: 492573503.

Ghanem, Yahya, Al-Rabeei, Nabil Ahmed and Dallak, Abdulsalam. 2009. "Gastro-Oesophageal Reflux Disease among Patients Attending an Endoscopic Clinic in Yemen." *Arab Journal of Gastroenterology.* 9. Volume 10, Issue 3, Pages 109-111. Descriptors: Gastro-oesophageal reflux; Risk factors; Yemen. Abstract: Background and study aims Gastro-oesophageal reflux disease (GORD) can have a major impact on quality of life and be associated with substantial morbidity. The aim of this study was to determine pattern and some of the risk factors of GORD among Yemenite patients. Patients attending a medicine outpatient clinic and who underwent upper GI endoscopy for different indications were recruited. A total of 852 patients with and 1648 patients without endoscopic diagnosis of GORD were categorized as study and control groups, respectively. Results GORD was most common in the

age group of 20–40 years (OR = 2.76, 95% CI). It tended to occur more frequently in males patients than females (OR = 1.19, 95% CI). Tobacco smokers and Khat chewers were more likely to have GORD than non-tobacco smokers (OR = 2.78, 95% CI and OR = 3.00, 95% CI, respectively). GORD complications were as following: 66 (8%) had stenosis, 10 (2%) had Barrett's oesophagus and 768 (90%) had no complications. Conclusion: The most common risk factors for GORD were related to age, sex, tobacco smoking and Khat chewing habits. Stenosis and Barrett's oesophagus were commonest complications of GORD. ISSN: 1687-1979.

Giumlia-Mair, Alessandra, Keall, Edward J., Shugar, Aaron N. and Stock, Susan. 2002. "Investigation of a Copper-Based Hoard from the Megalithic Site of Al-Midamman, Yemen: An Interdisciplinary Approach." *Journal of Archaeological Science*. 2. Volume 29, Issue 2, Pages 195-209. Descriptors: Yemen, SEM, XRD, ICP, Bronze Age, Alloying, Analysis, Arsenic, Tin. ISSN: 0305-4403.

Giumlia-Mair, Alessandra, Keall, Edward, Stock, Susan and Shugar, Aaron. 2000. "Copper-Based Implements of a Newly Identified Culture in Yemen." *Journal of Cultural Heritage*. 1. Volume 1, Issue 1, Pages 37-43. Descriptors: Yemen; copper; copper-based alloys; arsenical copper; bronze; ICP analysis; SEM-EDX analysis; Bronze Age; Iron Age. ISSN: 1296-2074.

Gladstone, W., Tawfiq, N., Nasr, D., et al. 1999. "Sustainable use of Renewable Resources and Conservation in the Red Sea and Gulf of Aden: Issues, Needs and Strategic Actions." *Ocean Coast. Manage.* Volume 42, Issue 8, Pages 671-697. Notes: Cited By (since 1996): 6. Abstract: The coastal and marine environments and resources of the Red Sea and Gulf of Aden are globally significant and generally in a healthy state. Current regional issues include localized destruction of coral reefs, seagrass and mangroves; declines in some fisheries; exploitation of some endangered species; pollution from the development and transport of petroleum; and disposal of industrial and municipal wastes. The underlying causes of these issues are the natural vulnerability of the Red Sea due to its semi-enclosed nature; economic reliance on the petroleum industry; significant navigation risks; a rapidly increasing coastal population and associated developments; lack of fisheries information, surveillance and management; poor coastal zone planning; and limited technical expertise. Strategic actions addressing these issues will need to be implemented regionally and focus on coastal zone management that integrates environmental planning, environmental assessment and review; training and institutional development; public awareness and participation; information gathering especially fisheries statistics; reducing navigation risks; and the development of resource management and conservation strategies. Database: SCOPUS. ISSN: 0964-5691.

Goerlich, F. 1956. "Mikropalaeontologische Und Stratigraphische Untersuchungen Im Koenigreich Yemen." *Palaeontologische Zeitschrift*. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, Federal Republic of Germany. Volume 30, Issue 3-4, Pages 213-214. Descriptors: Arabian Peninsula; Asia; micropaleontology; Pliocene-Quaternary; Pliocene-Quaternary microfaunas-stratigraphy; Yemen. Abstract: Summarizes results of micropaleontologic and stratigraphic research in Yemen. The oldest part of a sequence capping a salt dome in the region began with beds containing a brackish-water fauna, probably of upper Pliocene age. Foraminifers in fossiliferous marine beds in the upper part of the profile are Recent in age. Database: GeoRef. ISSN: 0031-0220.

Goyet, C., Coatanoan, C., Eischeid, G., et al. 1999. "Spatial Variation of Total CO₂ and Total Alkalinity in the Northern Indian Ocean: A Novel Approach for the Quantification of Anthropogenic CO₂ in Seawater." *J. Mar. Res.* Jan. Volume 57, Issue 1, Pages 135-163.

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Descriptors: Article Subject Terms: Alkalinity; Carbon dioxide; Anthropogenic factors; Mixing processes; Water masses; Chemical oceanography; Oceanic circulation; Ocean basins; World Ocean Circulation Experiment (WOCE); Article Geographic Terms: Arabian Sea; Indian Ocean, Bengal Bay; Indian Ocean, Aden Gulf; Arabian Sea; Indian Ocean, Bengal Bay; Indian Ocean, Aden Gulf; Bangladesh, Bengal Bay; Indian Ocean; Yemen; World Ocean. Notes: TR: CS9924620. Abstract: As part of a cooperative effort of the Joint Global Ocean Flux Study (JGOFS) and of the World Ocean Circulation Experiment (WOCE) program, we have measured total CO sub(2) (TCO sub(2)) and total alkalinity (TA) along three sections in the northern Indian Ocean. One section through the Gulf of Aden to the Arabian Sea is parallel to the coast of Yemen. One section is across the Arabian Sea along the nominal 9N latitude and the other section is across the Bay of Bengal along the nominal 10N latitude. The measurements were performed on board R/V Knorr in September-October 1995. The primary purpose of this work is to understand the penetration of anthropogenic CO sub(2) along these ocean sections. Here, we present a novel approach to the calculation of anthropogenic CO sub(2) in the ocean based upon the fundamentals of water-sources mixing. Consequently, we first describe the observations and mixing of water-sources before we describe the quantification of anthropogenic CO sub(2) concentrations in these waters. The data show large spatial variations in surface seawater of both total CO sub(2) (up to 50 $\mu\text{mol kg}^{-1}$) and total alkalinity (up to 40 $\mu\text{mol kg}^{-1}$). The variations are mainly associated with physical processes characterized by water masses of different temperature and salinity. For example, at depths we observed low TCO sub(2) concentration at longitude 54E plus or minus 2E associated with the low-salinity water mass flowing northward. The contrasts between the sections across the Arabian Sea and the Bay of Bengal emphasize the large property differences between the two ocean basins. Multiparametric analyses on the data clearly show the relative contributions of different water-sources in each of the ocean sections. The mixing coefficients calculated from the multiparametric analyses are further used to quantify anthropogenic CO sub(2) concentrations in each water-source. The results indicate that the surface water-sources contain 47.8, 42.1 and 50.4 $\mu\text{mol kg}^{-1}$ in the Gulf of Aden, the Arabian Sea and the Bay of Bengal, respectively. In the surface waters there is slightly more anthropogenic CO sub(2) across the Bay of Bengal than across the Arabian Sea. In contrast, anthropogenic CO sub(2) has penetrated significantly deeper in the Gulf of Aden than in the Arabian Sea and in the Bay of Bengal. Database: Meteorological & Geostrophysical Abstracts. ISBN: 0022-2402.

Gragg, G. B. 2006. "Asia, Ancient Southwest: Scripts, South Semitic." Oxford: Elsevier. Page(s): 512-518. Descriptors: Ancient North Arabian; Ancient South Arabian; Abecedary; Alphabet; Boustrophedon; Cursive script; Ethiopic Semitic; Ge'ez; Graffiti; Saba; Sheba; Syllabary; Tigrinya; Ugaritic; Yemen. Abstract: The West Semitic writing traditions seem to have split early into a North Semitic and a South Semitic variant, with characteristic sign shapes and traditional sign order. The apparent focus of the spread of this system to Ancient North Arabian in one direction and Ancient Ethiopic (Ge'ez) in another was the constellation of Ancient South Arabian city-states in what is now Yemen. In Ethiopia the system underwent a unique transformation into a syllabary in which vowels are noted by more or less systematic modification of sign shapes. ISBN: 978-0-08-044854-1.

Great Britain. Directorate of Military Survey. . 1962. "Aden." London: D. Survey, War Office and Air Ministry: Printed by No. 1 SPC, RE. Ed. 1-GSGS. World 1:500,000; sheet 687 C; GSGS; 4830; Variation: GSGS (Series); 4830. Descriptors: Yemen (People's Democratic Republic) -- Maps, Topographic; Government publication; National government publication.

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Notes: Description: 1 map: col. 45 x 66 cm. Map Info: Scale 1:500,000. Note(s): Standard map series designation: Series 1404. Relief indicated by contours, altitude tints and spot heights. "Heights in metres." Shows boundaries, highways and roads, railways, airports, rivers and water features and other details. Map overprinted with 10,000 metre universal transverse Mercator grid. Includes glossary and index to adjoining sheets. Portion of map extended beyond neatline. "Sheet 687 C, series 1404." "British Crown copyright reserved." Other Titles: Series 1404. Responsibility: published by D. Survey, War Office and Air Ministry. OCLC Accession Number: 32435186.

Great Britain. Directorate of Military Survey. . 1962. "Bayhan Al Qasab." London: D. Survey, War Office and Air Ministry: Printed by No. 1 SPC, RE. Ed. 1-GSGS.World 1:500,000; sheet 687 B; GSGS; 4830; Variation: GSGS (Series); 4830.Descriptors: Yemen (People's Democratic Republic) -- Maps, Topographic; Yemen (Republic) -- Maps, Topographic; Government publication; National government publication. Notes: Description: 1 map: col. 45 x 65 cm. Map Info: Scale 1:500,000. Note(s): Standard map series designation: Series 1404. Relief indicated by contours, altitude tints and spot heights. "Heights in metres." Shows boundaries, highways and roads, railways, airports, rivers and water features and other details. Map overprinted with 10,000 metre universal transverse Mercator grid. Includes glossary and index to adjoining sheets. "Sheet 687324 B, series 1404." "British Crown copyright reserved." Other Titles: Series 1404. Responsibility: published by D. Survey, War Office and Air Ministry. OCLC Accession Number: 32435797.

Great Britain. Directorate of Military Survey. . 1962. "Al Mukalla." London: D. Survey, War Office and Air Ministry: Printed by No. 1 SPC, RE. Ed. 1-GSGS.World 1:500,000; sheet 686 A; GSGS; 4830; Variation: GSGS (Series); 4830.Descriptors: Yemen (People's Democratic Republic) -- Maps, Topographic; Government publication; National government publication. Notes: Description: 1 map: col. 45 x 65 cm. Map Info: Scale 1:500,000. Note(s): Standard map series designation: Series 1404. Relief indicated by contours, altitude tints and spot heights. "Heights in metres." Shows boundaries, highways and roads, railways, airports, rivers and water features and other details. Map overprinted with 10,000 metre universal transverse Mercator grid. Includes glossary and index to adjoining sheets. "Sheet 686 A, series 1404." "British Crown copyright reserved." Other Titles: Series 1404. Responsibility: published by D. Survey, War Office and Air Ministry. OCLC: 32435511.

Great Britain. Directorate of Military Survey; United States and Army Map Service. . 1964. "Assab." Washington, D.C.: Army Map Service, Corps of Engineers. Ed. 1-GSGS.World 1:500,000; sheet 687 d. GSGS; 4830; Variation: GSGS (Series); 4830.Descriptors: Djibouti -- Maps, Topographic; Ethiopia -- Maps, Topographic; Yemen (People's Democratic Republic) -- Maps, Topographic; Yemen (Republic) -- Maps, Topographic; Government publication; National government publication. Notes: Description: 1 map: col. 45 x 66 cm. Map Info: Scale 1:500,000. Note(s): Standard map series designation: Series 1404. Relief indicated by contours, altitude tints and spot heights. "Heights in feet." Shows boundaries, highways and roads, railways, airports, rivers and water features and other details. Portion of map extends beyond neatline. Map overprinted with 10,000 metre universal transverse Mercator grid: Ethiopia and Djibouti portions overprinted with East Africa grid. Includes glossary and index to adjoining sheets. Originally published: [London]: D Survey, War Office and Air Ministry, 1959. "Sheet 687 D, series 1404." "British Crown copyright reserved." Other Titles: Series 1404. Responsibility: published by D. Survey, War Office and Air Ministry; printed by [U.S.] Army Map Service, Corps of Engineers. OCLC Accession Number: 32404701.

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Great Britain. Directorate of Military Survey; United States and Army Map Service. 1960. "Al Ghaydah." Washington, D.C.: Army Map Service, Corps of Engineers. Ed. 1-GSGS. World 1:500,000; sheet 669 C; GSGS; 4830; Variation: GSGS (Series); 4830. Descriptors: Oman -- Maps, Topographic; Yemen (People's Democratic Republic) -- Maps, Topographic; Government publication; National government publication. Notes: Description: 1 map: col. 45 x 64 cm. Map Info: Scale 1:500,000. Note(s): Standard map series designation: Series 1404. Relief indicated by contours, altitude tints and spot heights. "Heights in metres." Shows boundaries, highways and roads, railways, airports, rivers and water features and other details. Map overprinted with 10,000 metre universal transverse Mercator grid. Includes glossary and index to adjoining sheets. Originally published: [London]: D Survey, War Office and Air Ministry, 1958. "Sheet 669 C, series 1404." "British Crown copyright reserved." Other Titles: Series 1404. Responsibility: published by D. Survey, War Office and Air Ministry; printed by [U.S.] Army Map Service, Corps of Engineers. OCLC Accession Number: 32370611.

Great Britain. Directorate of Overseas Surveys; Great Britain and Land Resources Division. . 1977. "Yemen Arab Republic. Wadi Rima." Surbiton, Surrey, England: Great Britain, Ministry of Overseas Development, Land Resources Division. Descriptors: Irrigation -- Yemen (Republic) -- Rima` Wadi Watershed -- Maps; Groundwater -- Yemen (Republic) -- Rima` Wadi Watershed -- Maps; Agricultural resources -- Yemen (Republic) -- Rima` Wadi Watershed -- Maps; Land use, Rural -- Yemen (Republic) -- Rima` Wadi Watershed -- Maps; Rima` Wadi (Yemen) -- Maps; Government publication; National government publication. Notes: Description: maps: photocopies; 44 x 48 cm. or smaller. Map Info: Scales differ. Note(s): Relief shown by contours. "This map accompanies Project report 16, Irrigation and agricultural development in Wadi Rima; Project report 17, An investment and development plan for Wadi Rima."/ Accompanied by maps. 2 sheets; 32 cm. Text map 5. Salinity and depth to groundwater, May 1976. Scale 1:100,000 -- Text map 6. Current land use. Scale 1:100,000. In lower left margins: DOS 3258C, DOS 3258D, DOS 3258J, DOS 3258K. Responsibility: prepared and printed by the Directorate of Overseas Surveys, for the Government of the Yemen Arab Republic. Abstract: Map 3. Outline of a possible irrigation development. Scale 1:25,000 -- Map 4. Proposed feeder roads and village water supplies. Scale 1:50,000. LCCN: 93-682565. OCLC Accession Number: 27379567.

Great Britain. Hydrographic Dept; United States and Defense Mapping Agency. . 1996. "Indian Ocean, Gulf of Aden to the Maldives and the Seychelles." CG33, National Ocean Service, distributor, Edition: 4th ed., June 1: Bethesda, Md.: Defense Mapping Agency; Riverdale, MD: NOAA Distribution Branch, N. International chart series; INT 703; Variation: International chart series; INT 703. Descriptors: Arabian Sea -- Navigation; Aden, Gulf of -- Navigation; Indian Ocean -- Navigation; Seychelles -- Maps; Maldives -- Maps; Government publication; National; government publication. Notes: Description: 1 map: col. 63 x 98 cm. Map Info: Scale 1:3,500,000; Depths shown by isolines and soundings. Relief shown by spot heights. "Crown copyright 1991." "Depths in meters."; Other Titles: Gulf of Aden to the Maldives and the Seychelles; Responsibility: produced under the superintendence of the Hydrographer of the Navy, United Kingdom, 1975, with later corrections; modified reproduction of INT 703, originally published Nov. 1991, by the British Admiralty. OCLC: 35905681.

Great Britain. Land Resources Division. 1978. Yemen Arab Republic: Montane Plains and Wadi Rima' Project: A Land and Water Resources Survey: Agricultural Development on the Montane Plains. Surbiton: Ministry of Overseas Development. Descriptors: Agricultural development projects -- Yemen (Republic); Montane Plains and Wadi Rima Project;

Geology of Yemen

Government publication. Notes: 2 v.: ill., maps (some in pocket), tables; 30 cm. Note(s): "YAR-01-31/REP-18/78." Other Titles: Agricultural development on the Montane Plains. OCLC Accession Number: 52227152.

Great Britain. Land Resources Division. 1977. Yemen Arab Republic: Montane Plains and Wadi Rima' Project: A Land and Water Resources Survey. Irrigation and Agricultural Development in Wadi Rima'. Surbiton: Ministry of Overseas Development. Descriptors: Agricultural development projects -- Yemen (Republic); Irrigation projects -- Yemen (Republic); Montane Plains and Wadi Rima Project; Government publication (gpb). Notes: 2 v.: ill., maps (some folded, some in pocket), tables; 30 cm. Note(s): "YAR-01-29/REP-16/77."; Other Titles: Irrigation and agricultural development in Wadi Rima'. OCLC Accession Number: 52321856.

Great Britain and Land Resources Division. 1976. Yemen Arab Republic Montane Plains and Wadi Rima (MPWR) Project: A Land and Water Resources Survey: Initial Development Prospects. Surbiton: Ministry of Overseas Development. Descriptors: Agricultural development projects -- Yemen (Republic); Government publication (gpb). Abstract: Vol. 1: The Montane Plains--v.2: Wadi Rima. Notes: v. Other Titles: Montane Plains and Wadi Rima Project. OCLC: 40239046.

Greenwood, J. E. G. W. and Bleackley, D. 1967. "Geology of the Arabian Peninsula; Aden Protectorate." U.S. Geological Survey Professional Paper. U. S. Geological Survey, Reston, VA, United States: United States. Volume P 560-C, Issue 28, Pages 96. Descriptors: Aden Yemen; Arabian Peninsula; areal geology; Asia; Cenozoic; economic geology; fault trends; ground water; igneous rocks; Mesozoic; mineral resources; Precambrian; resources; tectonics; volcanic rocks; Yemen. (See also this Bibliography, p. 635, Arabian peninsula.); illus. (incl. maps). Abstract: Precambrian basement, Jurassic-Tertiary, late Tertiary-Quaternary volcanics, structure, fault trends, mineral resources, water supply. Database: GeoRef. ISSN: 1044-9612. URL: http://pubs.er.usgs.gov/djvu/PP/pp_560_c.djvu.

Grinage, Chris. 2007. "Soldiers Help to Build Schools in Yemen." February 14, 2007. By Marine Corps Lt. Col. Chris Grinage, Combined Joint Task Force - Horn of Africa. Abstract: SOCOTRA, Yemen (American Forces



Press Service, Feb. 14, 2007) - Taking a heading directly off the tip of the Horn of Africa and southeast of Yemen will find travelers on a wind-swept 80-mile long by 20-mile wide island in the Indian Ocean that is both remote and beautiful. It is on this island that U.S. Army representatives from the Combined Joint Task Force - Horn of Africa found themselves recently lending support and technical advice to island residents to build better infrastructure. For the people of Socotra, the traditional building material for structures is stones available from the outskirts of towns. No mines or quarries exist as the Socotrans are protective of the environment. Houses and schools are built with glass in the windows, but some windows are without glass; instead they rely on heavy shutters to keep out the elements while allowing the sea breeze in to cool of the buildings. While these materials can stand the test of time and elements -namely monsoons that can bring strong winds and high seas - Army engineers seized the opportunity to spend three days in January with village elders and contractors in Usama Bin Zaid and Omar Al Kittab to improve their buildings. "We normally review the quality control in the building of traditional concrete blocks; however, the Socotrans were using

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stone," said Capt. Andrew Bouchard. "So we taught them to ensure the quality of the cement used to solidify the stones was free of organics that could weaken over time, as well as assisting in the quality control associated with straight and level walls." The Army team was also able to demonstrate to their counterparts how the materials in the cement can weaken metals over a short period of time when improperly mixed. The projects advised on by the Army team on this trip were two schools for the villages, with much of their attention focused on discussing effective solutions to make the schools more efficient. While helping to build the two schools, the team had to seek solutions to other engineering challenges, like adequate power sources. "Originally, we thought that we could run an electric power line from a substation further away, but that did not work well," said Bouchard. "The town has minimal power. Houses and the schools are without power. We are going to change the contract to include the introduction of solar power." The quality control expertise and future addition of electricity are small examples of how the task force is helping this community, much in the same manner as other communities in this region. While the technical aspects of the jobs were important, equally important was sharing an exchange of culture. An example of the cultural exchange occurred when Bouchard was invited to lunch by one of the town's leaders. "We talked about the island and his community, and how the leaders of the town are entrusted with the decisions that affect the village," said Bouchard. "The sheik told us how happy he was to have [the task force] involved with his community and he commented that he liked the fashion by which one school at a time is built so as not to impact the children learning." Bouchard added the meal was prepared by the sheik's wife and consisted of fish, rice, and goat, which he found out were Socotran diet mainstays. Bouchard also discovered during his discussion over lunch that a very large majority of the community's favorite football team is Arsenal of England. "They listen as often as possible given the radio reception," said Bouchard. The mission of the task force is to prevent conflict, promote regional stability and protect coalition interests to prevail against extremism. The task force began operations at Camp Lemonier, Djibouti May 13, 2003. It works with partner nations on humanitarian assistance, disaster relief, consequence management, civic action programs to include medical and veterinary care, school and medical clinic construction and water development projects. URL: <http://www.army.mil/article/1843/>

Grolier, M. J. Tibbitts, G. C., Jr and Ibrahim, M. M. 1980. "A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images." United States: U. S. Geological Survey, Reston, VA, United States. Open-File Report - U.S. Geological Survey. 1 sheet, 1980. Volume: OF 80-0565, page(s): 111. Descriptors: Arabian Peninsula; Asia; economic geology; geophysical surveys; hydrology; imagery; irrigation; Landsat; management; remote sensing; rivers and streams; surveys; USGS; water resources; water supply; Yemen. Notes: SP: USGS, Publications of the U. S. Geological Survey. ISSN: 0196-1497. Database: GeoRef. U. S. Geol. Surv., Open-File Serv. Sect., West. Distrib. Branch, Denver, CO, United States OCLC Accession Number: 1982-001127.

Grolier, M. J. and Overstreet, W. C. 1978. "Geologic Map of the Yemen Arab Republic (San'a')." USGS. IMAF. Notes: 1 map: col. 116 x 86 cm. fold. to 27 x 22 cm. in envelope 30 x 24 cm. USGD Library: M(200) I no. 1143-A.

Grolier, Maurice J. Domenico, J. A. Donato, Mary; Tibbitts, G. C., Jr. Overstreet, W. C. and Ibrahim, Mohammad Mukred. 1977. "Data from Geologic Investigations in the Yemen Arab Republic during 1976." Open-File Report. Volume: 77-733, page(s): 103 pages. Abstract: The results of semiquantitative spectrographic analyses for 31 elements in 126 specimens of rocks from the Yemen Arab Republic, collected mainly during February 1976 from the Precambrian area in the southeastern part of the country, provide background data for use in geochemical evaluation of areas potentially favorable for mineral deposits. Gold and thorium were undetected; the lower limits of determination are 10 parts per million (ppm) and 20 ppm, respectively. For the other elements, the abundances follow geochemical norms for crustal distribution: (1) Fe, Nb, and Zr in Holocene weathering products; (2) Ca and Sr in Pliocene limestone; (3) Mo in Pliocene(?) or Miocene(?) dikes; (4) Be, La, and Sn in Miocene(?) alkalic granite; (5) As, Be, and La in Tertiary and/or Cretaceous felsic tuff; (6) V in Tertiary and/or Cretaceous carbonaceous sedimentary rocks interbedded with volcanic rocks; (7) Be, La, Sn, and Zr in Tertiary and/or Cretaceous undivided volcanics; (8) Sn and W in Precambrian felsite and

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pegmatite; (9) Co, Cr, Ni, and Ti in Precambrian mafic rocks; (10) Mg and Sr in Precambrian marble and calcsilicate rocks; (11) Y in Precambrian schist; (12) B and Sc dispersed in rocks of many ages; and (13) Ag, Ba, Bi, Cd, Cu, Mn, Pb, Sb, Sn, and Zn in a hydrothermal replacement deposit in Precambrian sediment. None of the rocks contained as much as 205 ppm equivalent uranium. The highest values for Ag, Cu, Pb, Zn, and Cd were obtained on a sample of hydrothermally altered siltstone not personally collected by the writers. It was said to have come from the Ma'rib area in the eastern part of the Yemen Arab Republic. The source must be studied, because this single sample is high-grade base-metal ore. Among the samples collected by the writers, the economically most significant are altered tuffs, ignimbrites, and felsites exposed between Jibal Hufash and Manakhah on the road from Hudaydah to San'a'. They are strongly anomalous for As and weakly anomalous, variously, for Hg, Mo, and Pb, which elements may constitute an epigenetic dispersion pattern from hidden sulfide deposits. Inasmuch as chalcopyrite and native copper have been reported in the vicinity of Jabal Haraz in the Manakhah area, the rocks of the Yemen Volcanics in this region should be explored for base-metal sulfide deposits. The first results of paleontologic examinations of fossils collected during 1975 and 1976 are presented, as are a list of Landsat images covering the Yemen Arab Republic, and a selected bibliography of reports on geology and the allied sciences relating to the Yemen Arab Republic. Notes: 103 p.:ill., maps (2 fold. in pocket); 27 cm. URL:

<http://pubs.er.usgs.gov/usgspubs/ofr/ofr77733>.

Grolier, Maurice J. Ibrahim, M. Overstreet, W. C. Tibbitts, G. C. and Davidson, D. F. 1978. "Preparation of a Geologic Photo Map and Hydrologic Study of the Yemen Arab Republic." Open-File Report. Volume: 78-770, Notes: ii, 15 pages: maps; 28 cm. (20 p. - PGS). URL: <http://pubs.er.usgs.gov/usgspubs/ofr/ofr78770>.

Grolier, Maurice J. and Overstreet, William C. 1976. "Preliminary Geologic Map of the Southeastern Region, Yemen Arab Republic, Landsat-1 Image no. 1206-06504." Open-File Report. Volume 76-745, Notes: 4 leaves: 2 fold. maps (in pocket); 27 cm. (4 p., 3 sheets, scale 1:500,000 - PGS). URL: <http://pubs.er.usgs.gov/usgspubs/ofr/ofr76745>.

Grolier, Maurice J. and Overstreet, William C. 1976. "Preliminary Geologic Map of the Northeastern Region, Yemen Arab Republic, Landsat-1 Image no. 1152-06501." Open-File Report. USGS: Volume 76-744, Notes: 4 leaves: 3 folded maps (in pocket); 27 cm. (scale 1:500,000 - PGS). URL: <http://pubs.er.usgs.gov/usgspubs/ofr/ofr76744>.

Grolier, Maurice J., Tibbitts, G. Chase, Jr. and Ibrahim, Mohammed Mukred. 1984. "A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images." Water Supply Paper. USGS: Notes: v, P70 p.:ill., maps (1 col.); 24 cm. 1 plate in pocket. Availability: USGS Library.

Grolier, Maurice J. and Brinkmann, Robert. 1997. Environmental Research in Support of Archaeological Investigation in the Yemen Arab Republic, 1982-1987. United States: American Foundation for the Study of Man, Washington, DC, United States. Volume: 5, Descriptors: Arabian Peninsula; archaeology; Asia; Cenozoic; climate effects; ecosystems; human ecology; irrigation; Pleistocene; Quaternary; soils; water use; Yemen. Notes: Individual chapters within scope are cited separately; References: 720; illus. incl. 66 tables. ISBN: 0614017521. Database: GeoRef. OCLC Accession Number: 34553507.

Grolier, Maurice J. Overstreet, William C. Grolier, Maurice J. and Brinkmann, Robert. 1997. "Recommendations for further Environmental Studies." United States: American Foundation for the Study of Man, Washington, DC, United States. Volume: 5, Descriptors: absolute age; agriculture; Arabian Peninsula; archaeological sites; archaeology; artifacts; Asia;

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C-14; carbon; Cenozoic; dates; ecology; ecosystems; granulometry; Holocene; human activity; human ecology; irrigation; isotopes; land use; Mollisols; pedogenesis; Quaternary; radioactive isotopes; soils; Wadi al-Jubah; water use; Yemen. ISBN: 0614017521. Database: GeoRef. OCLC Accession Number: 34553507.

Grolier, Maurice J. Grolier, Maurice J. and Brinkmann, Robert. 1997. "A Geomorphic Inquiry into Soil Processes and Soil Irrigation Farming in the Al-Jadidah Basin of Wadi Al-Jubah, Yemen Arab Republic." United States: American Foundation for the Study of Man, Washington, DC, United States. Volume: 5, Descriptors: agriculture; Al-Jadidah Basin; Arabian Peninsula; archaeology; arid environment; Asia; denudation; drainage basins; erosion; fluvial features; hydrology; irrigation; land use; landform description; landform evolution; rates; runoff; sedimentation; soil erosion; soils; terrestrial environment; Wadi al-Jubah; wadis; water use; waterways; Yemen. Notes: illus. incl. sketch map. ISBN: 0614017521. Database: GeoRef. OCLC Accession Number: 34553507.

Grolier, Maurice J. Grolier, Maurice J. and Brinkmann, Robert. 1997. "Plate Tectonic and Climate Modification and Disruption of Drainage in Southwestern Arabia and the Al-Jadidah Basin, Wadi Al-Jubah, Yemen Arab Republic." United States: American Foundation for the Study of Man, Washington, DC, United States. Volume: 5, Descriptors: agriculture; Al-Jadidah Basin; Arabian Peninsula; Asia; Cenozoic; climate effects; drainage; drainage basins; fluvial features; Holocene; irrigation; landform evolution; neotectonics; paleogeography; paleosols; Quaternary; tectonics; variations; Wadi al-Jubah; wadis; water use; Yemen. Wadi al-Jubah Archaeological Project (Series), v. 5. ISBN: 0614017521. Database: GeoRef. OCLC Accession Number: 34553507.

Grolier, Maurice J. Ibrahim, M. M. Goddard Space Flight Center and Geological Survey (U.S.). 1978. Preparation of a Geologic Photo Map and Hydrologic Study of the Yemen Arab Republic. Reston, Va.: U.S. Geological Survey. Page(s): 15. Descriptors: Yemen (Republic) -- Maps; Government publication; National government publication. Notes: ii; maps; 28 cm. Note(s): Report prepared for Goddard Space Flight Center, Greenbelt, Maryland. Type III final report, September 1977. Includes bibliographical references (p. 15). Responsibility: M.J. Grolier ... [et al.]. OCLC: 7035464.

Grolier, Maurice J. Ibrahim, Mohammed Mukr and Tibbitts, G. Chase. 1984. A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images. Washington, D.C.: U.S. Geological Survey. Page(s): 70. Descriptors: Yemen; Arab; Republic; Hydrologic; Teledetection; Landsat; Satellite; Doc; Government publication; National government publication. Notes: v; 1 carte en pochette; 28 cm. Genre/Form: Publications officielles. Note(s): Bibliographie: p.56-58. Responsibility: by Maurice J. Grolier, G.C. Tibbitts, Jr., and Mohammed Mukred Ibrahim. OCLC Accession Number: 301168604.

Grolier, Maurice J. Tibbitts, G. Chase and Ibrahim, Mohammad Mukr. 1981. A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images. Reston, Va.: U.S. Geological Survey. Page(s): 103. Descriptors: Remote sensing -- Yemen (Republic); Government publication; National government publication; Microfiche (mfc). Notes: viii; maps; 26 cm. Note(s): One map on folded leaf in pocket. Includes bibliographical references (p. 81-84). Reproduction: Microfiche. [Denver, Colo.: U.S. Geological Survey, 1981?]. 3 microfiches. Other Titles: Yemen Arab Republic. Responsibility: by Maurice J. Grolier, G.C. Tibbitts, Jr., and Mohammad Mukred Ibrahim; prepared in cooperation with the Yemen Arab Republic under the auspices of the U.S. Agency for International Development. OCLC Accession Number: 9608915.

Geology of Yemen

Grolier, Maurice J. Tibbitts, G. Chase; Ibrahim, Mohammed Mukr and Geological Survey (U.S.). 1984. A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images. Washington: U.S. G.P.O. Page(s): 70. Descriptors: Hydrology -- Yemen, North -- Remote sensing; Landsat satellites. Notes: v; maps (some col.); 23 cm. Note(s): "Landsat 1 mosaic showing the four catchment areas, major drainage basins, and drainage network of the Yemen Arab Republic (San`a)": col. map on folded leaf in pocket. Bibliography: p. 56-58. Responsibility: by Maurice J. Grolier, G.C. Tibbitts, Jr., and Mohammed Mukred Ibrahim. LCCN: 83-600245. OCLC Accession Number: 9786251.

Grolier, MJ; Tibbitts, G. and Ibrahim, M. 1981. Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from LANDSAT Images. Performer: Department of the Interior, Washington, DC. Sponsor: Agency for International Development, Washington, DC. 1981. 115p. Report: AIDPN-AAM-557. Abstract: LANDSAT images were analyzed in June 1976 to make a qualitative appraisal of surface-and groundwater resources in the Yemen Arab Republic (YAR) for use in water management planning in that country. Results of that appraisal are herein presented. Initial sections describe the YAR's environmental characteristics and previous hydrologic investigations, the LANDSAT imagery system, and the analytical methods used in the survey, the latter comprising a bibliographic search, image interpretation of geological, hydrological, and vegetative data, and reconnaissance field checking. Database: NTIS Database (National Technical Information Service). NTIS: PB85150837.

1984. Grolier, MJ, Tibbitts, GC and Ibrahim, MM. "Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images." Available from Books and Open-File Reports Section. USGS Box 25425, Denver. Volume CO 80225. USGS Water-Supply Paper 1757-P, Pages 3 append. Descriptors: Remote sensing; Data interpretation; Landsat; Yemen; Hydrologic budget; Hydrologic systems; Satellite technology; Hydrological regime; Groundwater budget; Surface water; Streamflow; Land use; Agriculture. Abstract: Landsat 1 and Landsat 2 images were analyzed in June 1976 to describe the flow regimens of streams and the regional distribution of vegetation in the Yemen Arab Republic (YAR). The findings provide a factual basis for planning a surface water data collection program and for preparing maps of plant distribution and agricultural land use. Nine Landsat scenes cover the entire YAR. A false-color, composite mosaic of nine corresponding images was prepared. Catchment areas and the major drainage basins were delineated on this mosaic. A hydrological and ecological analysis of this array of imagery shows many kinds of streamflow regimens and, along the reaches of some streams at least, yearly and seasonal fluctuations or changes in streamflow. Similar fluctuations in soil moisture and possibly in groundwater supply were inferred from variations in the site of vegetated areas and the apparent (spectral) vigor of plant growth. In order of increasing water availability, the four catchment areas of the YAR are: Rub al Khali (Ar Rab al Khali), Wadi Jawf (Arabian Sea), Red Sea, and Gulf of Aden. Most streams are ephemeral. No lakes were detected during the period under investigation, but sebkhas (salt flats or low, salt-encrusted plains) are common along the Red Sea coast. Database: Water Resources Abstracts. OCLC: 9786251.

Grolier, MJ, Tibbitts, GC, Jr and Ibrahim, MM. 1981. "A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images." Available from the OFSS USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: \$18.75 in paper copy; \$3.50 in microfiche. Geological Survey Open-File Report 80-565, Pages 3 Append. Descriptors: Arid lands; Remote sensing; Foreign research; Drainage systems; Yemen Arab Republic; Land use; Irrigation effects; Vegetation; Ephemeral streams; Intermittant streams; Surface-groundwater relations; Groundwater potential; Water quality; Hydrologic cycle; Evaluation; Water resources

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development; Planning; Landsat; Arabian Peninsula; Red Sea; Tihama; Satellite technology. "Landsat-1 Mosaic of the Yemen Arab Republic (San'a), 1:500 000, showing hydrologic information, the major drainage basins and the drainage network within them : In : USGS open file report 80-565. A qualitative appraisal of the hydrology of the Yemen Arab Republic from Landsat images. Plate I." Abstract: Six series of Landsat-1 and Landsat-2 images taken between 1972 and 1976 were analyzed to describe the flow regimens of streams and the regional distribution of vegetation in the Yemen Arab Republic. The findings provide a factual basis for planning a surface-water data collection program, and for preparing maps of plant distribution and agricultural land use. They lay the foundation for modernized water development, for effecting a program of country-wide water management. The work was undertaken as part of the program of the U.S. Agency for International Development with the cooperation of the Yemen Mineral and Petroleum Authority, Ministry of Economy. A false-color composite mosaic of the nine images which cover the country was prepared using Landsat 1 images taken at relatively low sun-angle in winter 1972-73. Catchment areas and the major drainage basins of the country were delineated on this mosaic. In order of increasing water availability, the four catchment areas of the YAR are: Ar Rub al Khali, Wadi Jawf (Arabian Sea), Red Sea, and Gulf of Aden. Most streams are ephemeral. No lakes were detected during the period under investigation, but sebkhas--salt flats or low salt-encrusted plains--are common along the Red Sea coast. In spite of resolution and scale constraints, streamflow was interpreted as perennial or intermittent, wherever it could be detected on several Landsat images covering the same scene at seasonal or yearly intervals. Much of the land under cultivation is restricted to valley floors, and to valley slopes and irrigated terraces adjacent to stream channels. Little or no vegetation could be detected over large regions of the Yemen Arab Republic. Database: Water Resources Abstracts. OCLC: 705214983.

Gulbrandsen, Anders. 2010. "Yemen." In: Bridging the Gulf: Qatari Business Diplomacy and Conflict Mediation. Pages 40-50. United States -- District of Columbia: Arab Studies. ProQuest Dissertations and Theses. Abstract: Business is fundamentally political in the Gulf. This thesis identifies the centers of power in contemporary Qatar, and highlights the overlap of commerce and politics. Qatari business diplomacy - defined as Doha's use of foreign policy to protect its investments and utilization of financial capacity to drive its diplomacy - is explored through three case studies, where Qatar has acted as a conflict mediator: Yemen, Lebanon, and Sudan. This exploration is done against the backdrop of Qatar's international relations and a changing regional balance of power. The thesis is largely based on primary sources, including interviews with representatives from both sides in all three case studies of Qatari conflict mediation. Arab Studies. OCLC: 648988116. URL: <http://cdm15036.contentdm.oclc.org/cgi-bin/showfile.exe?CISOROOT=/p15036coll3&CISOPTR=657&filename=658.pdf>.

Gunaid, A. A., Hassan, N. A. and Murray-Lyon, I. 2003. "Prevalence and Risk Factors for Helicobacter Pylori Infection among Yemeni Dyspeptic Patients." Saudi Med. J. Volume 24, Issue 5, Pages 512-517. Notes: Cited By (since 1996): 6. Abstract: Objective: Helicobacter pylori (H. pylori) is one of the world's most common human bacterial infections. Acquisition of H. pylori infection may be associated with chronic gastritis, peptic ulceration and gastric cancer. This study was aimed at investigating the prevalence of H. pylori infection among dyspeptic patients, any correlation with dyspeptic symptoms and endoscopic findings and, any socioeconomic and environmental risk factors. Methods: The study was conducted between September 1997 and October 1998 in one Endoscopy Unit, Sana'a city, Yemen. A total of 275 consecutive patients with chronic dyspepsia were enrolled in the study. Endoscopic examination

was conducted, gastric biopsies were obtained from the antrum and corpus, and *H. pylori* infection was diagnosed at the time of endoscopy using the rapid urease test. Results: The prevalence of *H. pylori* infection in our patients was 82.2% (95% confidence interval (CI) 78 to 87%). Independent variables associated with infection were age >40 years (odds ratio (OR)=2.2; 95% CI: 1.0-4.64; P=0.043); the presence of ≥ 5 children under 14 years per household (OR=6.62; 95% CI: 2.245 to 19.5; P= 0.001); and duodenal ulcer disease (OR=3.7; 95% CI: 1.38 to 10.0; P=0.009). Conclusion: The prevalence of *H. pylori* infection in dyspeptic patients in Yemen seems to be high. Advancing age, 5 or more children per household and duodenal ulcer disease were found to be significantly associated with *H. pylori* infection. Database: SCOPUS. ISSN: 0379-5284.

Gunaid, A. A., Sumairi, A. A., Shidrawi, R. G., et al. 1995. "Oesophageal and Gastric Carcinoma in the Republic of Yemen." *Br. J. Cancer*. Volume 71, Issue 2, Pages 409-410. Descriptors: Epidemiology neoplasms; Gastric neoplasms; Oesophageal neoplasms; Qat chewing; Yemen. Notes: Cited By (since 1996): 32. Abstract: We conducted a preliminary survey on 3064 patients who underwent upper gastrointestinal endoscopy at the Al-Thawra Hospital in Sana'a, Republic of Yemen, between January and December 1991. The age/sex distribution, demographic features and social habits with respect to cigarette and water-pipe smoking and Qat chewing were compared for patients with oesophageal and gastric cancers (n = 183). A preponderance of women with carcinoma of the mid-oesophagus was noted, previously only recorded in areas of high prevalence. Unlike Western populations, smoking and alcohol consumption were not significant risk factors. A high frequency of Qat chewing and water-pipe smoking was found for both men and women and for a group with tumours of the gastro-oesophageal junction or cardia ($\chi^2 = 2.646$, $P > 0.05$). Numbers were insufficient to identify independent effects of each factor individually. Dietary habits alone were insufficient to account for the excess of affected females. A case-control study is now underway to investigate further the role of dietary factors, social habits, demographic features and *Helicobacter pylori* infection on the development of upper gastrointestinal cancer in the Yemen. Database: SCOPUS. ISSN: 0007-0920.

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Haak, Hilbrand and Hogerzeil, Hans V. 1995. "Essential Drugs for Ration Kits in Developing Countries." *Health Policy and Planning*. March 1. Volume 10, Issue 1, Pages 40-49. Abstract: Since the early 1980s drug ration kits have been used to improve the supply of essential drugs to rural health facilities in developing countries. This paper evaluates some of the experiences with kit systems in Angola, Bhutan, Democratic Yemen, Guinea-Conakry, Kenya, Mozambique, Sudan, Tanzania, Uganda and Zambia in relation to the selection of drugs for the kits and their quantities and cost. Data were collected through a review of published papers, annual reports and programme evaluations, by questionnaires among field staff and interviews with key experts. In comparing the 10 programmes, 21 drugs can be identified that are used in at least two-thirds of all kits. This list may be useful for evaluation and planning purposes. Six drugs (ORS, chloroquine and 4 antibiotics) usually account for over 60% of the cost of the kit. Careful monitoring of the price and quantities of these 6 drugs can therefore be very cost-effective. In the absence of reliable data on morbidity and drug needs in the initial phases of a kit system, the median drug quantities in kits from these 10 countries may serve as a starting point. Accumulating surpluses are sometimes perceived as a serious disadvantage of kit systems, ORS, benzyl-benzoate solution and iron tablets are the three drugs that have most frequently accumulated. These drugs are relatively cheap and usually have a long shelf-life; in most programmes they have been successfully redistributed to other health facilities while the kit content was being adapted. The overall financial loss due to accumulation of surpluses is therefore limited. Most programmes have reached a stable kit content within two years. ISSN: 1460-2237. OCLC: 43257616.

Hagens, Paul. 1990. "Land Evaluation in the Republic of Yemen." *Food & Agriculture Org.* Page(s): 165-174. ISBN: 9251031312. Database: Google Books. URL: http://books.google.com/books?id=nf9A3tGOkIC&pg=PA165&dq=yemen&lr=&as_drrb_is=b&as_minm_is=0&as_miny_is=1990&as_maxm_is=0&as_maxy_is=2010&num=100&as_brr=1&as_pt=BOOKS&ei=ApNDS436JaG4NNb_008H&cd=15#v=onepage&q=yemen&f=false.

Hall, M., Al-Khulaidi, A. W., Miller, A. G., Scholte, P. and Al-Qadasi, A. H. 2008. "Arabia's Last Forests Under Threat: Plant Biodiversity and Conservation in the Valley Forest of Jabal Bura (Yemen)." *Edinburgh J. Bot.* Volume 65, Issue 1, Pages 113-135. Descriptors: Arabia; Conservation; Evergreen forest; Rare species; Valley forest; Yemen. Notes: Cited By (since 1996): 1. Abstract: The isolated massif Jabal Bura (Yemen) is home to the largest area of 'valley forest' in southwest Arabia's western escarpment mountains. This study surveys the composition of this very rare forest and records the diversity of vascular plant species. It notes the valley forest as the home of several regionally rare species and records new locations for these taxa. A brief analysis of the canopy layer is provided, enabling comparisons with similar vegetation in northeast Africa. The paper discusses the importance of this regionally rare vegetation as well as threats to its conservation. Database: SCOPUS. ISSN: 0960-4286.

Hall, M., Scholte, P., Al-Khulaidi, A. W., et al. 2009. "Arabia's Last Forests Under Threat II: Remaining Fragments of Unique Valley Forest in Southwest Arabia." *Edinburgh J. Bot.* Volume 66, Issue 2, Pages 263-281. Descriptors: Arabia; Conservation; Rare species; Valley forest; Yemen. Abstract: Over the last three decades, vegetation surveys in southwest Arabia have documented the existence of a small number of valley forest patches. A well-known area is in Wadi Rijaf, Jabal Bura, a protected area which has recently been surveyed by the current authors. The other valley forest sites in southwest Arabia have not been surveyed for over 15 years. This paper presents a descriptive study of five of these important valley forest

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localities. To provide an assessment of conservation value, field studies recorded the extent, quality and composition of the vegetation and the presence of regionally rare species. The significance of these remaining patches of Arabian forest, and the immediate threats to their survival, are also discussed. Database: SCOPUS. ISSN: 0960-4286.

Hämäläinen, Pertti. 1991. *Yemen: A Travel Survival Kit*. Berkeley, CA: Lonely Planet. 2nd edition. Descriptors: Yemen- travel and description. ISBN: 0-86442-114-1.

Hamdi, Mohamed. 1997. "Sana'a, Yemen." United Kingdom: E & FN Spon, London. Descriptors: aquifers; Arabian Peninsula; Asia; controls; ground water; legislation; monitoring; policy; pollution; Sana'a Yemen; technology; waste water; water management; water quality; water resources; Yemen. This is a chapter in a handbook for policy makers and environmental managers in water authorities and engineering companies engaged in water quality programmes, especially in developing countries. It is also suitable for use as a textbook or as training material. References: 8; sketch maps. ISBN: 0419229108. Database: GeoRef. OCLC: 57379782.

Hamed, M. M. 1995. "Implications of comprehensive peace on the Middle East's transportation sector." *Transportation Research Record*. Transportation Research Board: Pages 71-74. Descriptors: Budgeting; Defense; Development; Farm roads; Government funding; Improvements; International relations; International roads; Military organizations; Pipelines; Ports; Public transit; Railroads; Secondary roads; Transportation planning; Egypt; Iran; Israel; Jordan; Kuwait; Middle East; Oman; Saudi Arabia; Syria; United Arab Emirates; Yemen; Agricultural roads; Defense budgets; Military spending; Public transportation; Reduction (Decrease); Transportation development. Notes: Figures (1); References (6); Tables (6). Abstract: The spread of peace in the Middle East is expected to bring major reductions in military spending, freeing up funds that could be used in the transportation sector which is, at present, underdeveloped. A case study of 10 Middle Eastern countries (Egypt, Iran, Israel, Jordan, Kuwait, Oman, Saudi Arabia, Syria, United Arab Emirates, and Yemen) shows that if these countries were to cut their defense budgets, as a percentage of the gross national product, to the world average, total annual savings would amount to more than \$24 billion (U.S.), \$2 billion of which could be spent in the transportation sector. As a result, countries such as Israel, Syria, and United Arab Emirates could expect to increase transportation spending by more than 80%. Areas in the transportation sector that would benefit from increased government spending include pipelines, international roads and railways, public transportation, village and agricultural roads, and port and container facilities. This paper appears in *Transportation Research Record No. 1498, Transportation Finance, Training, Strategic Management, and Economic Analysis*. Database: TRIS. ISSN: 0361-1981.

Hammond, Andrew. 2008. *What the Arabs Think of America*. Westport: Praeger, 2008. 246pp. Praeger Security International. Abstract: "These days, Americans and America provoke strong opinions from Arabs of all sorts, from politicians and journalists to the ordinary men and women of the 'Arab Street'. Their voices aren't always heard in the West, but for over a decade British journalist Andrew Hammond, based in the Middle East, has been listening to what they have to say, and in this book they are heard loud and clear." "Many of the issues are political. What do the Arabs think of American support for Israel or the close US relationship with Saudi Arabia? How have they reacted to the American occupation of Iraq? Moving beyond politics, what is the Arab view of American film, television or the latest hip-hop or rap music heard everywhere from the Lebanon to Algeria? And what, for that matter, do Arabs think of Americans themselves, their life-style, attitudes and character?" "Incorporating interviews with individuals of all sorts from all over the Arab world, *What the Arabs Think of America* gives

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voice to the unheard partner in a relationship in crisis." ISBN: 1846450004; 9781846450006. OCLC: 76925011.

Handley, C. and Dottridge, J. 1997. "Causes and Consequences of Extreme Water Shortage in Ta'iz, Yemen; Groundwater in the Urban Environment; Volume 1, Problems, Processes and Management." Proceedings of the ...IAH Congress on Groundwater.. A.A.Balkema, Rotterdam, Netherlands. Volume 27, Pages 325-330. Descriptors: agriculture; alluvium aquifers; aquifers; Arabian Peninsula; arid environment; Asia; boreholes; degradation; environmental effects; ground water; hydrology; irrigation; land use; rainfall; Ta'iz Yemen; terrestrial environment; water quality; water supply; water use; Yemen. References: 5; illus. incl. 1 table, geol. sketch map. Database: GeoRef. ISBN: 9054109238.

Handley, Chris D. 2001. Water Stress: Some Symptoms and Causes a Case Study of Ta'iz, Yemen. Aldershot; Burlington, USA: Ashgate. Page(s): 1 online resource (xiv, 250 p.). Descriptors: Water-supply -- Yemen (Republic) --; Ta'izz; Water resources development --; Environmental aspects -- Yemen (Republic) -- Ta'izz; Water conservation -- Yemen (Republic); -- Ta'izz. Abstract: Machine generated contents note: 1 Introduction -- 2 Autopsy of an Aquifer - - 3 A Socio-Economic Map of Water Allocation and Use -- 4 Discussion: Anatomy of a Water Crisis -- 5 Conclusions. Notes: System Info: Master and use copy. Digital master created according to Benchmark for Faithful Digital Reproductions of Monographs and Serials, Version 1. Digital Library Federation, December 2002. Note(s): Includes bibliographical references (p. 227-245) and index. Print version: Handley, Chris D. Water stress: some symptoms and causes. Aldershot; Burlington, USA: Ashgate; Responsibility: Chris D. Handley. ISBN: 0754615243. OCLC: 606588434; 247864006. Table of contents: <http://www.loc.gov/catdir/toc/fy031/00111836.html>.

Handley, Chris D. 1999. "Autopsy of an Aquifer; a Case Study of Al Hayma, Yemen; Impacts of Urban Growth on Surface Water and Groundwater Quality; Proceedings of an International Symposium Held during IUGG 99." IAHS-AISH Publication. International Association of Hydrological Sciences, International. Volume 259, Pages 133-141. Descriptors: Al Hayma Valley; aquifers; Arabian Peninsula; Asia; case studies; fluvial features; ground water; hydrology; models; rainfall; runoff; wadis; water balance; Yemen. References: 14; illus. incl. 6 tables. Abstract: Despite the absence of an unique solution, a combination of the following methods permits an assessment of "who stole the water?" from the main aquifer on which a city of 400 000 people depends: (a) the Penman-Monteith method for deriving crop and soil evaporation, (b) the US Soil Conservation Service curve number method for calculating runoff, and (c) groundwater flow modelling to match historical water level trends. Database: GeoRef. ISSN: 0144-7815.

Harding, T. G. and Smith, K. H. 2000. "Masila Block, Yemen, Produced Water Disposal; Challenges and Solutions; Proceedings of the Sixteenth World Petroleum Congress; Exploration, New Petroleum Provinces, Drilling and Production Technology, Enhanced Recovery, Deepwater Fields." Proceedings - World Petroleum Congress = Actes Et Documents - Congres Mondial Du Petrole. [publisher varies], [location varies], International. Volume 16, Pages 342-344. Descriptors: Arabian Peninsula; Asia; cores; Cretaceous; experimental studies; laboratory studies; Lower Cretaceous; Masila Block; Mesozoic; permeability; petroleum engineering; porosity; production; Qishn Formation; reservoir properties; reservoir rocks; steam injection; well-logging; Yemen. Database: GeoRef. ISBN: 0852932944.

Harding, T. G., Varner, J., Flexhaug, L. A. and Bennion, D. B. 2005. "Design and Performance of a Water Disposal Well Stimulation Treatment in a High Porosity and

Permeability Sand.” J Can Pet Technol. Petroleum Society: Volume 44, Issue 12, Pages 59-64. Descriptors: Oil wells; Injection (oil wells); Mechanical permeability; Porosity; Sand; Structural analysis. Abstract: Injectivity problems associated with produced water disposal have been ongoing in the Masila project in Yemen. Disposal wells experience an immediate low injectivity upon commencement of injection as compared to the productivity measured during pumping clean-up of the wells. It has been hypothesized that this behaviour, referred to as the check-valve effect, is caused mainly by mobile formation fines in the near-well vicinity. Injectivity often declines further because of plugging by impurities in the disposal water. Laboratory and field work have been done to test several methods of improving water disposal well performance, including the application of horizontal wells and proppant fracture stimulation of vertical wells. Another technique tried in the field was a stimulation treatment involving HCl/HF acid followed by a thin-film polymer. The intent of the treatment was to destroy potentially mobile formation fines in the near wellbore area and then to stabilize those that remained in an attempt to reduce the check-valve effect. The acid and polymer treatment was developed through laboratory core testing and was employed on a newly drilled water disposal well. The procedures and results of the laboratory work are described along with the design and implementation of the stimulation treatment. The injection performance of the well is examined relative to other disposal wells in the field. Initial results of the stimulation treatment were disappointing but the well has improved over time to become a moderately good injector. However, the results of the test have not provided enough encouragement to date to warrant further work in the field. ISSN: 0021-9487.

Harding, Tom G., Smith, Ken H. and Norris, Brett. 2004. “Horizontal Water Disposal Well Performance in a High Porosity and Permeability Reservoir.” J Can Pet Technol. Petroleum Society: Volume 43, Issue 11, Pages 21-31. Descriptors: Horizontal wells; Anisotropy; Fracturing (oil wells); Injection (oil wells); Installation; Particle size analysis; Porosity; Precipitation (chemical); Sandstone; Sediments; Shale; Water quality. Abstract: Nexen Petroleum International Ltd. (Nexen) has a 52% interest and is operator of the Masila Block in the Republic of Yemen. Oil and water are produced mainly from the under pressured Qishn Formation, a non-marine to marine clastic sequence of Lower Cretaceous Age, which is roughly 61 m (200 ft) thick and lies at a depth of 191 m (5,500 ft) from surface. Currently, oil production is 36,567 m³/d (230,000 BOPD) at a water cut of about 80%. The 160,000 m³/d (1.0 MMBWPD) of water produced are currently reinjected under matrix injection pressures into 24 vertical and four horizontal wells. These are completed in the best quality sands (the S2/S3 members of the Upper Qishn Formation) that have average porosity and permeability of 20% and 3.65E-12 m² (3,700 md), respectively. Despite the exceptional disposal reservoir quality, injection problems continue to exist that have caused Nexen to study and evaluate numerous methods of improving injectivity. After extensive laboratory core and field testing, hypotheses have been developed to explain the behaviour of the water disposal wells including the so-called “check valve effect.” Horizontal wells and proppant fractured wells were employed to test the hypotheses and to improve injectivity. This paper reviews the laboratory results and discusses the placement of horizontal injectors along with the drilling and completion details of the wells. The performance of the horizontal disposal wells under matrix injection is compared to conventional vertical disposal wells and proppant fractured vertical wells. Produced water is expected to reach 238,500 m³/d (1.5 MMBWPD) and improvements in disposal well performance will reduce the number of wells that will need to be drilled to handle this volume, thereby improving overall project value. ISSN: 0021-9487.

Hardison, Chaitra M., et al. 2009. *Cross-Cultural Skills for Deployed Air Force Personnel: Defining Cross-Cultural Performance*. Santa Monica: RAND, 2009. 184 pages. Abstract: Air Force leadership recognizes that the

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cross-cultural performance of Air Force members now plays a greater role in mission success than ever before. The Air Force therefore asked RAND to assist in developing a comprehensive program for preparing members of the Air Force in cross-cultural skills. RAND researchers responded by first creating a taxonomy covering all behaviors relevant to cross-cultural performance after a review of the literature and discussions with Air Force personnel. From this taxonomy, the researchers developed a framework of 14 categories of cross-cultural behaviors: 9 categories of enabling behaviors and 5 categories of goal-oriented behaviors. Enabling behaviors help facilitate a variety of day-to-day activities and are likely to be needed in a variety of jobs. These categories are foreign language skills; verbal and nonverbal communication skills; social etiquette skills; stress management in unfamiliar cultural settings; behavior change to fit the cultural context; gathering and interpreting observed information; applying regional knowledge; self-initiated learning; and respecting cultural differences. Goal-oriented behaviors are associated with specific mission-related activities and are likely to be needed only by individuals working in certain Air Force Specialty Codes (AFSCs). These categories are establishing authority; influencing others; negotiating with others; establishing credibility, trust, and respect; and resolving conflict. The importance of the 14 behavior categories for deployed performance was evaluated by surveying approximately 21,000 previously deployed airmen. Respondents also were asked to indicate how much training they had received. Recommendations for the design of a comprehensive program of cross-cultural training and education were made based on extensive analyses of the results, which included determining whether training needs differed by AFSC, grade (enlisted/officer), and deployment location. DTIC: ADA499701. URL: <http://handle.dtic.mil/100.2/ADA499701>.

Hardisty, P. E., Watson, J. and Ross, S. D. 1996. "A Geomatics Platform for Groundwater Resources Assessment and Management in the Hadramout-Masila Region of Yemen." Application of Geographic Information Systems in Hydrology and Water Resources Management. Proc. HydroGIS'96 Conference, Vienna, 1996. IAHS; Publication 235: Vienna, Austria. Issue 235, Pages 527-533. Descriptors: Water resources; Aquifers; Database systems; Geophysics; Groundwater; Mapping; Mathematical models; Petroleum geology; Project management; Remote sensing; Testing; Water analysis; Well drilling. Abstract: An integrated geomatics platform was designed for the multi-year groundwater resources assessment project at the Hadramout-Masila district of Yemen Arab Republic. A comprehensive data base incorporating all anticipated data requirements was constructed, with accompanying field data input forms. The GIS platform will be used to generate MODFLOW input fields for quasi-3D groundwater flow modeling of the region. Geomatics, combining remote sensing, GPS and GIS technologies provided a powerful platform for storing, standardizing, analyzing and presenting a wide variety of hydrogeological data covering a large and remote area. ISSN: 0144-7815.

Hardy, Ernest E., and A. van Wambeke. *Executive Summary for the Land Classification and Soil Survey of the Yemen Arab Republic*. S.I: s.n, 1983. Notes: Prepared for the Near East Bureau, U.S. Agency for International Development. "Contract No. AID/NE-C-1665." "May 1983." ii, 8 p. ; 28 cm. OCLC: 700352518. URL: <http://catalog.hathitrust.org/api/volumes/oclc/63233069.html>.

Hargrave, A.L. 1961. Aden - Ground control for aerial mapping for the lahej irrigation project /including dam site area/ - Report to the government. FAO 1961 - EPTA Report no 1453 - 13 p. Keywords: Dams; Irrigation; Aerial Surveying; Cartography; Topography; Data Collection; Data Processing; Equipment; Democratic Yemen. EPTA PROJECT. Report Number: LA-EPTA 1453. FAO Library Accession Number: 051453.

Harper, Stephen. 2002. South Arabia and Aden, 1964-1967: Tribesmen and Terrorists. In Thompson, Maj Gen Julian. *The Imperial War Museum Book of Modern Warfare*. London: Sidgwick & Jackson. Page(s): 376. Abstract: The Imperial War Museum book of modern warfare: British and Commonwealth forces at war 1945-2000. Harper's chapter in Major General Thompson's *The Imperial War Museum Book on Modern Warfare* and the very short piece in Arnold are also worth looking at. Notes: xxiii, 376 pages: ill., maps; 24 cm. ISBN: 0283063645.

Harris, Paul M. and Kowalik, William S. 1995. "Facies Dimensions within Carbonate Reservoirs; Guidelines from Satellite Images of Modern Analogs; AAPG International Conference and Exhibition; Abstracts." AAPG Bull. American Association of Petroleum Geologists, Tulsa, OK. Aug. Volume 79, Issue 8, Pages 1221. Descriptors: Abu Dhabi; Arabian Peninsula; Asia; Atlantic Ocean; Australasia; Australia; Bahamas; Belize; Caicos Platform;

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carbonate platforms; carbonate rocks; Caribbean region; Central America; Chinchorro Bank; Coral Sea; depositional environment; distribution; Florida; Great Barrier Reef; Gulf of Mexico; imagery; lagoonal environment; lithofacies; marine environment; models; modern analogs; North Atlantic; offshore; Pacific Ocean; patterns; permeability; petroleum; planar bedding structures; porosity; remote sensing; reservoir rocks; sand bodies; satellite methods; sedimentary rocks; sedimentary structures; shallow-water environment; Shark Bay; shelf environment; siliciclastics; South Pacific; southern Florida; Southwest Pacific; stratigraphic traps; tidal flats; traps; United Arab Emirates; United States; variations; West Indies; West Pacific; Western Australia; Yemen; Yucatan Peninsula. Database: GeoRef. ISSN: 0149-1423.

Harrower, M. J. 2009. "Is the Hydraulic Hypothesis Dead Yet? Irrigation and Social Change in Ancient Yemen." *World Archaeol.* Volume 41, Issue 1, Pages 58-72. Descriptors: Ancient states; Geographic information systems; Irrigation; Southwest Arabia; Yemen. Abstract: Irrigation played an important role throughout ancient Southwest Arabian histories. Irrigation structures provide some of the earliest evidence of crop agriculture and large-scale flash floodwater irrigation systems sustained ancient states; the region thus offers important potential for reconsidering links between irrigation and social change. This paper examines millennia-long connections between social relations and the increasing technological and organizational complexity of irrigation in ancient Yemen. While the hydraulic hypothesis in its original deterministic formulation does not adequately account for the complexity and diversity of regional histories, large centrally managed irrigation systems played an indisputably significant role in Southwest Arabian state formation. Irrigation not only generated the food to sustain burgeoning populations but, just as importantly, afforded ancient kings the ideological prestige of commanding transformation of hyper-arid areas into lush, bountiful oases. Database: SCOPUS. ISSN: 0043-8243.

Harrower, Michael J. 2008. "Hydrology, Ideology, and the Origins of Irrigation in Ancient Southwest Arabia." *Current Anthropology*; June 2008, Vol. 49 Issue 3, 497-510, 14p, 2 Black and White Photographs, 3 Charts, 1 Graph, 2 Maps. Subject Terms: Irrigation; Hydrology; Ideology; Social Factors; Geomatics; Landforms; Drainage; Tombs. Abstract: As an archaeologically less-known region, Southwest Arabia offers new insights that can contribute to interregional understanding of agriculture's beginnings. The relative importance of environmental and social factors is an issue that has proven particularly contentious for both general and regionally focused explanations of transitions to agriculture. Geomatics analyses of landforms and runoff and ethnoarchaeological consideration of cairn tombs and water rights along the Wadi Sana drainage of Hadramawt Governate, **Yemen**, highlight the joint importance of two proximate dimensions of environmental conditions and social relations-hydrology and ideologies of territoriality. In contrast with a focus on one or the other, perspectives that draw on the strengths of both scientific quantification and humanistic interpretation provide for more accurate understanding of the circumstances that shaped the lives and livelihoods of early farmers. ISSN: 00113204. DOI: 10.1086/587890.

Harrower, Michael J. 2010. "Geographic Information Systems (GIS) Hydrological Modeling in Archaeology: An example from the Origins of Irrigation in Southwest Arabia (Yemen)." *Journal of Archaeological Science*. 07. Volume 37, Issue 7, Pages 1447-1452. Descriptors: Geographic information systems; Hydrology; Mathematical models; Archaeology; Remote sensing; Water -- Management; Arabian Peninsula; Yemen (Republic). Abstract: From small bands of foragers, pastoralists, and village agriculturists, to states and civilizations water accessibility and management played a crucial role in sustenance and social life throughout the

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ancient world. Recent advances in Geographic Information Systems (GIS) and related remote sensing technologies offer powerful means of analyzing water flow that are well-suited to clarify design and operational requirements of different irrigation and water management systems. Ancient Southwest Arabian irrigation technologies developed over thousands of years culminating in some the ancient world's most advanced flashflood water systems. This paper describes satellite imagery Digital Elevation Model (DEM) extraction and GIS hydrological modeling procedures conducted for the Wadi Sana watershed of Hadramawt Governate, Yemen. Results help illustrate one of the local contexts in which small-scale irrigation originated in Southwest Arabia and additionally serve as an example for those interested in applying similar methods in other regions. ISSN: 0305-4403.

Harrower, Michael James. 2006. *Environmental Versus Social Parameters, Landscape, and the Origins of Irrigation in Southwest Arabia (Yemen)*. Columbus, Ohio: Ohio State University. Page(s): 267. Descriptors: Irrigation engineering, Prehistoric -- Yemen (Republic); Geographic information systems; Geomatics; Ethnoarchaeology. Abstract: Abstract: Using the Wadi Sana watershed of Hadramawt Governate, Yemen as a case study, this dissertation examines how environmental and social factors structured the origins of irrigation in prehistoric Southwest Arabia. It applies three methods, archaeological survey, geomatics, and ethnoarchaeology set within a framework of scientific and humanistic landscape archaeology. Results of archaeological survey and radiocarbon dating confirm that irrigation originated in Southwest Arabia during the mid 6th millennium calibrated BP and identify shrûj surface runoff irrigation as one of the earliest irrigation techniques in the region. Conflicts between explanations emphasizing environmental versus those stressing social factors have long structured investigations of prehistory and models of transitions to agriculture. To evaluate the relative, interconnected influence of environmental versus social factors this study applies: 1) geomatics to evaluate the hypothesis that locations of ancient irrigation structures in Wadi Sana are closely associated with hydrological variables reflecting close behavioral ties to environmental conditions, and 2) ethnoarchaeology to interpret sociocultural, political, and ideological parameters of ancient irrigation. A sample of 174 irrigation structures is statistically compared with satellite imagery-derived data including landform and hydrological Geographic Information System (GIS) map data layers. A cross-cultural overview of irrigation, synopses of typological and social aspects contemporary irrigation in Yemen, and a preliminary ethnoarchaeological study of water-use and irrigation in present-day Wadi Sana help illustrate how organizational/logistical challenges and perceptions of landscapes and water-rights shaped irrigation's origins. Collective results illustrate why a combination of processual and postprocessual perspectives including both quantitative hypothesis testing and qualitative interpretation best illustrate the relative importance of environmental and social factors. Research findings demonstrate that ancient forager-herders in Wadi Sana chose irrigation structure locations based on intimate knowledge of low-energy monsoon runoff along rocky hillslopes, and that new understandings of landscapes as hydraulically malleable domains of anthropogenic control, exclusive rights to water, and new forms of territoriality were crucial to irrigation's origins. Notes: Dissertation: Thesis (Ph. D.)--Ohio State University, 2006. System Info: Available online via OhioLINK's ETD Center; System requirements: World Wide Web browser and PDF viewer. Includes bibliographical references (p. 200-263). Responsibility: by Michael J. Harrower. OCLC Accession Number: 70135954.

Hasan, `Abd Allah `Abd al-Jabbar. 2004. *Himayat Al-Tharwah Al-Maiyah*. Aden: Dar Jami`at `Adan lil-Tiba`ah wa-al-Nashr. Descriptors: Water quality management -- Yemen

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(Republic); Water-supply -- Yemen (Republic); Water resources development -- Yemen (Republic); Internet resource. Abstract: Water resources; protection; Yemen. Notes: 98 p. 24 cm. Note(s): Includes bibliographical references (p. 74-83). Responsibility: al-muallif, `Abd Allah `Abd al-Jabbar Hasan. LCCN: 2007-331896. OCLC: 124540334. URL: <http://www.loc.gov/catdir/toc/mena0901/2007331896.html>.

Hasan, `Abd Allah `Abd al-Jabbar. 2002. *Azmat Al-Miyah Fi Al-Yaman Wa-Tathiruha `alá Al-Tanmiyah: Al-Badail Wa-Al-Hulul*. San`a: Markaz `Abbadil lil-Dirasat wa-al-Nashr. Page(s): 152. Descriptors: Water-supply -- Yemen (Republic); Water resources development -- Yemen; (Republic). Abstract: Water-supply; influences; development; Yemen. Notes: ill. 22 cm. Note(s): Includes bibliographical references (p. 119-126). Responsibility: `Abd Allah `Abd al-Jabbar Hasan. LCCN: 2003-468474. OCLC: 53981823.

Hasan, AAJ. 2000. *Irrigation Water Resources in Republic of Yemen*. Notes: TY: GEN. Database: COS Conference Papers Index. URL: <http://search.proquest.com/docview/42275402?accountid=12084>.

“Hassan dam construction approved.” 2010. *Yemen Today*. October 25, 2010. Abstract: The Hassan dam project, projected to cost USD 98 million, has recently been approved by the Supreme Tender Committee. The dam will bring about a dramatic change in the Abyan agricultural sector and will also improve the food situation in Yemen in general, the Deputy Minister for Irrigation sector at the Ministry of Agriculture said. He said that the project is considered to be one of the strategic projects that will increase cereals, fruits, vegetables, and animal fodder production to cover the local market’s needs and increase exports. He pointed out that the dam is being financed by government of Abu Dhabi and the government of Yemen. The Hassan dam aims to increase water resources, control floods, regulate irrigation through control gates, protect agricultural products, and control the negative effects of the stream’s flow. It also aims to rehabilitate the dam’s downstream channels to bring water to local farms, increase irrigation efficiency, and increase groundwater recharge. The dam will also assist in the development of the monitoring process of water distribution in the canals as well as promote social cooperation for water distribution in the region. The dam will irrigate 10,000 acres and 13,000 families will benefit from the agricultural lands that are affected. The assembly area is 31,200 square kilometers and the average annual water flow is about 39 million cubic meters, whereas the dam’s reservoir is 4.2 square kilometers. The highest water level of the dam will be 135.5 meters. The Hassan dam manager, Yousif Ahmed Frie, pointed out that the dam consists of two major components; the first is the controlling of rain water with a storing capacity of 20 million cubic meters and the second one includes irrigation and control channels, distribution facilities, irrigation outlets, and an agricultural irrigation route, adding that the dam will restore the lands that were washed away during the 1982 floods, increase agricultural productivity, and feed the underground reservoirs of the wells that supply the Aden, Abian, and Lahj Governorates in addition to increasing agricultural production and providing jobs to a large number of the workforce in the governorate in various fields during the dam’s construction period. He noted that Wadi Hassan is one of the steepest valleys in the region and most of the monsoon rains the wadi receives are washed into the sea. The reservoir will act as a storage unit for this rainwater and control flooding. Abyan valley delta is an agricultural area that is formed by the Wadi Hassan and Wadi Bana precipitations during the monsoon floods. It is one of the most fertile areas in Yemen, starting from mountainous ranges up to the valley’s mouth in the Gulf of Aden. The delta is 35 kilometers long and 15 kilometers wide. The building of the dam is considered to be important because it will prevent the washing away of fertile soil by flash floods

which destroy agricultural projects in the low laying areas. URL:
<http://www.yobserver.com/local-news/10020011.html>.

Hassan, Hussein. 2003. "Review: Sharecropping in the Yemen: A Study in Islamic Theory, Custom and Pragmatism. William J. Donaldson: Sharecropping in the Yemen: A Study in Islamic Theory, Custom and Pragmatism." *Journal of Islamic Studies*. January 1. Volume 14, Issue 1, Pages 76-79. ISSN 0955-2340. doi: 10.1093/jis/14.1.76.

Hassan, L. A. J. A. L. and Shwafi, N. A. A. 1997. "Asymmetry Analysis in Two Marine Teleost Fishes Collected from the Red Sea Coast of Yemen." *Pak. J. Zool.* Volume 29, Issue 1, Pages 23-25. Descriptors: Asymmetry; Red Sea; Teleost fishes; Yemen. Notes: Cited By (since 1996): 1. Abstract: Asymmetry analysis have been carried out for some bilateral characters of two marine teleost fishes, *Saurida undosquamis* and *Sillago sihama* collected from the Red Sea coast of the Republic of Yemen. The results show that in the *S. undosquamis* the level of asymmetry of pectoral fin ray and eye lens weight increase with the increase of the length of the fish. This is also true for the postorbital length in *S. sihama*. The cause and origin of the asymmetry in this species have been discussed from the point of view of different toxicants and their presence and distribution in the area. Database: SCOPUS. ISSN: 0030-9923.

Hassan, LAJ, Fareed, KH and Azab, AM. 1997. "Some Vertebral Anomalies in Fishes Collected from the Republic of Yemen." *Pak. J. Zool.* Volume 29, Issue 3, Pages 302-304. Descriptors: Mutations; Vertebrae; Article Taxonomic Terms: *Barbus apoensis*; *Chelon macrolepis*; Article Geographic Terms: Yemen; Yemen; abnormalities; animal morphology; Marine; Brackish; Freshwater. Abstract: Vertebral anomalies in *Chelon macrolepis* (Pisces: Mugilidae) collected from Houdaida Province at the Red Sea coast of Yemen and *Barbus apoensis* collected from the freshwater falling water pools at the Province of Ibb, south of Sana'a, have been described. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0030-9923.

Hassan, MAH, Majed, AA-E, Hamid, TA-S and Abdel Moneim, MA. 2001. "Distribution of Trace Elements in Tissues of Five Fish Species Collected from the Red Sea Coast of Yemen." *Bull. Natl. Inst. Oceanogr. Fish. (Egypt)*. 311-322. Volume 27, Pages 311-322. Descriptors: Heavy metals; Marine fish; Pollution effects; Tissues; Trace elements; Waste water; Article Taxonomic Terms: *Epinephelus*; *Lethrinus lentjan*; *Saurida undosquamis*; *Scomberoides commersonianus*; *Scomberomorus commerson*; Article Geographic Terms: Red Sea; Yemen; Groupers; Narrow-barred spanish mackerel; Marine. Abstract: The distribution of trace elements in different tissues of 5 fish species collected from the Red Sea Coast of Yemen (*Scomberoides commersonianus*, *Saurida undosquamis*, *Epinephelus*, *Lethrinus lentjan*, *Scomberomorus commerson*) were investigated. The study was conducted to determine the levels of Cd, Cr, Cu, Fe, Mn, Ni, Pb, V and Zn using Atomic Absorption Spectrophotometer. High concentrations of Cd, Cr, Cu, Fe, Mn, Ni and Pb were observed in *Scomberoides commersonianus* with mean values of 2.50, 1.30, 2.00, 6.00, 0.60, 2.00 and 1.30 $\mu\text{g/g}$ dry weight respectively, while the high values of V and Zn were measured in *Saurida undosquamis* with mean values 1.80 and 20.00 $\mu\text{g/g}$ dry wt, respectively. Generally the concentrations of trace elements reported in the different fish tissues are within the acceptable worldwide ranges and lower than those reported in the world literature. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 1110-0354.

Hattab, F. N. and Angmar-Månsson, B. 2000. "Fluoride Content in Khat (*Catha Edulis*) Chewing Leaves." *Arch. Oral Biol.* Volume 45, Issue 3, Pages 253-255. Descriptors: Fluoride; Khat leaves. Notes: Cited By (since 1996): 3. Abstract: Khat (qat) leaves are chewed for their

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psycho-stimulative effects; there is an unconfirmed suggestion that they contain a high concentration of fluoride (F). Khat samples from Yemen were suspended in deionized water, spun, and the supernatants exposed to a chelator that decomplexes F, which was assayed with an Flectrode coupled to an ion analyser. F released into whole saliva after chewing khat for 15 min and from khat suspended in stimulated whole saliva for 1.5 h in vitro was measured also. Total F in dried khat leaves and their ash was assayed by the acid-hexamethyldisiloxane microdiffusion method. All methods demonstrated negligible amounts of F in or from khat leaves (< 0.02 µg F/ml leached into water or saliva: 0.06 µg F/ml in saliva after chewing; 0.93 µg total F/g in dried leaf; 2.07 µg total F/g in ash). Database: SCOPUS. ISSN: 0003-9969.

Hawkins, Lorraine. 2007. *Women's Lives and Social Change in Old Sana', the Republic of Yemen*. United States -- New York: Anthropology. ProQuest Dissertations and Theses. Abstract: Fieldwork conducted in the late 1990s involved getting to know women of all ages and their life stories in a neighborhood of Old Sana', the Republic of Yemen. Most women were married young and are housewives. The neighborhood social life promotes traditionalism and a gendered division of labor that prescribes roles for women as wives and mothers. An account of Yemeni history and women's history shows "the traditions" have framed the discourse and the gender ideologies within which Yemeni people negotiate the terms of modernity. Nationalist discourses on women and development bear more relevance for women of the upper classes. Lower middle class families have had to struggle for household survival and to maintain social status during the national economic crisis of the 1990s. Families were continuing to marry their daughters young, placing their trust in what they conceive as the traditions involved with early marriage. The argument presented is that these choices should be analyzed as class-based cultural responses in the day-to-day struggle with the consequences of modernity in Yemen. Not everyone in the neighborhood has followed the "traditional" gender ideology. Women sellers who have prospered through a women's informal economy along with other upwardly mobile families did express more favorable attitudes towards girls' education. A few young women did attend university. The stories of these young women along with the life stories of women sellers are included in order to understand the factors that influence social change in women's lives. Regarding the issue of education versus early marriage, recommendations are made taking into consideration parents' decision-making and their concerns regarding security in the future for their daughters. Notes: Anthropology; Ph.D. ISBN: 9780549046240; 0549046240. OCLC Number: 226375433.

Hazen and Sawyer. . 1977. "Yemen Arab Republic, National Water and Sewerage Authority: Taiz Water Supply and Sewerage Project, Water System Improvements." New York: Hazen and Sawyer. Descriptors: Ta`izz (Yemen) -- Aerial Photographs; Ta`izz (Yemen) -- Maps. Notes: Description: 1 map; 83 x 112 cm. Map Info: Scale 1:5,000. Other Titles: Taiz water supply and sewerage project, water system improvements. OCLC Accession Number: 367986577.

Hazen and Sawyer and Yemen Arab Republic National Water and Sewerage Authority. . 1977. "Taiz Water Supply and Sewerage Project." New York: Hazen and Sawyer. Descriptors: Water-supply -- Yemen (Republic) -- Ta`izz -- Maps; Sewerage -- Yemen (Republic) -- Ta`izz -- Maps; Water-supply -- Yemen (Republic) -- Ta`izz Region -- Maps; Sewerage -- Yemen (Republic) -- Ta`izz Region -- Maps. Notes: Description: 5 maps; 84 x 113 cm. or smaller. Scales vary. Note(s): At head of title: Yemen Arab Republic, National Water and Sewerage Authority. Sheets 1 and 2 are photocopies. Sheets 3, 4, and 5 are photomaps. Relief shown by contours and spot heights on some sheets. Responsibility: Hazen and Sawyer, engineers.

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Abstract: Plate I. Plan of recommended project and alternatives, 1:50,000.--Plate II. Al Haima water resources, 1:20,000.--Plate III. Water system improvements, 1:5,000.--Plate IV. Sewerage system improvements, 1:5,000.--Plate V. Storm drainage improvements, 1:5,000. LCCN: 78-695575. OCLC Accession Number: 5485994.

Health Data Publications no. 16. Yemen. 1962. Performer: Walter Reed Army Medical Center Washington D C. Sep 1962. 21 pages. Abstract: Contents: Minerals, industry, transportation and communications; Food and nutrition, water supply; Animals of medical importance; Diseases of Yemen; Health services and medical facilities. OCLC: 227365399.

Hearn, AB. 1969. "Growth and Performance of Cotton in a Desert Environment: I. Morphological Development of the Crop; ii. Dry Matter Production; iii. Crop Performance." *Journal of Agricultural Science, Camb*, 1969, Vol 73, no 1, I.P 65-74, ii.P 75-86, iii.P 87-97. 19 Fig, 13 Tab. 65 REF. Descriptors: Cotton; Plant Growth; Plant Morphology; Environmental Effects; Fiber Crops; Arid Lands; Deserts; Planting Management; Crop Production; Crop Response; Plant Physiology; Flood Irrigation; Alluvium; Sierozem; Soil-Water-Plant Relationships; Varieties; Spatial Distribution; Irrigation Water; Equations; Economic Efficiency; Effects; Photosynthesis; Leaves; Carbon Dioxide; Light; Soil Water; Evapotranspiration; Seeds; Dry Matter Production; Plant Requirements; Yemen; Dry Weight; Unit Leaf-Area Index; Beer's Law. Abstract: Agriculture in southern Yemen is based on annual spate floods, deep alluvial soils, and deep-rooted crops such as cotton. General principles of cotton growth were studied under a variety of experiments in 1963 and 1964. The results of variety, sowing date, irrigation water and plant spacing tests indicate that morphological change and dry weight increase are linked to predict crop performance. An exponential equation is developed for dry weight and unit leaf-area index, based on beer's law as opposed to linear regression. Varieties and agronomic practices are discussed in economic terms. An empirical relationship between water, dry matter production and cotton seed yield is evaluated physically and biologically based on work by penman and dewit, and practically based on commercial yields and watering rates. Experimental procedure for i includes number of mainstem nodes, variety, water, branches, fruiting points, and treatment effects. Potential photosynthesis, leaf distribution, CO_2 exchange resistance, light, vegetative and reproductive growth are evaluated for ii. Soil water, evapotranspiration, seed cotton, plant weight and structure, water, mainstem, fruiting points, and boll and fibre character are investigated in III. Database: Water Resources Abstracts. ISSN: 0021-8596.

Heathcote, Brig G. S. 1966. "*Operations in the Radfan*." Royal United Services Institute for Defence Studies Journal. February 1966. Volume Vol. 111, Issue No. 641, Pages 30-40. ISSN: 0307-1847.

Heba, HM, Saeed, MA and Al-Saad, HT. 2001. "Assessment of N-Alkanes in Sediments from Northwest Arabian Gulf and the Red Sea Coast of Yemen." *Mar. Mesop. Spec. Issue*. Volume 16, Issue 2, Pages 345-356. Descriptors: Coastal zone; Saturated hydrocarbons; Sediment analysis; Sediment chemistry; Transport processes; Article Geographic Terms: Red Sea; Yemen; Marine. Abstract: Sediment samples taken from different locations from the Northwest Arabian Gulf and the Red Sea Coast of Yemen were analyzed to determine origins and sources of n-alkanes. In sediments from the Northwest Arabian Gulf, odd and even carbon numbers were found. These came from different sources such as phytoplankton, zooplankton, bacteria and fungi; higher molecular weight compound was found as another sources. In the sediment of the Red Sea coast of Yemen the distribution exhibited odd carbon number predominance in C_{15} - C_{21} and C_{25} - C_{31} range which is characteristic of autochthonous and allochthonous natural input, where slight even carbon number predominance

in the C sub(20)-C sub(30) range invoked reduction or bacterial processes. Moreover concentration of n-alkanes in both sediment from North-West Arabian Gulf and Red Sea were also within the range of the other parts of the world. The present study show that concentration of n-alkanes in sediment of Northwest region of the Arabian Gulf and Red Sea coast of Yemen are governed by four transport processes: 1) Aeoline transport of fossil fuel and combustion products followed by deposition on the surface water and subsequent sedimentation; 2) Transport of combined n-alkanes source (e.g. storm water runoff, municipal sewage effluents, oil spillage from ports and industrial inputs); 3) Direct introduction of waste material via ship leisure boats and fishing boats; and, 4) Resuspension of materials reaching coastal aquatic sediment via aeoline transport and deposition in setting areas. Database: ASFA: Aquatic Sciences and Fisheries Abstracts.

Heba, Hassaan M .A. Mohamed Al-Kahali and Majed Al-Edresi. 2007. “*Heavy Metal Contamination in the White Muscles of Some Commercial Fish Species From Al-Hodeidah -Red Sea coast of Yemen.*” *Abstract:* The distribution of seven trace metals namely Zn, Mn, Cd, Cu, Co, Ni, and Pb in some commercial fish species was determined. Samples of the white muscles from Latjanus sp.(snappers), Mullet (Mugil sp.), Indian Mackerel (Rostreglier kanagurata), catfish (Arius thalasinus), and Longtail tuna (Thunus tonggol) collected along the coast of Al-Hodiedah Red Sea coast of Yemen, were analyzed by using Flame Atomic Absorption Spectrophotometer (AAS). The results showed high concentrations of all the studied elements, and the concentration were varied from one species to another. Nevertheless, elevated concentrations of trace metals were observed in Lutjanus sp., and tuna. Our findings also showed high concentrations of Pb in all fishes, in general. Also, high concentrations of Cd were exhibited in Lutjanus and catfish, with 0.65 µg/g and 0.6 µg/g respectively. The manganese (Mn), Copper (Cu), Cobalt (Co), and Nickel (Ni) mean concentrations ranged between 1.93 and 6.69 µg/g. The mean concentrations of Zn in this study were lower when compared with those reported in other parts of the world. In conclusion, although values of trace metals observed in our study are within the acceptable worldwide range, however they are lower than those reported elsewhere. The present study considers the recommendation of carrying out continuous monitoring program for the Red Sea coast of Yemen, and that the levels of heavy metals must remain within the prescribed worldwide ratio... In conclusion, this investigation showed that the concentration of trace metals in the white muscles of some commercial fish species collected from Al-Hodiedah were higher when compared to else where along the Red Sea Coast. This might be due to the activities in the study area, fat content, age, and different species have different affinities for certain metal up take. In addition the sewage discharges in the area and recently the dredging along the beach. The study recommended a continuous monitoring program for the Red Sea Coast of Yemen, and the levels of heavy metals must remain within the prescribed worldwide limit. URL: http://ipac.kacst.edu.sa/eDoc/2007/165228_2.pdf.

Hellegers, P J G J; Perry, C J; Al-Aulaqi, Nasser. 2011. “Incentives to reduce groundwater consumption in Yemen.” *Irrigation and Drainage*. Volume 60 (1). Feb 2011. *Abstract:* In this paper options for changing the incentive structure to reduce unsustainable groundwater consumption in Yemen are evaluated. Special attention is paid to incentives that decrease the profitability of irrigation water use and subsidies on improved irrigation technology. Although the literature and economic theory suggest that the range of possible incentives is wide (water pricing, metering, water rights, water markets, taxes, subsidies, information, participatory management, etc.), the results of this study show that the range of potentially effective incentives

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in the Yemeni political context is more limited due to difficulties of implementing and enforcing change. The Yemeni case is unique, as there is a close linkage between water and qat production. Reducing water consumption will substantially reduce the benefits from qat production and consequently farm income, which is a politically sensitive way of bringing about a balance between supply and demand of water. ISSN: 1531-0361.

Helmores, P. I. and Howard Humphreys & Sons. 1982. Yemen Arab Republic, Preservation of the Old City of Sana'a: Water Supply, Sewerage and Stormwater Drainage: Report. Descriptors: Water-supply engineering -- Yemen (Republic) -- Sana'a; Water supply -- Yemen (Republic) -- Sana'a; Cities and towns -- Conservation and restoration -- Yemen (Republic) -- Sana'a. Notes: iii, 76, 12 leaves: ill. 30 cm. Genre/Form: Photographs, Original. Note(s): "Howard Humphreys & Partners, consulting engineers"--Cover. "November 1982." Includes 12 leaves of color photographs and 8 folded leaves of architectural drawings. Other Titles: Preservation of the old city of Sana'a. Responsibility: P.I. Helmores. OCLC: 85172558.

Hendrikse, Mirjam. 2000. And from Water we Created Every Living Thing: A Study about Actors and Factors Influencing the Behaviour of Dhamari Farmers with Regard to Water Distribution in Yemen. Nijmegen: CIDN. Page(s): 5. Descriptors: Water-supply -- Yemen (Republic); Water resources management -- Yemen (Republic); Water use -- Yemen (Republic); Waterhuishouding; Boeren; Thesis/dissertation. Notes: x, 124; maps; 24 cm. Dissertation: Thesis (Ph. D.)--University of Nijmegen, 2000. Note(s): Includes bibliographical references (p. 111-118). Responsibility: Mirjam Hendrikse. ISBN: 9072639952; 9789072639950. OCLC: 57244984.

Hendy, C. R. C. and Land Resources Development Centre (Great Britain). 1981. Livestock Production. Surbiton: Land Resources Development Centre. Page(s): 200. Descriptors: Agricultural development projects -- Yemen (Republic); Montane Plains and Wadi Rima Project; Government publication. Notes: xvi; ill. 30 cm. Note(s): "YAR-01-41/REC-29/80."; Responsibility: C.R.C. Hendy. OCLC: 68763901; 68706137.

Henrici, Amy C. and Baez, Maria. 2001. "First Occurrence of *Xenopus* (Anura, Pipidae) on the Arabian Peninsula; a New Species from the Upper Oligocene of Yemen." *J. Paleontol. Paleontological Society, Lawrence, KS, United States: United States*. Jul. Volume 75, Issue 4, Pages 870-882. Descriptors: Amphibia; Anura; Arabian Peninsula; Asia; biogeography; biometry; Cenozoic; Chordata; climate change; first occurrence; fossilization; fresh-water environment; Lissamphibia; morphology; new taxa; Oligocene; paleoclimatology; Paleogene; Pipidae; skeletons; taxonomy; Tertiary; Tetrapoda; upper Oligocene; Vertebrata; *Xenopus arabiensis*; Yemen. Notes: References: 48; illus. incl. 2 tables, sketch map. Abstract: A freshwater interbed of the Yemen Volcanic Group in central western Yemen yielded impressions of numerous, articulated, mostly complete frog skeletons. Recent dating of the volcanics and the stratigraphic position of the fossil bearing bed in the sequence support a Late Oligocene age for the frogs. These frogs are described as a new species of *Xenopus*, a genus that is today mostly confined to subsaharan Africa, and they provide evidence of the former, wider distribution of this genus on the Afro-Arabian Plate. The new species, *X. arabiensis*, differs from other *Xenopus* in its long maxilla and maxillary tooth row. It resembles *X. muelleri* in its dentate, azygous vomer and prominent, cone-shaped, distally-pointed prehallux, but differs from *X. muelleri* in having an atlantal intercotylar notch and longer distal prehallux bone. Climatic changes during the Neogene probably led to the extinction of *Xenopus* on the Arabian Peninsula; however, the timing of this event is not certain. Database: GeoRef. ISSN: 0022-3360. URL: <http://www.journalofpaleontology.org/>.

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Henry L. Stimson Center; National Intelligence Council (U.S.); United States and Dept. of State. 2010. Fresh Water Futures Imagining Responses to Demand Growth, Climate Change, and the Politics of Water Resource Management by 2040. Washington, DC: Stimson Center. Page(s): 1 online resource (25 p.). Descriptors: Water-supply -- Political aspects --; Congresses; Water-supply -- Economic aspects --; International rivers -- Congresses; Water-supply -- International; cooperation -- Congresses; Water rights -- International; Conflict management -- International; Water-supply -- Afghanistan; Water-supply -- Yemen (Republic); Mekong River; Ganges River (India and Bangladesh); Kali River (India and Nepal); Indus River. Abstract: On 29 January 2010, The Stimson Center, under the sponsorship of the National Intelligence Council and the US State Department, organized a workshop in Washington, DC, focused on the future of global fresh water resources and the politics of water resource management. Specific in-country cases included Yemen and Afghanistan, and transboundary cases included the river basins of the Mekong, Ganges, Mahakali, and Indus rivers. Building on this base, the workshop then considered criteria for identifying basins where future tensions or instabilities could emerge and assessed the roles that technological innovations, market mechanisms, river basin institutions, and other policy approaches play in the cooperative management of shared water resources. Scope note -- Executive summary -- Discussion: Background -- Within boundary cases: Yemen and Afghanistan -- Transboundary cases: the Mekong, Ganges, Mahakali, and Indus -- Identifying basins at risk and potential solutions -- Annex: Institutions. Notes: Note(s): Title from cover screen (viewed on June 7, 2010). "May 2010." Includes bibliographical references. Responsibility: prepared by the Stimson Center. OCLC Accession Number: 638968521.

Heritage Foundation Washington, DC, and Carafano James J., Weitz Richard Andersen, Martin E. 2009. "Maritime Security: Fighting Piracy in the Gulf of Aden and Beyond (Heritage Special Report, Number 59, June 24, 2009)." 24 Jun. Page(s): 29 Report Number: SR-59 XD-XD Monitor Series: XD. Abstract: The Heritage Foundation's Maritime Security Working Group -- composed of representatives from academia, the private sector, research institutions, and government -- produces cutting-edge policy recommendations for making the seas safer for the United States, its friends and allies, and global commerce. The fourth occasional report by the group addressing the most pressing issues confronting maritime security examines the issue of piracy in the Gulf of Aden and the appropriate U.S. response. This report describes the threat of piracy to global commerce and the safety and security of ships transiting the Gulf of Aden; Addresses domestic and international legal aspects of responding to piracy and other criminal acts at sea; Proposes the appropriate mix of private-sector and U.S. military responses to piracy, including long-term investments in constabulary maritime assets; Recommends solutions for improving the capacity of regional powers to protect freedom of the seas; and Outlines a strategy for dealing with the root of the problem, which is lack of governance in Somalia. Though the report's proposals are focused on the Gulf of Aden, they have implications for combating piracy worldwide. Since 2003, piracy has been reported off the coasts of Bangladesh, Nigeria, Brazil, and Peru. Raising levels of piracy off the coast of East Africa, however, could be a precursor to a new global trend. The recent successes of the Somali pirates may empower and inspire other groups. The frequency and level of violence from piracy acts could increase. Within the last month, there were two attacks in Port-au-Prince, Haiti, and a coastal tanker was hijacked off the coast of Colombia. While the appropriate response for each threat must be tempered by local conditions, the solutions and instruments for responsible action in the Gulf of Aden will hold lessons for meeting the challenge of piracy in other parts of the

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world. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf); Occasional rept. Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA506760. URL: <http://handle.dtic.mil/100.2/ADA506760>.

Hersi, Osman Salad, Leckie, Dale A. and Al Khalifa, Shaikh bin Salman (chairperson). 2008. "Depositional Setting of Cretaceous Reservoirs, Southern Yemen and Northern Somalia; Geo 2008 Conference Abstracts." *GeoArabia* (Manama). Gulf Petrolink in Bahrain, Manama, Bahrain. Volume 13, Issue 1, Pages 170, 172. Descriptors: Africa; Al Mado Basin; Arabian Peninsula; Asia; basin analysis; basins; braided streams; carbonate rocks; Cretaceous; deltaic environment; deposition; depositional environment; East Africa; faults; fluvial environment; geometry; Gondwana; grabens; Harshiyat Formation; lithostratigraphy; Mahra Group; marine environment; Mesozoic; paleoenvironment; paleogeography; permeability; petroleum; petroleum exploration; Qishn Formation; recovery; reserves; reservoir properties; reservoir rocks; Sayun-Al Masila Basin; sedimentary basins; sedimentary rocks; sedimentation; shallow-water environment; Somali Republic; streams; systems; Tawila Group; Tethys; thermal maturity; Tisje Formation; Yemen; Yesomma Formation. Database: GeoRef. ISSN: 1025-6059.

"High and Dry." 2002. *Economist*. Economist Newspaper Limited: 03/30. Volume 362, Issue 8266, Pages 41-41. Descriptors: Water use; Khat; Water-supply; Yemen (Republic) -- Social conditions; Yemen (Republic). Abstract: Discusses the way that Yemenis use a third of their water supply to cultivate the shrub called qat. Popularity of the plant among adult men in Yemen; Decline of well water in Yemen; Argument that qat has economic benefits; Description of fighting that erupts over the water problem. ISSN: 0013-0613.

"High water levels in Marib and Batis Dams." 2010. *Yemen Today*. July 14, 2010. Abstract: The water level in the Marib Dam has risen to 45 million cubic meters as a result of the heavy rainfall in various areas of Yemen in the past two days. Under-Secretary of Marib province, Ali Muhammad al-Fatimid, was briefed Tuesday on the amount of water flowing into the dam and the maintenance of drainage channels and sub systems. The Deputy Director of the Marib Dam Project, Engineer Ahmed al-Arifi, said the water level in the dam on Tuesday rose to 45 million cubic meters, while the water level last April rose to 100 million cubic meters. The gate of the main channel for groundwater was opened in the valley of Ubaida for three months, where the quantity of water flowing amounted to 80 million cubic meters. The Batis Dam, in Abyan province, has water levels that rose to four meters as a result of heavy rains. Under-Secretary of Abyan province, Ahmed Ghaleb al-Rahawi, visited the the Abyan Delta and was briefed on the functions of the irrigation and the distribution of flood flows in the Batis, Haija, Sakin and Ais channels, Due dam, and Abu Shanab and al-Noshaira bridge. Al-Rahawi ordered the control of any violations for irrigation system, as well as the distribution of flood water to agricultural areas that were not watered in the previous season. URL: <http://www.yobserver.com/local-news/10019158.html>

Hinchcliffe, Peter at al. 2006. *Without Glory in Arabia: The British Retreat from Aden*. London: I B Tauris, Page(s): 327. Abstract: A more recent book by three Civil Servants with personal knowledge of Aden is that by Hinchcliffe, Ducker and Holt. The first two authors were based in Aden during the final years and frequently came into contact with the military operations in the theatre. Notes: xxiii, 327 pages: ill., maps; 22 cm. ISBN: 9781429462563. OCLC Accession Number: 122913877.

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Hobson, Chris. 2009. "JSCSC Library Bibliography: Campaign & Battle Series: Aden and the Radfan Campaigns, 1963 – 1967." Joint Services Command and Staff College: January 2009. Abstract: British military involvement in Southern Arabia dates back to 1839 when it was occupied by troops of the East India Company in order to secure harbour facilities on a coastline where few harbours existed, then or now. Until 1937 Aden was ruled as part of British India but it later became a British Crown Colony and then, with the inclusion of its mountainous hinterland, a British Protectorate. After more than a hundred years spent in the political doldrums, several influences came together during the 1960s to make Aden the focus of attention and which resulted in two related but very different counter-insurgency campaigns, one urban and one in remote mountainous terrain. The arid, rocky and sparsely populated region north of Aden, known as the Radfan, has not seen any real change for hundreds of years. It was ruled, if that word can be used in this context, by local tribesmen whose main source of income came from robbing travellers who passed through the area. It was a rugged, unforgiving and lawless region that had no natural resources but was strategically important in that a major trade route from the north had to pass through it and the area could be used as a base of operations from which to threaten Aden itself. However, to the north of the Radfan was the newly-established People's Democratic Republic of Yemen (PDRY), a state encouraged and funded by President Nasser of Egypt, one of Britain's most ardent Arab enemies. The PDRY was also supported by the Soviet Union as part of its Cold War strategy. For the PDRY to export its brand of revolution to Aden and oust the British, its forces had to travel along the Dhala Road through the Khuraybah Pass and the Radfan mountains. The two main challenges posed to British forces in the Radfan was the difficulty in operating in such a remote and inhospitable area and the fact that the enemy were expert mountain fighters who had the advantage of knowing the local geography without reliance of maps or aerial photography. The two Radfan expeditions in 1964 and 1965 were adjudged to have achieved their tactical aim but it cannot be said that they had any long-lasting effect on the developments then taking place in Southern Arabia.

Partly in response to the threat from neighbouring North Yemen, negotiations for a unified state of Southern Arabia commenced in the early 1960s but these were protracted and difficult and resulted in much in-fighting between rival factions as well as a growing number of terrorist incidents against British forces and interests in Aden. The creation of the Federation of South Arabia in 1963 was not welcomed by most of the local population and only served to harden resolve against the British Government. When it became known in 1966 that Britain was going to withdraw from Aden completely the following year the pace of terrorist activity increased greatly. The densely populated Crater district of Aden became the focus of terrorist and counter-insurgency operations during the final years of the British occupation. As political negotiations continued the British armed forces planned the final withdrawal from Aden, which took place in November 1967.

Hobson, Chris. 1986. "*Beverleys in Aden: Operations by no. 84 Squadron, RAF, 1958-67.*" Air Pictorial. November 1986. Volume Vol. 48, No. 11, Pages 441-447. ISSN: 0002-2462.

Hodgkin, Jonathan and Water and Sanitation for Health Project (U.S.). 1991. A Progress Report on Establishing Regional Training, O & M, and Repair Workshops in the Republic of Yemen. Arlington, Va: Water and Sanitation for Health Project. Page(s): 58. Descriptors: Sanitation -- Yemen; Water Supply -- Yemen. Notes: x; 28 cm. Note(s): "Prepared for the USAID Mission to the Republic of Yemen under WASH Task No. 261." "October 1991." "Contract No. 5973-7-00-8081-00, Project No. 836-1249." Responsibility: by Jonathan Hodgkin. OCLC Accession Number: 54665736.

Geology of Yemen

Hodgkin, Jonathan and Water and Sanitation for Health Project (U.S.). 1989. Operation and Maintenance of Rural Water Supplies in the Yemen Arab Republic. Arlington, Va: Water and Sanitation for Health Project. Page(s): 103. Descriptors: Sanitation -- Yemen; Water Supply -- Yemen. Notes: viii; ill. 28 cm. Note(s): "Prepared for the USAID Mission to the Yemen Arab Republic under WASH Task No. 015." "March 1989." "Contract No. 5942-C-00-4085-00, Project No. 936-5942." Includes bibliographical references (p. 33-34). Responsibility: by Jonathan Hodgkin. OCLC Accession Number: 54352793.

Hogan, E. Asmon, I. Brooks, R. Cassam, M. and Furtick, W. 1982. Agricultural Sector Assessment, Yeman Arab Republic. Performer: Agency for International Development, Washington, DC. Ministry of Agriculture (Yemen (San'a)). Yemen. Wizārat al-Zirā'ah wa-al-Tharwah al-Samakīyah. Dec 1982. 344 pages. Report: AIDPN-AAL-964. Abstract: Yemen is by far the most fertile country on the Arabian Peninsula, yet agriculture remains an arduous undertaking. This report assesses the Yemeni agricultural sector and examines constraints to and opportunities for agricultural development in Yemen. The report discusses the social milieu, the economy, agricultural institutions, agricultural education and training, horticulture, dry land agriculture and irrigated field crops, livestock and poultry, irrigation, fisheries, forestry, farm systems, and agricultural marketing. Database: NTIS Database (National Technical Information Service). NTIS: PB85-135150. OCLC: 47202472.

Holden, Alan and Kerr, Helen M. 1997. "A Subsurface Lithostratigraphic Division of the Hauterivian to Aptian, Furt (Informal) and Qishn Formations, Yemen." Mar. Pet. Geol. 9. Volume 14, Issue 6, Pages 631-642. Descriptors: Yemen; stratigraphy; Furt; Qishn. Abstract: The Mesozoic basins of Yemen have a multiphase history of rift development. Sediments of the 'Furt Formation' were deposited as a result of a second, discrete phase of rift activity during the Hauterivian to Barremian and unconformably overlies older deposits (A. C. Ellis, H. M. Kerr, C. P. Cornwell and D. O. Williams, 1996, *Petroleum Geoscience*2, 29-42). The name is taken from the suggested type well, AI Furt-1, where the unit reached its maximum drilled thickness to date, in the Jeza-Howarime Basin. The lithology in the type well predominantly comprises calcareous mudstones with subordinate carbonates. In western Yemen and more marginal settings, the 'Furt Formation' is dominated by arenaceous facies. Biostratigraphic analysis suggests that the upper and lower limits of the 'Furt Formation' are bounded by stratigraphic breaks. Regional seismic lines suggest and biostratigraphy confirms the extension of the 'Furt Formation' into basin margin areas and other rift basins, supporting the case for regarding the Furt section as a formation in its own right. The Qishn Formation has been divided on a tripartite basis. The oldest units are the 'Clastic' and 'Lower Carbonate Members' which are lateral facies and age equivalents. The 'Clastic Member' is found in the west of Yemen while the 'Lower Carbonate Member' is best developed in the east. The transition between the two is seen in the Jeza-Howarime Basin. The middle unit, the 'Shale Member', is a regionally extensive mudstone facies thought to relate to a maximum flooding event. The youngest unit, the 'Carbonate Member', comprises a limestone sequence. The Qishn Formation is unconformably overlain by the clastics of the Harshiyat Formation and in the extreme east of the Yemen by the carbonates of the Fartaq Formation. The Qishn Formation represents a transition from a rift to a post rift-phase. ISSN: 0264-8172.

Honjo, Susumu and Weller, RA. 1997. "Monsoon Winds and Carbon Cycles in the Arabian Sea: One of the most Significant Natural Phenomena that Influences the Everyday Life of More than 60 Percent of the World's Population." *Oceanus*. Volume 40, Issue 2, Descriptors: Carbon cycle; Carbon cycle in ocean; Coastal waters; Downwelling; Ekman transport; Jet

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stream-monsoon relationships; Monsoon winds; Monsoons; Ocean-atmosphere system; Sea breezes; Storms; Surface pressure; Upwelling; Article Geographic Terms: Asia, Arabian Peninsula; Arabian Sea; India; Indian Ocean; Oman; Pakistan; Somalia; Yemen. Abstract: The monsoon, a giant sea breeze between the Asian massif and the Indian Ocean, is one of the most significant natural phenomena that influences the everyday life of more than 60 percent of the world's population. In summer, heating of the land produces a region of intense low surface pressure over northwestern India, Pakistan, and northern Arabia. A broad region of southwesterly winds develops, quite different from the northeast trades found in the other oceans at the same latitudes. The elevated east African coastline intensifies the wind near the surface and directs it parallel to the coasts of Somalia, Yemen, and Oman. This strong flow, the Findlater Jet, is remarkable for its steadiness of direction and its strength, which can exceed 36 knots in July. The offshore Ekman transport that results gives rise to intense upwelling along the coast, where cold, nutrient-rich water is brought up to the surface, and to convergence and downwelling in the central and eastern part of the Arabian Sea. Database: Meteorological & Geostrophysical Abstracts. ISSN: 0029-8182.

Hovden, Eirik; Jami`at Bir Zayt; Norske universitetsred; Universitetet i Bergen and Senter for utviklingsstudier. 2007. Rainwater Harvesting Cisterns and Local Water Management: A Qualitative geographical/socio-Anthropological Case Study and Ethnographic Description from the Districts of Hajja, Mabyan and Shiris, Governorate of Hajja, Yemen. Bergen: BRIC. Page(s): 177. Descriptors: Water resources development -- Yemen; (Republic); Water-supply -- Yemen (Republic); Cisterns -- Yemen (Republic); Thesis/dissertation. Notes: xiii; ill., maps; 25 cm. Dissertation: Author's thesis--University of Bergen, [2007]. Note(s): On cover: Birzeit University, NUFU, and Bergen University. Includes bibliographic references (p. 173-177). Responsibility: Eirik Hovden. ISBN: 8274530411; 9788274530416. LCCN: 2010-453022. OCLC Accession Number: 658120192.

Howard, Prof. Michael. 1965. "Federation of South Arabia." Royal United Services Institute for Defence Studies Journal. February 1965. Volume Vol. 110, Issue No. 637, Pages 112-120. ISSN: 0307-1847.

Huber, BA and Van Harten, A. 2001. "Ninetis Subtilissima (Araneae: Pholcidae): Redescription and SEM ultrastructure." Am. Mus. Novit. American Museum of Natural History: Jun. Volume 336, Issue 1, Pages 1-8. Descriptors: Morphology; Ninetis subtilissima; Pholcidae; Spiders; Yemen; Araneae. Abstract: Ninetis subtilissima Simon, 1890 is redescribed and some data on SEM (Scanning Electron Microscope) ultrastructure are presented based on specimens collected near the type locality in Yemen. Database: BioOne Abstracts and Indexes. ISSN: 0003-0082. URL: http://www.uni-bonn.de/~bhuber1/PDFs/ninetis_subtilissima_2001.pdf.

Huchon, Philippe and Khanbari, Khaled. 2003. "Rotation of the Syn-Rift Stress Field of the Northern Gulf of Aden Margin, Yemen." Tectonophysics. 4/10. Volume 364, Issue 3-4, Pages 147-166. Descriptors: Continental extension; Rift propagation; Strain localization; Yemen; Gulf of Aden. Abstract: Remote sensing and field studies of several extensional basins along the northern margin of the Gulf of Aden in Yemen show that Oligocene–Miocene syn-rift extension trends N20°E on average, in agreement with the E–W to N120°E strike of main rift-related normal faults, but oblique to the main trend of the Gulf (N70°E). These faults show a systematic reactivation under a 160°E extensional stress that we interpret also as syn-rift. The occurrence of these two successive phases of extension over more than 1000 km along the continental margin suggests a common origin linked to the rifting process. After discussing other possible mechanisms such as a change in plate motion, far-field effects of Arabia–Eurasia collision, and

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stress rotations in transfer zones, we present a working hypothesis that relates the 160°E extension to the westward propagation since about 20 Ma of the N70°E-trending, obliquely spreading, Gulf of Aden oceanic rift. The late 160°E extension, perpendicular to the direction of rift propagation, could result from crack-induced extension associated with the strain localization that characterises the rift-to-drift transition. ISSN: 0040-1951.

Hudes, Karen. 1999. "Groundwater Management in Yemen: Legal and Regulatory Issues." World Bank. Volume: Number 456, Chapter 9, page(s): 133-136. World Bank Technical Paper No. 456. Abstract: "Water is becoming an increasingly scarce resource for most of the world's citizens. The current trends indicate that the overall situation is likely to deteriorate further, at least for the next decade, unless the water profession eschews 'business as usual' practices, which can only allow incremental changes to occur." Groundwater is the least understood and least appreciated, yet the most important, natural resource available to mankind. Groundwater represents about 97% of the existing fresh water resources, excluding the resources locked in polar ice. More than one and a half billion people in the urban parts of the world today depend on groundwater. Groundwater supply is more reliable than the seasonal, and sometimes erratic, surface water and provides the main line of defense against drought. Moreover, the quality of groundwater is, by and large, superior to surface water and cheaper to develop. However, when available, data on groundwater is very scanty. As a result, the World Bank is now paying increasing attention to this valuable resource, through both operations and sector work. This publication represents the proceeding of the seminar "Groundwater: Legal and Policy Perspectives" that was organized by the Legal Vice Presidency of the World Bank. It explains some basic technical aspects of groundwater, surveys the regulatory framework for it, and discusses the World Bank experience and international law regarding this precious resource. It is a timely publication and should also assist in a better understanding and appreciation of this valuable source. It will be of interest to Bank staff, borrowing country officials, international agencies and research organizations working on groundwater. ISSN: 08213-4613X. Database: Google Books. URL:

http://books.google.com/books?id=zSqJoro0jVIC&pg=PA133&dq=yemen&lr=&as_drrb_is=b&as_minm_is=0&as_miny_is=1990&as_maxm_is=0&as_maxy_is=2010&num=100&as_brr=1&as_pt=BOOKS&ei=ApNDS436JaG4NNb_008H&cd=3#v=onepage&q=yemen&f=false.

1969. Hudson, Maj L. E. "Aden." Marine Corps Gazette. October 1969. Volume 53, Issue No. 10, Pages 33-38. ISSN: 0025-3170.

Human Rights Watch (Organization). 2009. Hostile Shores Abuse and Refoulement of Asylum Seekers and Refugees in Yemen. New York, NY: Human Rights Watch. December 20, 2009, page(s): 1 online resource (52 p.). Descriptors: Political refugees -- Yemen (Republic); Political refugees -- Abuse of -- Yemen (Republic); Political refugees -- Somalia; Political refugees -- Ethiopia; Asylum, Right of -- Yemen (Republic); Refoulement -- Yemen (Republic). Abstract: "Since 2008 more than 100,000 mainly Somali and Ethiopian asylum seekers and migrants have arrived on Yemen's shores by boat. Many suffer horribly along the way. The smugglers who carry them cram their passengers into overcrowded boats and savagely beat those who try to move. Smugglers have murdered passengers and have often forced them to disembark in deep water and swim to shore, leading to many deaths from drowning. More than 1,000 people have died making the crossing in the past two years. After arriving in Yemen the exhausted travelers face one of two very different receptions, depending not on why they have come but on where they come from. Those from Somalia are welcomed as refugees without exception. But the majority of those from Ethiopia are treated like criminals to be hunted down

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and deported, even if they came to Yemen in search of asylum. The government compels them to run a gauntlet of obstacles before they can apply for asylum. But even those Ethiopians who manage to get recognition as refugees from the United Nations High Commissioner for Refugees (UNHCR) still face discriminatory government policies that make their lives even harder and fuel racially motivated violence and harassment. Hostile Shores: Abuse and Refoulement of Asylum Seekers and Refugees in Yemen documents the abuse and discrimination that many asylum seekers suffer at every stage of their attempt to find refuge from persecution. Human Rights Watch calls upon the government of Yemen to end its discriminatory treatment of non-Somali asylum seekers. It also lays out necessary steps for UNHCR to develop a more effective strategy for pressing the Yemeni government to meet its international obligations.”--P. [4] of cover. Notes: Title from PDF title page (Human Rights Watch, viewed Dec. 22, 2009).

“December 2009”--Table of contents page. ISBN: 1564325814; 9781564325815. OCLC Accession Number: 492291554. URL: <http://www.hrw.org/node/87224/section/1>

The Human Settlements Situation in the Yemen Arab Republic: Country Profile. 1984. Baghdad: UN. Page(s): 114. Descriptors: Economic Statistics; Demographic Statistics; Statistical Data; Human Settlements; Housing; Households; Housing Statistics; Land; Water Supply; Sanitation; Electric Power; Transport; Communications; Health Services; Education; Building Materials; Construction Industry; Housing Finance; Economic Indicators; Environmental Indicators; Human Settlements Management; Yemen; Government publication; International government publication; Internet resource. Notes: xi; charts, graphs, maps, tables. Note(s): Misc. General Info: Distribution: General. OCLC Accession Number: 123397240.

Hunting Surveys, Ltd. (London, England). 1979. “People’s Democratic Republic of Yemen.” S.l: s.n. Ed of 1979. Descriptors: Yemen (Republic) -- Maps. Notes: Description: 1 map on 4 sheets: col. 78 x 107 cm. Map Info: Scale 1:500 000; Note(s): Map of Yemen (People’s Democratic Republic) showing international boundaries, transportation, water and vegetation features and populated places. Relief shown by contours and shading. Inset: Socotra. International spheroid. Responsibility: map compilation and cartography by Hunting Surveys Limited. OCLC: 220820188.

Husain, Tahir and Chaudhary, Junaid Rafi. 2008. “Human Health Risk Assessment due to Global Warming a A Case Study of the Gulf Countries.” Int. J. Environ. Res. Public Health. Molecular Diversity Preservation International: Matthauesstr 11. Dec. Volume 5, Issue 4, Pages 204-212. Descriptors: Air pollution forecasting; Climate and vegetation; Climatic change forecasting; Climatic change influences on water resources; Climatic changes; Climatic regions; Coastal zone; Deserts; Disease transmission; Ecosystem disturbance; Ecosystems; Emissions; Environmental impact; Environmental research; Global warming; Greenhouse effect; Greenhouse gases; Heat wave effects on health; Humidity; Intergovernmental Panel on Climate Change; Mortality; Mortality causes; Numerical simulations; Precipitation; Public health; Rainfall; Sea level; Stress; Temperature; Vegetation; Water resources; anthropogenic factors; terrestrial ecosystems; Article Geographic Terms: Bahrain; Oman; Qatar; United Arab Emirates; Yemen. Notes: TR: CS0941517. Abstract: Accelerated global warming is predicted by the Intergovernmental Panel on Climatic Change (IPCC) due to increasing anthropogenic greenhouse gas emissions. The climate changes are anticipated to have a long-term impact on human health, marine and terrestrial ecosystems, water resources and vegetation. Due to rising sea levels, low lying coastal regions will be flooded, farmlands will be threatened and scarcity of fresh water resources will be aggravated. This will in turn cause increased human suffering in different parts of the world. Spread of disease vectors will contribute towards high mortality,

along with the heat related deaths. Arid and hot climatic regions will face devastating effects risking survival of the fragile plant species, wild animals, and other desert ecosystems. The paper presents future changes in temperature, precipitation and humidity and their direct and indirect potential impacts on human health in the coastal regions of the Gulf countries including Yemen, Oman, United Arab Emirates, Qatar, and Bahrain. The analysis is based on the long-term changes in the values of temperature, precipitation and humidity as predicted by the global climatic simulation models under different scenarios of GHG emission levels. Monthly data on temperature, precipitation, and humidity were retrieved from IPCC databases for longitude 41.25ADGE to 61.875ADGE and latitude 9.278ADGN to 27.833ADGN. Using an average of 1970 to 2000 values as baseline, the changes in the humidity, temperature and precipitation were predicted for the period 2020 to 2050 and 2070 to 2099. Based on epidemiological studies on various diseases associated with the change in temperature, humidity and precipitation in arid and hot regions, empirical models were developed to assess human health risk in the Gulf region to predict elevated levels of diseases and mortality rates under different emission scenarios as developed by the IPCC. The preliminary assessment indicates increased mortality rates due to cardiovascular and respiratory illnesses, thermal stress, and increased frequency of infectious vector borne diseases in the region between 2070 and 2099. Database: Meteorological & Geostrophysical Abstracts. ISSN: 1661-7827.

Hurdeman, A. J. M. Breunese, J. N. Al-Asbahi, A. Lutgert, J. E. and Floris, F. J. T. 1989. Assessment of Halite-Cemented Reservoir Zones with a Combined geological/engineering Approach: A Case Study. San Antonio, TX: Publ by Soc of Petroleum Engineers of AIME. Volume: OMEGA, page(s): 335-343. Proceedings: SPE Annual Technical Conference and Exhibition 1989, October 8, 1989 - October 11. Conference: 1989. Descriptors: Oil Fields; Oil Well Logging; Oil Well Production; Oil Wells--Permeability; Petroleum Reservoir Engineering; Salts--Fused. Abstract: This case study of the Azal oil field in the Yemen Arab Republic describes the combination of geological and engineering techniques used to identify the presence and distribution of halite-cemented layers in a sandstone reservoir. Fluid flow to the wells in the Azal field, which is dominated by gas and water coning, can be strongly influenced by these halite-cemented layers. Detailed core analysis revealed halite zones in the oil column. The amount of halite was calculated by comparing the porosity after the core had been cleaned with chloroform with that after it had been cleaned with methanol. Multiple simulation runs, in which the spatial distribution, the dimensions and the vertical permeability were varied, resulted in a stochastic model that best matched the production history. OCLC: 27191581.

Hurdeman, A. J. M., Breunese, J. N., Al-Asbahl, A., Lutgert, J. E. and Floris, F. J. T. 1991. "Assessment of Halite-Cemented Reservoir Zones." JPT, Journal of Petroleum Technology. Volume 43, Issue 5, Pages 518-523. Descriptors: Oil Well Cementing; Oil Fields - Yemen; Oil Well Logging; Oil Wells - Computer Simulation; Petroleum Reservoir Engineering. Abstract: This paper describes the techniques used to identify the presence and distribution of halite-cemented layers in a sandstone reservoir. The distribution of these layers in the wells was found by matching the core data with two independent halite identifiers from the well logs. Numerical well models were used to assess the dimensions and spatial distribution of the halite-cemented layers. Multiple simulation runs in which the spatial distribution, the dimensions, and the vertical permeability were varied resulted in a stochastic model that best matched the production history. Gas and water coning are retarded by the halite-cemented layers if the perforations are properly located. ISSN: 0149-2136. URL: <http://www.onepetro.org/mslib/servlet/onepetroreview?id=00019603&soc=SPE>

Geology of Yemen

Hyankova, K. and Zenisova, Z. 1988. "Quality of Ground Waters in the People's Democratic Republic of Yemen on the Example of Wadi Markhah and Wadi Khawrah." *Acta Geologica et Geographica Universitatis Comenianae: Geologica*. [publisher unknown], Bratislava, Slovak Republic. Volume 44, Pages 177-185. Descriptors: Arabian Peninsula; Asia; ground water; hydrogeology; infiltration; interpretation; Southern Yemen; surveys; Wadi Khawrah; Wadi Markhah; water quality; Yemen. Notes: AGGCAC; References: 3; 2 plates, 1 table, sketch maps. Database: GeoRef. ISSN: 0567-7491.

Geology of Yemen

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ILACO. 1981. Rada integrated rural development project: Geology of the Nahiyah Rada. ILACO, Arnhem. 50 pages; 30 cm. + 5 bijl. In Dutch. OCLC: 67329887.

Inoue, Kento, Abe, Yukuo, Murakami, Masahide and Mori, Tadayasu. 2006. "Feasibility Study of Desalination Technology Utilizing the Temperature Difference between Seawater and Inland Atmosphere." *Desalination*. Volume 197, Issue 1-3, Pages 137-153. Descriptors: Desalination; Distillation; Heat pipes; Mathematical models; Pipelines; Temperature measurement; Water supply. Abstract: A new desalination technology named Desalination Pipeline is proposed. The Desalination Pipeline system enables simultaneously desalination and efficient transport of distilled water by applying the working principle of a heat pipe without its liquid recirculation function. The energy source for the operation of the Desalination Pipeline system is the temperature difference between seawater and inland atmosphere. A formulation for the model calculation of the Desalination Pipeline system is established and verified by a laboratory experiment. And then, an estimation of the production and the transportation rates of distilled water are performed on the basis of the existing environmental and climate data of two target regions, Sana'a, the capital of Republic of Yemen, and El-Quren in Hashemite Kingdom of Jordan. The estimation result indicates that the Desalination Pipeline system can supply distilled water through one year for some inland area about 100 km apart from the coastal area at a distilled water production rate of 3.2-35.0 L/min (about 10,000 m³/y) for a pipe with a diameter of 2 m, 19-205 L/min (about 60,000 m³/y) for a pipe with a diameter of 4 m. The latter nearly matches the flow rate through a small qanat 60-1500 L/min. 2006. ISSN: 0011-9164. URL: <http://dx.doi.org/10.1016/j.desal.2005.12.021>.

Integrated Regional Information Networks (IRIN). 2010. "Yemen: Capital city faces 2017 water crunch." United Nations Office for the Coordination of Humanitarian Affairs Humanitarian News and Analysis. Abstract: Yemen's capital, Sanaa, may run out of economically viable water supplies by 2017 as available groundwater is unable to keep pace with the needs of a fast-growing population, experts warn. "The water we are drilling around the capital is now down to the water which fell on earth 8,000 years ago," said Saleh al-Dubby, director of the World Bank-funded Sanaa Basin Water Management Project. Sanaa Basin groundwater levels have fallen sharply in recent decades, especially since the 1960s which saw the start of borehole drilling, a practice which was greatly expanded in the 1970s. Groundwater levels in the Sanaa Basin dropped from less than 30 metres below the surface in the early 1970s to more than 150 metres below the surface in 1995, according to al-Dubby. Experts estimate that groundwater levels are decreasing by up to 4-6 metres a year. Sanaa has 120 legal wells of which 80 are productive; 30 are deep wells. With an annual output from the Sanaa Basin of around 200 million cubic metres of water and an input of only 50 million cubic metres, a crisis is looming. To hit water, drills must bore 100-400 metres into the volcanic aquifer, and in places 300-500 metres into the sandstone aquifer, according to the Water Basin Project. In a few instances, oil rig drills have bored down to 1,000 metres to find water. Overall, the average drilling depth in Sanaa is estimated at 200-300 metres. "All this has happened in only 30 years," said al-Dubby. This exploitation of "fossil water" is causing great concern among experts. "This is a disaster. We are tapping into the last natural strategic resources," said Ashraf al-Eryani of the German Technical Cooperation. He said Yemen was the first place on earth to be doing this. URL: <http://www.irinnews.org/Report.aspx?ReportId=88522>.

Integrated Regional Information Networks (IRIN). 2009. "Yemen: Major new water source discovered in parched Hadhramaut." (June 25, 2009) United Nations Office for the

Geology of Yemen

Coordination of Humanitarian Affairs Humanitarian News and Analysis. Abstract: A water company in Hadhramaut Governorate, southern Yemen, has discovered an important new source of water near the provincial capital, Mukalla, after four months of exploration. "Using modern machinery, we have discovered a huge underground drinking water resource in Al-Ghaliyah on the outskirts of Mukalla," Awadh Al-Ganzal, head of the Local Corporation for Water Supply and Sanitation (LCWSS), told IRIN. "Our preliminary assessments regarding the newly discovered field have shown that it will provide Mukalla with potable water for the next 50 years... Water quality is great." "The field in Al-Ghaliyah consists of nine wells, each able to produce 30 litres a second. It will definitely supply the city with drinking water for decades to come," said Mahfood Obaid Bagwaigo, manager of the Mukalla Water Supply and Sanitation company. "Engineers struck water in sandstone at a depth of 225-320 metres. They couldn't go beyond that because of the immense pressure of water in the reservoir," he added. URL: <http://www.irinnews.org/Report.aspx?ReportId=84999>.

International Development Association. 1978. Development Credit Agreement (Water Supply Engineering and Technical Assistance Project) between People's Democratic Republic of Yemen and International Development Association. Uniform Title: Treaties, etc. Yemen (People's Democratic Republic). July 14, 1978. Washington, D.C: International Development Association. Descriptors: Loans, Foreign -- Yemen (People's Democratic Republic); Debts, External -- Yemen (People's Democratic Republic); Economic assistance -- Yemen (People's Democratic Republic); Technical assistance -- Yemen (People's Democratic Republic); Water-supply engineering -- Yemen (People's Democratic Republic) -- Finance; International Development Association -- Finance; Government publication; International government publication. Notes: 10 p. 27 cm. Note(s): "Conformed copy"--Cover. Cover title. Other Titles: Water supply engineering and technical assistance project. OCLC: 45863898.

International Development Association. 1977. Project Agreement (Sana'a Second Water Supply and Sewerage Project) between International Development Association and National Water and Sewerage Authority. Washington, D.C: International Development Association. Descriptors: Loans, Foreign -- Yemen, North; Water-supply -- Yemen, North -- San`a -- Finance; Sewerage -- Yemen, North -- San`a -- Finance; International Development Association -- Finance; Yemen Arab Republic National Water and Sewerage Authority -- Finance; Government publication; International government publication. Notes: 24 pages; 28 cm. Note(s): Title from cover. "Credit number 670 YAR." "Dated January 14, 1977." "Conformed copy." OCLC: 70830353.

International Development Association. 1977. Development Credit Agreement (Sana'a Second Water Supply and Sewerage Project) between Yemen Arab Republic and International Development Association. Uniform Title: Treaties, etc. Yemen, 1977 Jan. 14. Washington, D.C: International Development Association. Descriptors: Loans, Foreign -- Yemen (Republic); Economic assistance -- Yemen (Republic); Water-supply -- Yemen (Republic) -- Finance; Sewerage -- Yemen (Republic) -- Finance; International Development Association -- Finance; Government publication; International government publication. Notes: 23 p. 28 cm. Note(s): "Conformed copy"--Cover. Cover title. OCLC: 53009913.

International Development Association. 1975. Project Agreement (Hodeida Water Supply and Sewerage Project) between International Development Association and National Water and Sewerage Authority. Washington, D.C: International Development Association. Descriptors: Loans, Foreign -- Yemen (Republic); Water-supply -- Yemen (Republic) -- Hudaydah -- Finance; Sewerage -- Yemen (Republic) -- Hudaydah -- Finance; International Development

Geology of Yemen

Association -- Finance; Yemen Arab Republic National Water and Sewerage Authority -- Finance; Government publication; International government publication. Notes: 13 pages; 27 cm. Note(s): "Credit number 559 YAR." "Dated June 20, 1975." "Conformed copy." OCLC: 70705853.

International Development Association. 1975. Development Credit Agreement (Hodeida Water Supply and Sewerage Project) between Yemen Arab Republic and International Development Association. Uniform Title: Treaties, etc. Yemen, 1975 June 20. Washington, D.C: International Development Association. Descriptors: Loans, Foreign -- Yemen (Republic); Economic assistance -- Yemen (Republic); Water-supply -- Finance -- Yemen (Republic); Sewerage -- Finance -- Yemen (Republic); International Development Association -- Finance; Government publication; International government publication. Notes: 15 pages; 27 cm. Note(s): "Conformed copy." Other Titles: Hodeida water supply and sewerage project. OCLC Accession Number: 53072166.

International Development Association. 1974. Project Agreement (Sana'a Water Supply Project) between International Development Association and National Water and Sewerage Authority. Washington, D.C: International Development Association. Descriptors: Loans, Foreign -- Yemen, North; Water-supply -- Yemen, North -- Finance; International Development Association -- Finance; Yemen Arab Republic National Water and Sewerage Authority -- Finance; Government publication; International government publication. Notes: 14 pages; 27 cm. Note(s): "Credit number 464 YAR." "Dated March 4, 1974." "Conformed copy." Other Titles: "Sana'a Water supply Project." OCLC: 70699521.

International Development Association. 1974. Development Credit Agreement (Sana'a Water Supply Project) between Yemen Arab Republic and International Development Association. Uniform Title: Treaties, etc. Yemen, Mar. 4, 1974. Washington, D.C: International Development Association. Descriptors: Loans, Foreign -- Yemen (Republic); Economic assistance -- Yemen (Republic); Water-supply -- Yemen (Republic) -- San`a -- Finance; Agricultural credit; International Development Association -- Finance; Government publication; International government publication. Notes: 15 pages; 28 cm. Note(s): "Conformed copy." OCLC: 52966854.

Issa A. M. Al_Kahtani; Suhaib Y.K. Al-Darzi. 2007. "Old and Modern Construction Materials in Yemen: The Effect in Building Construction In Sana'a." *Journal of Social Sciences*. Volume 3(3), pages 138-142. Keywords: Building material; concrete block; Yemen architecture. Abstract: Sana'a city in Yemen is one of the oldest cities in the worlds, which has different forms of building built with different types of materials. In the present work, the old and new forms of buildingconstruction and the building materials used in Sana'a, the sources available for the new material, the effects of new material usage on building forms are all presented with the advantages and disadvantagesof each material. The old shapes of buildings in Yemen and the classical and modern forms ofconstruction using different types of materials are considered in the study. Survey is used to investigate the building forms and material types in Sana'a. Several conclusions are submitted showing that, the new building material, such as concrete block, is preferred in building comparing with old material, such as stone, which makes it the best choice for the low income people but sometimes the limited resources make old material the only available choice. Several steps needed to develop and encourage the use of new building materials are recommended. ISSN: 1549-3652.

Italconsult, World Health Organization and the United Nations Development Programme. 1994. "Hodeida Water Supply: Master Plan." Rome: Italconsult. Descriptors: Water-supply --

Geology of Yemen

Yemen (Republic) -- Sana`a; Water-supply -- Yemen (Republic) -- Hudayadah; San`a (Yemen) -
- Maps; Hudaydah (Yemen) -- Maps; Atlas (atl). Notes: Description: 3 v.: ill., maps; 42 x 62 cm.
Other Titles: At head of title: Sana`a and Hodeida water supply project. Responsibility: prepared
for the World Health Organisation as executing agency for the United Nations Development
Programme by Italconsult. Abstract: v. 1 Master plan, report -- v. 2 Master plan, annexes -- v. 3
Master plan, drawings. OCLC Accession Number: 32184537.

Italconsult; Yemen; World Health Organization and United Nations Development
Programme. 1973. Hodeida Water Supply: Preliminary Engineering and Feasibility Studies:
Interim Report. Rome: Italconsult. Page(s): 25. Descriptors: Water-supply -- Yemen (Republic) -
- Sana`a; Water-supply -- Yemen (Republic) -- Hudayadah; San`a (Yemen); Hudaydah (Yemen);
Sana` (Yemen); Al Hudaydah (Yemen). Notes: folded plan; 29 cm. Note(s): At head of title:
Sana`a and Hodeida water supply project. "UNDP: YEM 507." "WHO: Yemen 3202."
Responsibility: prepared for the World Health Organization as executing agency for the United
Nations Development Programme by Italconsult. OCLC Accession Number: 42998146.

Italconsult and World Health Organization. *Water supply for Sana'a and Hodeida*. Rome:
Italconsult, 1973. Prepared for the World Health Organization as executing agency for the
United Nations Development Programme by Italconsult. (reference contained within Shaaban
and AlEryant, 1982). Description: iv, 138 pages: ill, maps; 30cm. OCLC: 704165720.

Geology of Yemen

J

Jancloes, M. 1998. "The Poorest First: WHO's Activities to Help the People in Greatest Need." World Health Forum. Volume 19, Issue 2, Pages 182-187. Notes: Cited By (since 1996): 1. Abstract: Through its Division of Intensified Cooperation with Countries and Peoples in Greatest Need, WHO is giving special attention to the relationship between poverty and ill-health. The work of the Division is outlined in the present article. Poverty is the main reason why babies are not vaccinated, clean water and sanitation are not provided, curative drugs and other treatments are not available, and mothers die in childbirth. It is the main cause of low life expectancy, handicap, disability, and starvation, and a major factor in mental illness, stress, suicide, family disintegration, and substance abuse. Poverty is spreading, just as the gap between rich and poor is growing in both developed and developing countries. In 1989, the World Health Assembly asked the World Health Organization (WHO) to pay attention to the special needs of the most poor countries, a request which led to the development and launching of the Intensified Cooperation with Countries and Peoples in Greatest Need initiative. The goals of the initiative are to enable poor countries to develop public policies and implement strategies for improving the health status of their populations, to promote innovative intersectoral action, and to make the best possible use of international cooperation in health matters. The main task has been to develop and implement community-based strategies for primary care in approximately 30 countries. In-country actions are described for Angola, Bangladesh, Bolivia, Burkina Faso, China, Guatemala, Guinea-Bissau, Moldova, Myanmar, Vietnam, and Yemen. Lessons learned are presented and future requirements considered. Database: SCOPUS. ISSN: 0251-2432.

Johnston, Charles Hepburn. 1964. The View from Steamer Point: Being an Account of Three Years in Aden. London: Collins. Notes: 224 p. illus., map (on lining papers) ports. 22 cm. OCLC Accession Number: 5716675.

Joint Publications Research Service Arlington VA. 1990. "JPRS Report, Near East & South Asia." 28 Sep. Page(s): 86 Report Number: JPRS-NEA-90-054 XJ-XD Monitor Series: XD. Abstract: This report contains information concerning the military, international relations, civil affairs, and international politics pertaining to the following Near East and South Asian countries: (1) Jordan, (2) Egypt, (3) Iraq, (4) Israel, (5) Lebanon, (6) Republic of Yemen, (7) Kuwait, (8) Morocco, (9) Iran, (10) Saudi Arabia, (11) Sudan, and (12) Tunisia Abstract Classification: Unclassified Technical Reports Collection. OCLC Accession Number: ADA344045. URL: <http://handle.dtic.mil/100.2/ADA344045>.

Joint Publications Research Service, Arlington, VA. 1986. "Near East/South Asia Report, People's Democratic Republic of Yemen Labor Unions: Report of Central Committee to 5th General Congress." 24 Dec. Page(s): 73 Report Number: JPRS-NEA-86-153 XX-FBIS Monitor Series: FBIS. Size: 5 MB. DTIC Accession Number: ADA369575. URL: <http://handle.dtic.mil/100.2/ADA369575>.

Joint Publications Research Service, Arlington, VA. 1986. "Near East/South Asia Report." 02 Apr. Page(s): 80 Report Number: JPRS-NEA-86-042 XJ-XD Monitor Series: XD. Abstract: This Near East/South Asia report concerns the following countries: (1) Egypt, (2) Morocco, (3) Tunisia, (4) Israel, (5) Lebanon, (6) Bangladesh, (7) United Arab Emirates, (8) Yemen, (9) Afghanistan, and (10) Iran. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: View Full Text (pdf); File: /U2/a351239.pdf; Size: 4 MB. OCLC Accession Number: ADA351239. URL: <http://handle.dtic.mil/100.2/ADA351239>.

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Joint Publications Research Service, Arlington, VA. 1986. "Near East/South Asia Report." 05 Feb. Page(s): 128 Report Number: JPRS-NEA-86-015 XJ-XD Monitor Series: XD. Abstract: This Near East/South Asia report contains articles on Egypt, Tunisia, Bahrain, Israel, Lebanon, Syria, PDR Yemen, Afghanistan, Iran, and Pakistan. The articles in this report deals with International Affairs, Regional Affairs, Armenian Affairs, Palestinian Affairs, Politics and Economics. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: 7 MB. DTIC Accession Number: ADA337323. URL: <http://handle.dtic.mil/100.2/ADA337323>.

Joint Publications Research Service Arlington, VA. 1985. "Near East/South Asia Report." 25 Jun. Page(s): 256 Report Number: JPRS-NEA-85-084 XJ-XD Monitor Series: XD. Abstract: Partial Contents: International Affairs, Gulf Cooperation, Industrial Development, Cultural Cooperation, Blood Revenge, Drought, Water Resources, Military Intelligence, People's Democratic Republic of Yemen, Car Crash Kills, Dam Statistics, Reconstruction and Development. Abstract Classification: Unclassified Technical Reports Collection. Full Text (pdf) Availability: 14 MB. DTIC Accession Number: ADA350291. URL: <http://handle.dtic.mil/100.2/ADA350291>.

Joint Publications Research Service Arlington VA. 1982. "Near East/North Africa Report, no. 2617." 09 Sep. Page(s): 201 Report Number: JPRS-81728 XJ-XD Monitor Series: XD. Abstract: Partial Contents: Yemen Arab Republic - Interview With Chairman of Federal Reserve Bank. Abstract Classification: Unclassified Technical Reports Collection. File: 9 MB. DTIC Accession Number: ADA353281. URL: <http://handle.dtic.mil/100.2/ADA353281>.

Joint Publications Research Service Arlington VA. 1978. "Translations on Near East and North Africa, Number 1829. Focus on Political Violence in the Yemens." 11 Aug. Page(s): 105 Report Number: JPRS-71671 XJ-XD Monitor Series: XD. Notes: Full Text (pdf) Availability: File: 5 MB. DTIC: ADA375643. URL: <http://handle.dtic.mil/100.2/ADA375643>.

Jones, E. E., Kim-Farley, R. J. and Algunaid, M. 1985. "Diphtheria: A Possible Foodborne Outbreak in Hodeida, Yemen Arab Republic." BULL. WHO. Volume 63, Issue 2, Pages 287-293. Notes: Cited By (since 1996): 9. Abstract: Between 29 August 1981 and 16 January 1982, an epidemic of diphtheria produced 149 cases in Hodeida, Yemen Arab Republic. The overall attack rate was 11.8 per 10 000; the most frequent victims were males under 5 years of age, with an attack rate of 55.7 per 10 000. Severity of the illness varied inversely with age and the number of previous doses of DPT. A case-control study showed that vaccination with DPT was protective ($P = 0.03$) with an efficacy of 87.3% (95% confidence interval, 32.2-99.5%) among those who had received 3 or more doses. Risk factors for the development of disease were previous contact with a case ($P = 0.002$), previous contact with a person having skin disease ($P = 0.04$), obtaining drinking-water from a wheeled carrier ($P = 0.008$), and consumption of factory-made yoghurt ($P = 0.003$). The secondary attack among household contacts under 15 years of age was at least 1.3%. Database: SCOPUS. ISSN: 0042-9686.

Jong, RL. 1989. "Water Resources of GCC: International Aspects." Journal of Water Resources Planning and Management (ASCE) JWRMD5 Vol.115. No. 4, p 503-510. July 1989. Pages 9 ref. Descriptors: Arabian Peninsula; International agreements; Water resources; Water resources development; Gulf Cooperation Council; Interbasin transfers; Aquifers; Kuwait; Saudi Arabia; United Arab Emirates; Oman; Bahrain; Yemen; Iraq; Qatar; Shared resources. Abstract: Rapid economic development in the member states of the Gulf Cooperation Council (GCC) has led to major hydrologic stresses being laid on the aquifers underlying most of the Arabian Peninsula. These aquifers presently constitute the major local resource and, to a significant

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degree, they are shared across international boundaries. Several cases exist in which water issues have an international dimension. Countries involved in these cases are Kuwait and Saudi Arabia, United Arab Emirates and Oman, Bahrain and Saudi Arabia, Saudi Arabia and Oman, Kuwait and Iraq, Saudi Arabia and Qatar, and Yemen and Saudi Arabia. In addition, some water issues relate to all the Persian Gulf states. The 'Basic Law' of the GCC provides necessary and sufficient rules for the creation of an international framework to manage these shared groundwater resources. Database: Water Resources Abstracts. ISSN: 0733-9496.

Jonsson, Caroline, Loring, John, Persson, Per and Sjoberg, Staffan. 2007. "Modeling Glyphosate and Metal-Glyphosate Speciation at Solution-Mineral Interfaces; Abstracts of the 17th Annual V. M. Goldschmidt Conference." *Geochim. Cosmochim. Acta*. Aug. Volume 71, Issue 15S, Pages A449. Descriptors: Aden Yemen; adsorption; aqueous solutions; Arabian Peninsula; Asia; cadmium; chemical fractionation; chemical reactions; complexing; EXAFS data; experimental studies; FTIR spectra; geochemistry; glyphosate; goethite; herbicides; hydrochemistry; infrared spectra; manganite; metals; mineral-water interface; models; organic phosphorus; organo-metallics; oxides; pesticides; phosphorus; pollutants; pollution; spectra; stoichiometry; X-ray photoelectron spectra; Yemen. Notes: GCACAK; Accessed on Jan. 2, 2008. Database: GeoRef. ISSN: 0016-7037.

Jungfer, E. 2000. Water Resources Management for Village Water Supplies in Al-Mahwit Province, Yemen Arab Republic. Database: COS Conference Papers Index. URL: <http://search.proquest.com/docview/40805817?accountid=12084>.

Jungfer, Eckhardt V. 1987. Zur Frage Der Grundwasserneubildung in Trockenraeumen: Fallstudien Aus Der Arabischen Republik Jemen Und Dem Koenigreich Marokko. Translated title: "On the issue of groundwater recharge in arid evacuate: Case Studies From The Yemen Arab Republic and the Kingdom of Morocco." Federal Republic of Germany. Palm und Enke in Komm., Erlangen, Federal Republic of Germany. Erlanger Geographische Arbeiten.Sonderband. Volume: 18, Language: German. Descriptors: absolute age; Africa; aquifers; Arabian Peninsula; arid environment; Asia; basin range structure; case studies; climate effects; geomorphology; ground water; hydrodynamics; hydrogeology; influence; isotope geochemistry; Morocco; North Africa; petrography; recharge; terrestrial environment; theses; water; Yemen. References: 10 pages; ill., graph. darst. 5 beil. in rueckentasche. ISBN: 3920405668. Database: GeoRef in Process. OCLC: 30363918.

Jürgen D. Garbrecht and Guenther K. H. Garbrecht. 2004. Siltation Behind Dams in Antiquity. ASCE. Water Resources and Environmental History. Page(s): 35-43. Descriptors: Dams; History; Silts; Middle East. Abstract: The siltation behind dams in antiquity and measures to extend the operational life of reservoirs is illustrated for the Marib and Kebar dams in Yemen and Iran, respectively. For both dams siltation played a major role. The Marib dam impounded floodwaters to enable irrigation of downstream oases. Over several centuries, silts entrained in the irrigation water accumulated on the irrigated fields up to 15 m high, and the dam was raised to compensate for the loss of slope and conveyance due to the sedimentation. The Kebar dam was an arch dam designed as a small storage reservoir. In addition to small operational openings for irrigation water withdrawals, large openings on the upstream side of the dam were probably used during construction to pass the water of the river, but may also have been used for periodical flushing of accumulated sediments. Both examples show that the engineers of the time were keenly aware of reservoir siltation problems and were able to successfully extend the operational lifetime of the reservoirs by structural enhancements and probable sediment flushing. Notes: Water resources and environmental history

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(proceedings of conference June 27-July 1, 2004, Salt Lake City, Utah; sponsored by Environmental and Water Resources Institute (EWRI) of ASCE, EWRI National History & Heritage Committee, Utah Section of ASCE, and West Consultants, Inc.). ISBN: 0-7844-0738-X. Database: ASCE.

Geology of Yemen

K

Karim, Fareed M. A. "Road Traffic Accidents in Yemen." *International Journal of Injury Control and Safety Promotion*. Taylor & Francis: Volume 15, Issue 3, Pages 165-166.

Descriptors: Awareness; Economic impacts; Highway safety; Traffic accidents. Notes: References; Tables (2). Abstract: Highway accidents are responsible for an estimated 1.2 million deaths and as many as 50 million injuries across the world annually. Some factors contributing to highway accidents in Yemen are increasing urbanization and changes in social habits and standards of living. The author describes highway accident scenarios in Yemen, including trends and economic costs. The author concludes that for change in the Yemeni road safety scenario to occur, serious steps must be taken to create awareness about highway accidents and the impacts on society. Database: TRIS. ISSN: 1745-7300.

Karrer, Cristina; Journalistin; Padrutt, Reto, et al. 1997. *Jemen - Der Letzte Tropfen Wasser*. Zurich: NZZ. Descriptors: Jemen (Suedwestasien). Republik Jemen Wasserknaptheit; Wassermangel (Wasserversorgung) Videoaufzeichnung (Dokumententyp) Yemen (South West Asia). Republic of Yemen (Asie Du Sud-Ouest). Republique du Yemen; Manque D'eau (Approvisionnement En Eau) Water Shortage (Water Supply); Videorecording. Notes: 1 Videokassette (ca. 36 Min.); Responsibility: Cristina Karrer, Reto Padrutt. OCLC: 637418632.

Kazgiprovodkhoz, Selkhozpromexport. 1983. *Scheme of the water and land resources development in the Hadhramaut valley*. Volumes I-IX. Kazgiprovodkhoz, Selkhozpromexport, USSR. Moscow-Aden.

Kearns, Jean Ruley. 1981. *Social Soundness Analysis for the CID Title XII Integrated Crops and Water Management Project: Yemen Arab Republic*. Descriptors: Agricultural assistance -- Yemen (Republic); Water -- Yemen (Republic) -- Distribution; Consortium of International Development. Integrated Crops and Water Management Project, Yemem Arab Republic. Notes: 33 leaves; 28 cm. Note(s): Includes bibliographical references (leaf 33). Responsibility: submitted by Jean Ruley Kearns. OCLC Accession Number: 10575752.

Kebsi, Alkhateeb and Chandrasekharam, D. 2000. *Saltwater Contamination in the Coastal Aquifer, Tihama Plain, Wadi Surdud, Yemen Republic*; *Groundwater 2000*; Proceedings of the International Conference on Groundwater Research. Netherlands: A. A. Balkema, Rotterdam, Netherlands. International Conference on Groundwater Research, Copenhagen. Denmark Conference: June 6-8, 2000. Descriptors: aquifers; Arabian Peninsula; Asia; Baid Formation; Cenozoic; coastal environment; coastal plains; finite difference analysis; geochemistry; ground water; hydrochemistry; models; monitoring; pollution; Quaternary; salt-water intrusion; three-dimensional models; Tihama Plain; Wadi Surdud; water quality; water supply; Yemen. References: 3. ISBN: 9058091333. Database: GeoRef. OCLC: 44911949.

Kemp, Anthony. 1994. "The SAS: Savage Wars of Peace, 1947 to the Present." London: John Murray. Page(s): 222. Notes: Great Britain. -- Army. -- Special Air Service Regiment -- History. 256 pages: ill. 22 cm. ISBN: 0141390816. OCLC Accession Number: 222928731.

Kemp, JM. 1998. "Zoogeography of the Coral Reef Fishes of the Socotra Archipelago." *J. Biogeogr. Sep*. Volume 25, Issue 5, Pages 919-933. Descriptors: Article Subject Terms: Biogeography; Community composition; Community structure; Coral reefs; Ecological distribution; Endemic species; Habitat selection; Reef fish; Species diversity; Sympatric populations; Article Taxonomic Terms: Pisces; Article Geographic Terms: Yemen, Socotra; Socotra; Marine. Abstract: Fish communities and habitats were studied at the Socotra archipelago (Gulf of Aden, approximately 12 degree N 54 degree E). Extensive and unexpected hermatypic coral communities were recorded, at the centre of a 2200 km gap in knowledge of species and habitat distributions which coincides with a change from a western Indian Ocean

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coral reef fauna to an Arabian one. The fish assemblage associated with the Socotra archipelago corals is predominantly south Arabian. An east African influence, minimal on the mainland coasts of Arabia, is more evident here, and results in previously unrecorded sympatry between Arabian endemic species and their Indian Ocean sister taxa. A study of distributions of Chaetodontidae (butterflyfishes) in the north-western Indian Ocean reveals a number of distinct patterns, with a trend for species replacement along a track from the northern Red Sea to the Indian Ocean. A major feature of the reef fish zoogeography of the region is found to be a distinct south Arabian area, characterized by a 'pseudo-high latitude effect' which results from seasonal cold water upwelling along the Arabian sea coasts of Yemen and Oman and the Indian Ocean coast of Somalia. This south Arabian feature is consistent across a wide range of fish families. It is most pronounced in Oman and Yemen, and although it is the dominant influence at Socotra it is slightly 'diluted' here by the east African influence. The south Arabian area wholly or partly accounts for most of the major marine zoogeographic features around Arabia, and is the principal feature fragmenting Arabian coastal fish assemblages, and separating them from those of the wider Indo-west Pacific. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0305-0270.

Kent, Adam J. R., Baker, Joel A. and Wiedenbeck, Michael. 2002. "Contamination and Melt Aggregation Processes in Continental Flood Basalts: Constraints from Melt Inclusions in Oligocene Basalts from Yemen." *Earth Planet. Sci. Lett.* 9/30. Volume 202, Issue 3-4, Pages 577-594. Descriptors: Yemen; flood basalts; melts; inclusions; magma contamination. Abstract: Melt inclusions from Oligocene continental flood basalts (CFB) erupted in Yemen provide unique insight into the timing and nature of the processes that lead to crustal contamination and melt aggregation in CFB magmas. Large variations in trace element indices that are sensitive to the degree and composition of assimilated crustal material (e.g. $K_2O=0.20-1.94$ wt%, $Ba=13-543$ ppm, $K/Nb=128-1603$, $Ba/Th=9-303$) are evident in many inclusions, even where these derive from the same host lava, and reflect the complexity of the processes that lead to contamination within individual CFB melting and melt-transport systems. The compositions of melt inclusions relate to differences in the degree of contamination, but in addition require that there is substantial heterogeneity in the composition of the contaminant material itself. Many inclusions also appear to contain more primitive melts than typical Yemen CFB lava compositions, and as such would be highly sensitive to addition of crustal materials. Overall melt inclusions provide a markedly better record of the diversity of melt compositions present within given CFB magma systems than the bulk compositions of erupted lavas. Highly contaminated melts (with K/Nb and Ba/Nb up to 957 and 22, respectively) trapped within forsterite-rich olivines (Fo_{85-90}) require very high rates of assimilation relative to crystal fractionation, with Ma/Mc values (the mass ratio of assimilated to crystallized material) $\gg 1$. Such rapid assimilation may reflect decoupling of heat and mass transfer at the margins of larger magma chambers, within feeder dyke complexes, or at other sites where primitive magma is juxtaposed against wall-rocks that are already heated to temperatures near, or above, their solidus. In addition, relatively little assimilation appears to have occurred after crystallization of the phases that host melt inclusions, consistent with a thermal link between assimilation and phenocryst formation. Melt inclusions also show trace element variations related to mantle source compositions and mantle melting processes. Two inclusions with unusually Sr-rich and rare earth element-poor compositions are similar to those recognized from Mauna Loa, Hawaii, and may be related to melting of recycled gabbroic material within the upwelling Afar plume. In addition, many melt inclusions with crustally contaminated compositions also show large variations in trace element

ratios that are essentially insensitive to crustal contamination (e.g. Zr/Y=2–10) but are fractionated during progressive partial melting within an upwelling mantle column. The presence of both mantle and crustal-derived trace element signatures in the same inclusions demonstrates that melt transport systems in Yemen CFB were capable of transporting compositionally distinct melt batches, without complete mixing, through the asthenospheric and lithospheric mantle until final mixing and aggregation (and contamination) within crustal magma reservoirs. Thus, regardless of contamination, the ultimate compositions of many CFB lavas may be determined by magma mixing within the crust, rather than representing primitive compositions derived directly from the mantle. ISSN: 0012-821X.

Khalid A. and Germany, IHP/OHP National Committee, Federal Republic of Germany. 1994. Groundwater Recharge Possibilities in Arid Regions; Case Study of Yemen; Proceedings; International Symposium on Water Resources Planning in a Changing World. Federal Republic of Germany Bundesanstalt fuer Gewaesserkunde, Koblenz, Federal Republic of Germany. International Symposium on Water Resources Planning in a Changing World, Karlsruhe. Federal Republic of Germany Conference: June 28-30, 1994. Descriptors: Arabian Peninsula; arid environment; Asia; case studies; ground water; Kohlan Formation; land subsidence; recharge; runoff; Tawilah Group; terrestrial environment; Yemen. Notes: References: 2; sketch maps. Database: GeoRef. OCLC Accession Number: 1995-050940.

Kharbāsh, Ṣalāḥ ‘Abd al-Wāsi’. 1996. “Jiyūljīyat Al-Yaman / ta’lif Ṣalāḥ ‘Abd Al-Wāsi’ Al-Kharbāsh, Muḥammad Ibrāhīm Al-Anba’awī.” Ṣan’ā: Markaz ‘Abbādī lil-Dirāsāt wa-al-Nashr, 1996. Descriptors: Geology; Yemen; Geology -- Yemen (Republic). Notes: 206 pages; ill. 24 cm. al-Ṭab’ah 1. Includes bibliographical references. URL: <http://oskicat.berkeley.edu:80/record=b15289540~S1>.

Khater, A. R. Coletto, Carmen; Huerga, Argimiro and Martinez Cortina, Luis. 2003. Intensive Groundwater use in the Middle East and North Africa; Intensive use of Groundwater; Challenges and Opportunities. Netherlands: A.A. Balkema Publishers, Lisse, Netherlands. Workshop on Intensively Exploited Aquifers, WINEX, Madrid. Spain Conference: Dec. 13-15, 2001. Descriptors: Africa; aquifer vulnerability; aquifers; Arabian Peninsula; Asia; Bahrain; Dammam Aquifer; decision-making; demand; fresh water; ground water; international cooperation; Iraq; Kuwait; legislation; Middle East; North Africa; Oman; pollution; Qatar; Saudi Arabia; Umm er Radhuma Aquifer; water management; water quality; water resources; water supply; water use; Yemen. Notes: References: 26; illus. incl. 6 tables. ISBN: 9058093905. OCLC: 51178996.

Khatri, Mishri Lal, Di Muccio, Trentina and Gramiccia, Marina. 2009. “Cutaneous Leishmaniasis in North-Western Yemen: A Clinicoepidemiologic Study and Leishmania Species Identification by Polymerase Chain reaction–restriction Fragment Length Polymorphism Analysis.” *J. Am. Acad. Dermatol.* 10. Volume 61, Issue 4, Pages e15-e21. Descriptors: Cutaneous leishmaniasis; *L. donovani*; *L. infantum*; *L. tropica*; Leishmania PCR-RFLP; North-Western Yemen. Abstract: Background Cutaneous leishmaniasis (CL) is widespread in Yemen, but not fully documented. Objective. ISSN: 0190-9622.

Khayrat, A. H., Al-Jarallah, M. I., Fazal-ur-Rehman, X. and Abu-Jarad, F. 2003. “Indoor Radon Survey in Dwellings of some Regions in Yemen.” *Radiat. Measur.* 6. Volume 36, Issue 1-6, Pages 449-451. Descriptors: Yemen; Indoor radon survey; Nuclear track detectors; Passive radon monitors. Abstract: Indoor radon survey in a total of 241 dwellings, distributed in some regions of Yemen was performed, using CR-39 based radon monitors. The objective of this radon survey is to get representative indoor radon data of three regions, namely Dhamar, Taiz

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and Hodeidah, situated at different altitudes above sea level. The radon concentrations varied from 3 to 270 Bqm⁻³ with an average of 42 Bqm⁻³. It was found that the average radon concentration in the surveyed areas increases with altitudes. The highest average radon concentration of 59 Bqm⁻³ was found in Dhamar city while the lowest average concentration of 8 Bqm⁻³ was found in Hodeidah city. ISSN: 1350-4487.

Kim, Abraham. 2008. *Healing Divided Nations: Achieving Peaceful Reunification*. United States -- New York: Columbia University. ProQuest Dissertations and Theses. Abstract: Reunification cases represent two sovereign states that share a common national identity with a mutual desire to integrate their countries into a single polity. Despite this sentiment for union, some states have failed to integrate, while others have successfully achieved it. The challenge in this analysis is to understand why this variance exists and what causes states to reunify peacefully. Peaceful reunification requires cooperation. Although states within reunification dyads often express the desire for political integration, structural, ideological, and international obstacles make this cooperation difficult to accomplish. To comprehend what factors will overcome these impediments, this analysis draws insights from the strategic bargaining, civil war termination and nationalism literature and proposes four necessary conditions required for peaceful reunification. These conditions include: (1) the presence of political-economic engagement between the two states; (2) the existence of a severe political crisis in one state that spills over into the reunification partner state; (3) a willingness by the stronger state to offer a power-sharing arrangement as a crisis management solution for the embattled state; and (4) the support of a credible international power to enforce reunification commitments and defend against potential outside spoilers. To evaluate these factors, this dissertation uses controlled comparison and process tracing to analyze the reunification efforts of four dyads across time East- West Germany, North-South Yemen, North-South Korea, and China-Taiwan. This dissertation ultimately aims to challenge three popular explanations for what causes peaceful reunification--ethno-nationalist approach; functionalist/neofunctionalist perspective; and collapsist argument--and offer a dynamic and balanced approach to understand why and how this critical but poorly grasped political event occurs. Notes: Columbia University; Ph.D. Database: ProQuest Dissertations & Theses (PQDT). OCLC: 444033776.

Kim, Min J. 2009. *Becoming One: A Comparative Study of National Unification in Vietnam, Yemen and Germany*. United States- District of Columbia: Government. ProQuest Dissertations and Theses. George Washington University. Abstract: The purpose of this research is to understand the dynamic processes of modern national unification cases in Vietnam (1976), Yemen (1990) and Germany (1990) in a qualitative manner within the framework of Amitai Etzioni's political integration theory. There has been little use of this theory in cases of inter-state unification despite its apparent applicability. This study assesses different factors (military force, utilitarian and identitive factors) that influence unification in order to understand which were most supportive of unification and which resulted in a consolidation unification in the early to intermediate stages. In order to answer the above questions, the thesis uses the level of integration as a dependent variable and the various methods of unification as independent variables. The dependent variables are measured as follows: whether unified states were able to protect its territory from potential violence and secessions and to what extent alienation emerged amongst its members. Based on an examination of the case studies, I found the most effective unification mechanism (utilitarian factors and military force) did not, however, necessarily lead to the most successful consolidated unified state. This implies that a successful and consolidated national unification process requires certain levels of identitive factors be shared between the

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two states. I argue that the most effective and successful factors for unification is a combination of identitive and utilitarian aspects: utilitarian factors are crucial for bringing a relatively quick, peaceful and comprehensive unification process while identitive factors are vital in order to help bind people together during tumultuous unification process. Database: ProQuest Dissertations & Theses (PQDT). OCLC: 457045895. URL: <http://cdm15036.contentdm.oclc.org/cgi-bin/showfile.exe?CISOROOT=/p15036coll3&CISOPTR=295&filename=296.pdf>

King, Gillian. 1964. *Imperial Outpost – Aden: It's Place in British Strategic Policy*. London: Oxford University Press. Page(s): 95. Abstract: Concentrating on British strategic policy in relation to Aden is King's slim work, its drawback being that it was written four years before the final act of withdrawal and so is an incomplete survey. Notes: Chatham House Essays series. vi, 93 pages; maps; 19 cm. OCLC Accession Number: 16739861.

King, Jack W., Jr., Terence R. Forbes, Abdul Elah Abu Ghanem. 1985. "Benchmark Soils of the Yemen Arab Republic." *World Benchmark Soils Report No. 1*. October 1985." Soil Management Support Services (SMSS) Soil Conservation Service U.S. Department of Agriculture. On cover: New York State College of Agriculture and Life Sciences, Cornell University, Dept. of Agronomy, [and] Soil Management Support Services (SMSS), Soil Conservation Service, U.S. Dept. of Agriculture, [and] Ministry of Agriculture, Yemen Arab Republic. Accompanied by a Yemen general soil map in pocket. v, 86 pages: ill.; 28 cm. Abstract: "Until present, only limited information was available on the soils of the Yemen Arab Republic. The few soil surveys that had been conducted previously were not sufficient or adequately correlated in a national or international system to serve development needs. They varied in degree of detail, and required complementary studies to respond to an increasing demand for soil resource information. This reduced their usefulness and restricted the transfer of technical knowledge from other areas in the world with similar ecological conditions. The original project involved the mapping of soils of the Yemen Arab Republic. The resulting soil survey is an important part of the data base for planning the development of agriculture and urban infra-structures in North Yemen. The survey will assist in locating areas of high potential where more detailed soil information would facilitate the introduction of new technology for agricultural production. The objective of the soil survey was to produce a generalized 1:500,000 scale soil map based on field observations, which were also extrapolated by interpretations of satellite and air-photo imagery. The map shows associations of subgroups as recognized by *Soil Taxonomy* (USDA, 1975). The project mapped those areas of Yemen west of longitude 45 degrees, 30 minutes. The survey area does not include islands in the Red Sea. For eighteen months, one soil surveyor with support equipment and personnel was stationed as a staff member of the Agronomy Department at Cornell in Yemen with operations based in Taizz. Field work included soil profile examination and mapping. Soil analyses were required to place the soils into *Soil Taxonomy* classification. Representative soil profiles were sampled, tested, and described throughout Yemen as part of this effort. The surveyor was assisted by Yemeni personnel, both professional and nonprofessional. Soil samples were analyzed by the FAO-assisted Agricultural Research Service at Aussefeire; some special, texture, and mineralogical analyses were performed at Ithaca. Three soil profiles were analyzed by the National Soil Survey Laboratory (USDA-SCS) at Lincoln, Nebraska. This report begins with a synopsis of soil-forming factors and the genesis and classification of the soils of North Yemen (Chapter 1). This is followed by a brief description of the field survey and laboratory methods (Chapter 2) and the soilmap legend (Chapter 3). Part of the legend information includes estimated total areas (km²) of each map unit, subgroup, and soil order. A complete soil map (1:500,000) is found in a pocket on the back

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cover. Chapter 4 provides information for soil interpretations and management considerations. Finally detailed descriptions of the most important benchmark soils are given in the Appendix. It is hoped that all this information will provide the reader with a clear picture of Yemeni soils, their environment and their use.” ISBN 0-932865-02-X. OCLC: 16736601.

King, W. A., Mills, B. R., Gardiner, S. and Abdillah, A. A. 2003. “The Masila Fields, Republic of Yemen; Giant Oil and Gas Fields of the Decade, 1990-1999.” AAPG Memoir. American Association of Petroleum Geologists, Tulsa, OK, United States: United States. Volume 78, Pages 275-295. Descriptors: Arabian Peninsula; Asia; giant fields; history; lithofacies; Masila Yemen; natural gas; oil and gas fields; petroleum; production; remote sensing; satellite methods; structural traps; traps; Yemen. References: 31; illus. incl. sects., geol. sketch maps. Abstract: Masila Block 14, located in the Hadramawt Region in the east-central Republic of Yemen, is operated by Canadian Nexen Petroleum Yemen (a subsidiary of Nexen) on behalf of its partners, Occidental Peninsula and Consolidated Contractors International. Oil was first discovered in late 1990, with commerciality declared in late 1991. Oil production began in July 1993. There are now 16 known fields containing 56 pools. At year-end 2000, total proven ultimate recoverable oil reserves are 891 million bbl. Proven, probable, and possible reserve estimates are approaching 1.2 billion bbl of recoverable oil. The Masila fields are associated with the Upper Jurassic to Lower Cretaceous Say’un-Masila rift graben basin. Almost 90% of the oil reserves discovered are in the Lower Cretaceous upper Qishn sandstones, Qishn Formation, Tawilah Group. Oil also is found in seven other reservoirs consisting of Lower Cretaceous and Middle to Upper Jurassic clastics and carbonates as well as fractured granitic basement. This chapter focuses on the main oil-producing reservoirs, which are the informally named upper Qishn sandstones of the formal Qishn Clastics Member, Qishn Formation, Tawilah Group. The upper Qishn sandstones represent a transgressive sequence from braided river deposits into tide-influenced shorelines, overlain by subtidal and shelf deposits. The upper Qishn sandstone reservoirs have high porosity (15-28%) and high permeability (< or =10 d). They are relatively homogeneous and continuous in the lower half of the formation and are more heterogeneous and discontinuous in the middle to upper sections. The uppermost marine sandstones are more homogeneous because they are texturally more mature. The major field accumulations are tilted, normal-fault block structures located over basement paleohighs and dependent on cross-fault juxtaposition against overlying Qishn Carbonates Member top seal. The carbonated-dominated pre-Qishn section, including the source rock, is not present on the paleohighs and is thickest in the basement lows. The main source rock is the Jurassic (Kimmeridgian) Madbi Shale, a Type II marine source that is mature in “kitchens” adjacent to the structural highs. Secondary oil migration occurred upward along fault planes to the overlying traps. At year-end 2000, 2087 km (1304 mi) of two-dimensional seismic and four three-dimensional (3-D) seismic programs totaling 422 km² (165 mi (super 2)) have been acquired in the confines of the current Masila Block 14 boundary. Seismic acquisition in the Masila Block has been challenging because of the remote location, rugged topography, and rocky desert terrain. The land surface is incised by deep wadis, or canyons. Processing and interpretation problems are significant because of a low-velocity surface layer, scattered seismic energy, poor signal-to-noise ratio from numerous canyon walls, and “fault-shadow” velocity anomalies overlying many of the tilted fault-block culminations. The biggest production challenge is water handling. Much water is produced along with the oil because of a combination of medium-gravity (15 degrees -33 degrees API) moderate-viscosity oil, high reservoir permeability, and a strong regional aquifer. The upper Qishn oil is undersaturated in gas (average gas-oil ratio is 3-7 scf/bbl), requiring electric

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submersible pumps to provide sufficient artificial lift for the large volumes of produced fluid. At the end of December 2000, the annualized daily production rate collectively for all fields was 230,000 BOPD, with 725,000 BWPD and 6.8 mmcf solution gas/day. Cumulative oil production is more than 500 million bbl. Initial average well oil-production rates vary by producing zone but range from 1500 to 20,000 BOPD, with a few wells producing from more than one reservoir zone by minor zone commingling. In the early production years, oil and water produced in the fields were transported via pipeline to the central processing facility (CPF), where most fluid separation occurred. More recently, the majority of the separation of oil and water is being performed at individual fields using field-based hydrocyclones before transporting the “clean” oil to the CPF for final processing. Produced water is reinjected into the reservoirs. The clean oil is transported to the southern coast via a 140-km (85-mi)-long, 61-cm (24-in.) pipeline over a 106-km (66-mi) distance. Export oil is then loaded onto tankers via a single buoy mooring systems located 3.2 km (2 mi) offshore east of the coastal village of Al Mukulla. Database: GeoRef. ISBN: 0891813594.

King, W. A., Mills, B. R., Gardiner, Scott and Abdellah, A. A. 2001. “The Masila Fields, Republic of Yemen; American Association of Petroleum Geologists 2001 Annual Meeting.” Annual Meeting Expanded Abstracts - American Association of Petroleum Geologists. American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists (AAPG), Tulsa, OK, United States: United States. Jun. Volume 2001, Pages 105. Descriptors: Arabian Peninsula; Asia; block structures; carbonate rocks; clastic rocks; coastal environment; east-central Yemen; faults; marine environment; Masila oil fields; normal faults; oil and gas fields; permeability; petroleum; petroleum accumulation; porosity; production; Qishn Formation; reservoir rocks; sea-level changes; sedimentary rocks; shelf environment; source rocks; subtidal environment; systems; tilt; transgression; Yemen. Abstract: Masila Block 14 is operated by Canadian Occidental Petroleum Yemen on behalf of its partners Occidental Peninsula, Inc. and Consolidated Contractors International, Ltd., and is located in the Hadhramaut region, in east-central Republic of Yemen. Oil was first discovered on the Block in late 1990 with Commerciality declared in late 1991. Oil production at Masila began in July 1993. There are now 14 known fields containing 56 pools within the Masila Block. Total proved ultimate recoverable oil reserves are approaching 900 million STB. Proven, probable and possible reserve estimates are in excess of one billion barrels of recoverable oil. The Masila fields are in the Jurassic- to Lower Cretaceous-aged, Saar Graben. Almost 90% of the Masila reserves are reservoirized in the Lower Cretaceous Upper Qishn Clastics Member of the Qishn Formation. Oil is also found in at least seven other reservoirs consisting of Lower Cretaceous and Middle to Upper Jurassic age clastics and carbonates as well as fractured granitic basement. This talk focuses on the main producing horizon; the Upper Qishn Clastics Member. The Upper Qishn represents an upward transgressive sequence from braided river deposits into tidally influenced shorelines, overlain by subtidal and shelf deposits. The Qishn reservoir sandstones have both high porosity (18-21%), and high permeability (<10 Darcies). They are relatively homogenous and continuous in the lower section and are more heterogeneous in the middle-upper section. The uppermost marine sandstones are more mature and very homogeneous. The major field accumulations are tilted, normal, fault block structures located over basement paleohighs, and are dependent upon juxtaposition against overlying Qishn carbonates. The carbonate-dominated pre-Qishn section, including the source rock, is not present on the paleo-highs, and is thickest in the basement lows. The main identified source rock is the Madbi Shale, a Type II marine source which is mature in “kitchens” adjacent to the structural highs. Secondary oil migration occurred

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upward along fault planes to the overlying traps. Seismic acquisition in the Masila block has been difficult and expensive because of the remote location, rugged topography and rocky desert terrain. The land surface is incised by deep, wadis or canyons. To date, four 3D seismic programs totalling 162 mi (super 2) (414 km (super 2)), and 1,415 miles (2,264 km) of 2D data have been acquired. Processing and interpretation problems are significant due to a low velocity surface layer, scattered seismic energy, poor signal to noise ratio from numerous canyon walls, and to “fault shadow” velocity anomalies overlying many of the the tilted fault block culminations. The biggest production challenge in these fields is water handling. Much water is produced along with the oil, due to a combination of medium gravity (15-33 degrees API) moderate viscosity oil, high reservoir permeability and a strong regional aquifer. The Upper Qishn oil is undersaturated in gas (average GOR is 3 to 7 SCF/bbl) requiring electric submersible pumps to provide sufficient artificial lift for the large volumes of produced fluid. At end of December 1999, the daily production rate collectively for all fields was 210,000 STB/D, with 680,000 BWP/D and 6.5 MMCF/D solution gas. Cumulative oil production is over 400 million STB. Initial average well oil production rates vary by producing zone, but fall in a range of 1500 to 15,000 STB/D, with many wells producing from more than one reservoir zone with minor commingling. Oil and water are produced in the fields, transported via pipeline to the Central Processing Facility (CPF), where most fluid separation occurs. Increasingly, separation of oil and water is being performed at individual fields using hydrocyclones before entering the CPF. Produced water is re-injected into the reservoirs. The clean oil is moved to the southern coast via an 85 mile long (140 km) 24” pipeline. Export oil is then loaded onto offshore tankers, via a Single Buoy Mooring system (SBM) located 1.25 miles (2 km) offshore, near Mukulla. Database: GeoRef. ISSN: 0094-0038.

Klimov, IA. 1968. *Medical Geography of Yemen*. Performer: Joint Publications Research Service, Washington, D.C. 2 May 1968. 24 pages. Database: NTIS Database (National Technical Information Service). NTIS Order Number: JPRS-45242. URL: <http://search.proquest.com/docview/86464032?accountid=12084>.

Klinge, Hans. 1982. *Untersuchungen Zum Grundwasserhaushalt Der Tihama (Saudi Arabien)*. Giessen: Lenz-Verlag. Page(s): 164. Descriptors: Groundwater -- Tihama (Saudi Arabia and Yemen); Water balance (Hydrology) -- Tihama (Saudi Arabia and Yemen). Notes: iii; ill. 21 cm. Note(s): Abstract in English and German. Originally presented as the author's thesis (doctoral--Justus-Liebig-Universität Giessen)/ Bibliography: p. 134-140. Responsibility: Hans Klinge. ISSN: 0340-0654; LCCN: 83-245055. OCLC Accession Number: 11159461.

Klitschar, Michael, Ricci, Ugo, Al Hammadi, Nabil, Reichenpfader, Barbara, Ebner, Alexander and Giovannucci Uzielli, Maria Luisa. 1998. “Genetic Variation at the STR Loci D12S391 and CSF1PO in Four Populations from Austria, Italy, Egypt and Yemen.” *Forensic Sci. Int.* 10/12. Volume 97, Issue 1, Pages 37-45. Descriptors: D12S391; CSF1PO; Austria; Italy; Egypt; Yemen; Population study. Abstract: The short tandem repeat systems (STRs) D12S391 and CSF1PO were amplified by the polymerase chain reaction (PCR) on blood samples from 100 to 158 unrelated Austrians, Italians, Yemenians and Egyptians. The samples were analyzed by both native and denaturing electrophoresis and two primer pairs were tested for the CSF1PO locus. Except for the CSF1PO data on the Egyptians, no deviations from the Hardy-Weinberg equilibrium were detected. For D12S391, no significant differences were found between the two Arab populations and between the two European populations, but the differences between both Arab populations and the Italians were significant. For CSF1PO, differences were only observed between the Yemenians and all three other populations. No evidence of linkage disequilibrium

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between the two STRs was found. The observation of a D12S391 allele consisting of only 14 repeats was confirmed by sequencing. ISSN: 0379-0738.

Kobayashi, Yoshiharu. 2011. "Yemen, Republic of - Groundwater and Soil Conservation Project: P074413 - Implementation Status Results Report." World Bank. 4 pages. Project objectives: 1. Improve water use efficiency and increase farmers return to water through ad option of water saving technologies. 2. Increase surface and groundwater availability through rehabilitation of small to medium spate irrigation schemes, terrace rehabilitation, bank protection works and other water and soil conservation activities. 3. Establish a groundwater management framework and institution to manage local water resources sustainably through capacity building of government water institutions and community groups. Report Number: ISR4292. URL: <http://go.worldbank.org/OMTZDB5JY0>.

Koenig, Robert, and Richard Stone. 2001. "Collateral damage: the war in Afghanistan and rising tensions in the Middle East have temporarily put on hold efforts by scientists from Islamic nations to strengthen ties among themselves and with the West. (News Focus)." *Science* 294.5543 (2001): 766+. *Military and Intelligence Database*. Web. 1 Sep. 2011. Abstract: Farouk El-Baz led the team that chose where the Apollo landers set down on the moon. So **mapping** groundwater on the Arabian Peninsula figured to be a cinch for the Egyptian-born director of Boston University's Center for Remote Sensing. But that was before the 11 September terrorist attacks on the United States. The planned trip to Sharjah in the United Arab Emirates (UAE) for fieldwork has been put off indefinitely, he says, because "people just didn't feel right" about traveling there now. The suspension of such collaborative projects, of course, cannot be compared on any scale to the tragedy of the attacks and the current war in Afghanistan. But they pose a significant interruption to what in the last few years has been a loosening of the ideological shackles on Islamic science. Increasing ties with Western colleagues over the past decade have allowed researchers in many Islamic countries to convince their leaders of the value of science. In the Islamic world, "the tragedy has been a lack of comprehension of how important scientific research is to development," says Abdulkarim Al-Eryani, a Yale University-trained microbiologist who now serves as political adviser to **Yemen** President Ali Abdullah Saleh. One vehicle currently being pursued for stimulating science in the region is a nascent agency, based in the UAE, that would be modeled on the U.S. National Science Foundation (NSF). Some opinion-makers are also arguing for a Marshall Plan to restore the Islamic world in the same way the huge U.S.-led investment helped rebuild Europe after World War II. "The gap is far too wide between the haves and the have-nots, and science would be a wonderful vehicle to help bridge that gap," says Egyptian-born chemist Ahmed Zewail, director of the Laboratory for Molecular Sciences at the California Institute of Technology in Pasadena and the first Arab (and second Muslim after Abdus Salam of Pakistan) to win a Nobel Prize in science. But progress on such ideas has been halted by the tensions stemming from the war in Afghanistan and the continuing Palestinian intifada. And there is risk of a permanent setback. "Damage to long-term relations and scientific collaboration can be limited only if the Afghan war is short and targeted against the criminals," says chemist Atta-Ur-Rahman, Pakistan's minister for science and technology.

Kohler, S. 1995. "The Discussion on 'Sustainable Development' Illustrated by Studies of the Wadi Marcha, Republic of Yemen." *Erde*. Volume 126, Issue 2, Pages 127-137. Notes: Cited By (since 1996): 1. Abstract: This article argues that in Wadi Marcha, Yemen, ecological social, physical and economic conditions will soon decline if a sustainable water supply is not established. At present the traditional society relies on modern pumps. These pump much water,

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and they allow export crops to be grown, but the water will only last for a few decades. Hence a more efficient technology is required, but this will require only low production, and there are few alternatives to agriculture. -D.J.Davis. Database: SCOPUS. ISSN: 0013-9998.

Kohler, Stefan. 1999. *Institutionen in Der Bewässerungs -Landwirtschaft Im Jemen: Die Ursachen Der Wasserübernutzung Im Jemen Und Die Zukunftsperspektiven Für Die Bewässerungs-Landwirtschaft*. Wiesbaden: Reichert. Page(s): 205. Descriptors: Irrigation farming -- Yemen (Republic); Water-supply -- Yemen (Republic) -- Management; Landbouw; Irrigatie (waterhuishouding). Notes: xiii; ill. Note(s): Dissertation; Responsibility: von Stefan Kohler. Vendor Info: Otto Harrassowitz (HARR); Entry: 19990728; Update: 20090314. ISSN/ISBN: 3895001007; 9783895001000 LCCN: 99-514401. OCLC Accession Number: 41980721.

Kohler, Stefan. 1996. "The Demands and Limitations of Sustainable Water use in Arid Regions; a Discussion of "Sustainable Development" Taking the Wadi Markhah (Republic of Yemen) as an Example." *Applied Geography and Development*. Institute for Scientific Co-Operation, Tübingen, Federal Republic of Germany. Volume 47, Pages 25-36. Descriptors: agriculture; Arabian Peninsula; arid environment; Asia; developing countries; environmental analysis; ephemeral streams; ground water; human ecology; irrigation; land use; regional planning; reliability; streams; sustainable development; terrestrial environment; valleys; Wadi Markhah; water management; water resources; water use; Yemen. Notes: References: 13; illus. incl. 1 table. Database: GeoRef. ISSN: 0173-7619.

Kohler, Stefan. 1996. "The Demand and Limitations of Sustainable Water use in Arid Regions: A Discussion of "Sustainable Development" Taking the Wadi Markhah (Republic of Yemen) as an Example." 47. Descriptors: Sustainable Development; Arid Zones; Water Resources Development; Yemen. Notes: 25-36; Note(s): Bibliography: p. 35-36. - Includes a map. Responsibility: by Stefan Kohler. OCLC Accession Number: 84205320.

Kokinski, J. 1986. "Uphill Work." *World Health*. Dec. Pages 13-15. Descriptors: Article Subject Terms: Steel; Finance; Water supplies; Maintenance; Rural areas; Valleys; Rock; Groundwater (see also Aquifers); Preventive maintenance; Laying; Mountains; Galvanization; Water supplies (Potable); Sanitation; Safety; Training; Supplies; Hills; Costs (see also Economics; Low cost); Electricity; Article Geographic Terms: Arab Countries; Yemen; Pipes (see also conduits, drains, pipelines,sewers); United nations. Notes: Publication focus: Case Study. Abstract: A project initiated by the United Nations Development Programme to improve the rural water supplies of the Yemen Arab Republic, where sanitary conditions were extremely poor, was hindered by the comparatively high cost of supplying the mountain top village settlements with groundwater from the valleys. Galvanized steel pipes had to be laid over rocky ground, electricity supplies were scarce and access to sites was often difficult. Funding for technical training in water supply operation and maintenance was insufficient, and in spite of strong governmental support current plans could at best provide less than 40 per cent of the rural population with safe drinking water. Database: Aqualine.

Korchuganova, N. I., Mezhelovskiy, I. N. and Mezhelovskiy, N. V. 2001. "Opyt Kompleksirovaniya Neotektonicheskikh i Geofizicheskikh Issledovaniy Pri Poiskakh Podzemnykh Vod Na Yugo-Zapade Araviyskoy Plity. Comprehensive Neotectonic and Geophysical Studies during Ground Water Exploration in Southeastern Arabian Plate." *Razvedka i Okhrana Nedr*. Nedra, Moscow, Russian Federation (RUS): Russian Federation. Jun. Volume 2001, Issue 6, Pages 63-65. Descriptors: Arabian Peninsula; Arabian Plate; Asia; electrical sounding; geophysical methods; geophysical profiles; geophysical surveys; ground

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water; neotectonics; NMR spectra; plate tectonics; spectra; surveys; tectonics; Yemen. Database: GeoRef. ISSN: 0034-026X.

Kossmat, Franz. 1907. "Geologie der Inseln Sokotra, Semba und Abd el Kuri." Vienna: Denkschriften der Kaiserlichen Akademie der Wissenschaften, Mathematisch-Naturwissenschaftliche Klasse, Band 71, Halbband 1, S. 1-62. OCLC: 638095123.

Kraft, Walter, Garling, Fritz and Matecki, Juergen. 1971. "Die Hydrogeologischen Verhaeltnisse in Der Mittleren Tihama; Ein Beitrag Zur Geologie Der Jemenitischen Arabischen Republik. Hydrogeological Conditions in Central Tihama; a Contribution to the Geology of Yemen." Zeitschrift Fuer Angewandte Geologie. Akademie-Verlag, Berlin, Federal Republic of Germany Federal Republic of Germany. Volume 17, Issue 6, Pages 239-249. Descriptors: aquifer properties; Arabian Peninsula; Asia; composition; geology; ground water; hydrogeology; movement; resources; Tihama; Yemen. Notes: illus. (incl. sketch maps. Database: GeoRef. ISSN: 0044-2259.

Kroschel, J., Fritsch, E. and Huber, J. 1996. "Biological Control of the Potato Tuber Moth (*Phthorimaea operculella* Zeller) in the Republic of Yemen using Granulosis Virus: Biochemical Characterization, Pathogenicity and Stability of the Virus." *Biocontrol Sci. Technol.* Volume 6, Issue 2, Pages 207-216. Descriptors: biochemical characterization; biological control; granulosis virus; pathogenicity; *Phthorimaea operculella*; ultraviolet persistence. Notes: Cited By (since 1996): 7. Abstract: A granulosis virus infecting the potato tuber moth, *Phthorimaea operculella*, has been identified, isolated and purified from diseased potato tuber moth larvae collected from potato fields in the highland basin Qa al- Boun of the Republic of Yemen. The granulosis virus was propagated by feeding potato tuber moth larvae with potatoes treated with a concentration of one granulosis virus-infected fourth instar larva to 5 l of water (corresponding to an occlusion body (OB) concentration of 2×10^6 OB ml⁻¹). Restriction enzyme analysis of viral DNA revealed that the isolated virus seemed to correspond to an isolate from the Lima region of Peru. A median LC₅₀ value of 7.3×10^4 OB ml⁻¹ was calculated for a purified virus preparation. Different preparations of the granulosis virus were investigated for their persistence in the field on tubers and leaves. A purified virus preparation (PoGV) applied to potato tubers and exposed in the open had a half-life of 1.3 days. On leaves, the activity of granulosis virus spray deposits of an unpurified virus preparation (PoGV I) and of a glycerine-formulated preparation (PoGV II) also declined with exposure time. Mortalities of potato tuber moth larvae of 43% for PoGV I and 49% for PoGV II were recorded when first instar larvae were fed with potato leaves collected 2 days after treatment. After 8 days, 25.8% of the larvae had died from PoGV I treatment and 19.4% from PoGV II. Neither preparation displayed any effect 17 days after application. Database: SCOPUS. ISSN: 0958-3157.

Kroschel, J., Fritsch, E. and Huber, J. 1996. Biological Control of the Potato Tuber Moth (*Phthorimaea operculella* Zeller) in the Republic of Yemen using Granulosis Virus: Biochemical Characterization, Pathogenicity and Stability of the Virus. *Biocontrol Sci. Technol.* Volume: 6, no. 2, page(s): 207-207-216. Abstract: A granulosis virus infecting the potato tuber moth, *Phthorimaea operculella* has been identified, isolated and purified from diseased potato tuber moth larvae collected from potato fields in the highland basin Qa al-Boun of the Republic of Yemen. The granulosis virus was propagated by feeding potato tuber moth larvae with potatoes treated with a concentration of one granulosis virus-infected fourth instar larva to 5 l of water (corresponding to an occlusion body (OB) concentration of 2×10^6 OB ml⁻¹). Restriction enzyme analysis of viral DNA revealed that the isolated virus seemed to correspond to an isolate from the Lima region of Peru. A median LC_{sub(50)} value of 7.3×10^4 OB

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ml super(-1) was calculated for a purified virus preparation. Different preparations of the granulosis virus were investigated for their persistence in the field on tubers and leaves. A purified virus preparation (PoGV) applied to potato tubers and exposed in the open had a half-life of 1.3 days. On leaves, the activity of granulosis virus spray deposits of an unpurified virus preparation (PoGV I) and of a glycerine-formulated preparation (PoGV II) also declined with exposure time. Mortalities of potato tuber moth larvae of 43% for PoGV I and 49% for PoGV II were recorded when first instar larvae were fed with potato leaves collected 2 days after treatment. After 8 days, 25.8% of the larvae had died from PoGV I treatment and 19.4% from PoGV II. Neither preparation displayed any effect 17 days after application. ISSN: 0958-3157. Database: Technology Research Database. URL: <http://search.proquest.com/docview/15646392?accountid=12084>.

Kruff, K. de, and P. T. Scholte. *Vegetation map of Yemen Republic*. Amersfoort, The Netherlands: DHV Consultants BV, 1990. In English and Arabic. 1 map on 2 sheets: color; sheets 122 x 90 cm. "Copyright belongs to the Netherlands Minister for Development Cooperation". Description based on: Western Part. Includes inset location map. "August 1990". OCLC: 649847254.

Kuharev, N. 1998. Extraordinary Oxygen Regime as a Phenomenon of the Arabian Upwelling: Life and Concentrations of Fish in the Hypoxy Zone -- Rule Or Exception? Grahamstown, South Africa: FISA. African Fishes and Fisheries Diversity and Utilisation. Poissons Et Peches Africains Diversite Et Utilisation. Page(s): p 299. Descriptors: Article Subject Terms: Feeding behaviour; Fishery surveys; Hypoxia; Migratory species; Ontogeny; Oxygen depletion; Trawling; Article Taxonomic Terms: Harpodon squamosus; Lepturacanthus savala; Physiculus argiropastus; Saurida undosquamis; Scomber japonicus; Synagrops adeni; Article Geographic Terms: Aden Gulf; Yemen, Socotra; Marine. Abstract: The material was compiled from YugNIRO scientific research fishing expeditions from 1962 till 1992 in the northern Aden Gulf and near Socotra Island in the zone of the Arabian and Somalia upwelling. As a result of the special studies conducted by the author during the trawl surveys, it was stated that a lot of fish species live, concentrate and feed themselves actively on the continental slope of southern Arabia in the subsurface water mass at depths from 240-280m down to 300-400 m, in the hypoxy layer with oxygen content from 0.2 to 0.5ml/l, saturation 8-12%. It is exciting that in well known experiments on hypoxy many fishes from such catches otherwise die quickly under those conditions. Fish from catches were divided into two ecological groups: settled fish and migrating fish. From a series of around-the clock trawlings from a depth range of 10 to 500m, it was noted that settled fishes (48 species) did not make daily vertical migrations. These fish inhabit the bottom layer in the hypoxy zone and were found beyond its borders at a depth range of 150 to 500m and greater. *Saurida undosquamis*, *Lepturacanthus savala*, *Synagrops adeni*, *Physiculus argiropastus*, *Nettostoma parviceps*, *Harpodon squamosus*, *Hoplostetus* spp., *Centroforus granulosus*, *Halelurus* spp. and *Eridachnis radklifi* form the largest concentrations. Migrants (9 species) concentrate near the bottom in the hypoxy zone during the daily vertical migrations in the period from 5-6 a.m to 4-5 p.m. (280-350m). At night they ascent to a depth of 60-80 m, to a zone with higher oxygen content (3-4ml/l). *Psenopsis cyanea*, *Scomber japonicus*, *Bentosema pterotum*, *Decapterus kurroides* and *Nemipterus randalli* form the most dense concentrations. Slow-moving schools of *Psenopsis cyanena*, individuals of *Lepturacanthus savala* and *Eridachnis radklifi* were observed from the inhabited underwater device in the hypoxy zone at a depth of 270-370m and at a distance of 0.3-3m from the bottom. Rushes of fishes towards the bottom were fixed. Some common biological features for both groups were: (1)

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Intensive feeding with protein dietary components, directly in the hypoxia zone. All the inhabitants of this zone are predators at high trophic levels; (2) Development of eggs and early ontogenesis in the epipelagic zone with high oxygen content; (3) Rushing swimming in the hypoxia layer that points at consumption of energy from anaerobic metabolism by fishes. Extended areas with a sharp oxygen shortage inhabited by fishes and invertebrates in the Arabian Sea, near the South-Eastern coast of Africa, in the northern and eastern Pacific near the coast of Peru and Venezuela, and in the Black and Azov Seas. It is assumed the fishes are supplied with energy from biochemical processes that allows them to assimilate oxygen in extremely low concentrations and to anaerobically use protein, products of nitrogen catabolism and glycogen in their energetic metabolism at hypoxia. Notes: Summary only. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. OCLC Accession Number: 4878918.

Kühn, Peter, Pietsch, Dana and Gerlach, Iris. 2010. "Archaeopedological Analyses Around a Neolithic Hearth and the Beginning of Sabaeen Irrigation in the Oasis of Ma'rib (Ramlat as-Sab'Atayn, Yemen)." *Journal of Archaeological Science*. 06. Volume 37, Issue 6, Pages 1305-1310. Descriptors: Neolithic period; Paleoclimatology -- Holocene; Radiocarbon dating; Hearths, Prehistoric; Land use; Soil micromorphology; Bronze age; Yemen (Republic). Abstract: Archaeopedological analyses in the oasis of Ma'rib (Yemen) yield new information of Neolithic land use, Bronze Age soil formation, and Sabaeen irrigation. The AMS radiocarbon age of a Neolithic fireplace buried under Sabaeen irrigation sediments in the Southern oasis indicates Pre-Sabaeen human activities in Wadi Dhana about 5600 years ago. The associated Mid-Holocene palaeosol, developed in fluvial sediments of Wadi Dhana and also in the filling of the hearth, marks the Bronze Age-land surface before it was covered with irrigation sediments. Based on AMS radiocarbon data from charcoal in reservoir sediments of the "Great Dam" and an estimated time span of pedogenesis of the Mid-Holocene palaeosol in this region, we propose the beginning of the irrigation in Ma'rib in the period of 2500–1000calyr BC. [Copyright & Elsevier]; Copyright of *Journal of Archaeological Science* is the property of Academic Press Inc. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use. This abstract may be abridged. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material for the full abstract. (Copyright applies to all Abstracts.). ISSN/ISBN: 03054403. URL: <http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=48913680&site=ehost-live&scope=site>.

Kweton, A. and Rappenhoener, D. 1989. "Soil Erosion and Water Balance in the Haraz Mountains and Yemen Arab Republic; Resource Conservation and Desertification Control in the Near East." Federal Republic of Germany Dtsch. Stiftung international. Entwickl. Zentralstelle Ernaehr. Landwirtschaft., Feldafing, Federal Republic of Germany. Descriptors: agriculture; Arabian Peninsula; Asia; climate; Entisols; environmental geology; erodibility; erosion; hydrology; land use; leaching; moisture; runoff; siltation; soil erosion; soil profiles; soils; Yemen. Notes: sects., charts, 1 table, sketch map. Database: GeoRef in Process. GeoRef Accession Number: 25036-2.

Geology of Yemen

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Lambert, Louise. 2007. "HIV and Development Challenges in Yemen: Which Grows Fastest?" *Health Policy and Planning*. January 1. Volume 22, Issue 1, Pages 60-62. ISSN: 0268-1080.

Land Resources Development Centre. 1980. Yemen Arab Republic Montane Plains and Wadi Rima Project: A Land and Water Resources Survey Soils and Land Suitability of the Montane Plains: Maps. Surbiton Land Resources Development Centre: Descriptors: Soils -- Yemen; Montane Plains; Government publication; Microfilm. Abstract: Contains 10 maps. Notes: 1 30cm. OCLC Accession Number: 316347246.

Land Resources Development Centre (Great Britain). 1979. Yemen Arab Republic: Montane Plains and Wadi Rima' Project: A Land and Water Resources Survey. Socioeconomic Survey of Wadi Rama': Methods and Data. Surbiton: Ministry of Overseas Development. Descriptors: Agricultural development projects -- Yemen (Republic); Montane Plains and Wadi Rima Project; Government publication (gpb). Notes: 2 v.: ill., maps (some in pocket), tables; 30 cm. "YAR-01-44/REC-34/79."; Other Titles: Socioeconomic survey of Wadi Rama': methods and data. OCLC Accession Number: 68706233.

Langbein, Rolf and As-Saruri, Mustafa L. 1992. "Dolomitisierung Und Silifizierung in Tiefwasserkarbonaten Des Tertiaers Der Suedlichen Arabischen Halbinsel. Dolomitization and Silicification in Deep-Water Carbonates of the Tertiary of the Southern Arabian Peninsula; Sediment '91; 6. Treffen Deutschsprachiger Sedimentologen. Sediment '91; Sixth Conference of German-Speaking Sedimentologists." *Zentralblatt Fuer Geologie Und Palaeontologie, Teil I: Allgemeine, Angewandte, Regionale Und Historische Geologie. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, Federal Republic of Germany Federal Republic of Germany; Angewandte, Regionale und Historische Geologie. Volume 1991, Issue 12, Pages 2859-2872. Descriptors: Arabian Peninsula; Asia; burial metamorphism; carbonate rocks; carbonatization; Cenozoic; compaction; deep-sea sedimentation; diagenesis; dolomitization; early diagenesis; framework silicates; marine sedimentation; metamorphism; opal; quartz; sedimentary rocks; sedimentation; silica minerals; silicates; silicification; Tertiary; Yemen. Notes: illus. incl. sect., 3 tables, geol. sketch map. Database: GeoRef. ISSN: 0340-5109.*

Langbein, Rolf and As-Saruri, Mustafa Latif. 1998. "Die Rus Formation (Unteres Eozoen) Auf Der Suedlichen Arabischen Halbinsel. Beitrage Zur Geologie Des Suedlichen Jemen. Geology of Southern Yemen." *Zeitschrift Fuer Geologische Wissenschaften. Akademie-Verlag, Berlin, Federal Republic of Germany Federal Republic of Germany. Volume 26, Issue 5-6, Pages 673-682. Descriptors: Arabian Peninsula; Asia; carbonate rocks; Cenozoic; clastic rocks; cross sections; Eocene; gypsum; limestone; lithofacies; lower Eocene; marl; metamorphic rocks; Paleogene; sebkha environment; sedimentary rocks; shallow-water environment; slates; sulfates; synsedimentary processes; terrestrial environment; Tertiary; Yemen. Notes: ZGWSA7; References: 12; sects., sketch map. Database: GeoRef in Process. ISSN: 0303-4534.*

Langston, Elizabeth. 2005. *The Islamist Movement and Tribal Networks: Islamist Party Mobilization Amongst the Tribes of Jordan and Yemen*. United States -- Kentucky: University of Kentucky. ProQuest Dissertations and Theses. Abstract: This study examines the nature of the relationship between Islamist social movement parties and tribes. Specifically, it is argued that, in countries with strong tribal heritages and free elections, Islamist movement parties will seek to integrate tribal networks and attend to tribal considerations in their campaign strategies in order to mobilize the most voters. To better understand the dynamics between these two centers of power---who are generally perceived as competitors in elections---I examine the choices Islamist

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political parties make in selecting candidates for parliament, districts in which to compete, and their rates of success versus other candidates. To address these issues, two cases are selected for intensive study: Jordan and Yemen. Based on extensive field work in both countries, two types of data are gathered. As an exploratory method to gauge the significance of tribal institutions and networks to the Islamists, I use participant observation of tribal gatherings and Islamist movement organization meetings and events; in-depth interviews with grassroots activists, party elites, and members of parliament; and an overview of local newspaper coverage of campaign issues. Next, as an explanatory method, I analyze the lists of candidates for parliament in national elections in the two countries between the years 1989 and 2003. The study suggests that Islamist parties do indeed attend to tribal considerations in campaign decisions, but that intervening variables, such as the design of electoral institutions and local decisions regarding the primacy of tribal or party loyalty, also impact Islamist strategy and success. A final observation from the study concerns the continued repression of Islamist parties and the retreat from efforts at sincere liberal reform in Jordan and Yemen. That leads to the conclusion that Islamist parties can be expected to continue to work through tribal institutions, in these cases and elsewhere, so long as other forms of civil society organization are repressed. University of Kentucky; Ph.D. Database: ProQuest Dissertations & Theses.

Laredo, D., Dawson, JW and Hashem, M. 1986. "Small Rural Water Systems Project in the Yemen Arab Republic; A Midterm Evaluation." Water and Sanitation for Health Project Field Report no.197 September 1986.120 pages. 6 fig, 3 tab. 7 append. AID Contract 5942-C-00-. Pages Project 936-5942. Descriptors: Developing countries; Institutional constraints; Yemen; Rural areas; Water supply development; Evaluation; Public policy; Rural sociology; Water supply; Management planning. Abstract: A midterm evaluation for USAID/Yemen of Phase II of the Small Rural Water Systems Project was conducted from September 8 to 30, 1986. This second phase was intended to provide institutional development services to strengthen the managerial, technical, and financial capabilities of the Rural Water Supply Department (RWSD) of the Ministry of Public Works (MPW) so that the department could effectively respond to the need for improved village water systems. Findings includes: (1) The project's field accomplishments may be classified as an unqualified success. The contractor, New Trans Century Foundation (NTF), has overcome the combined constraints of logistics and terrain to produce 172 water supply systems that are well engineered and constructed according to high-quality standards; (2) In reaching this level of field expertise, NTF has organized itself into a highly efficient turnkey construction unit, and its staff have mastered the intricacies and political sensitivities of many elements of Yemen 's rural society; and (3) The primary objective of Phase II, however, as stated in the Grant Agreement , was to provide institutional development (ID) services to RWSD. In this realm, the project is far from successful, as NTF has made little headway on its ID objectives vis a vis RWSD. This observation is not meant to imply RWSD was a willing partner in the process. RWSD operates as a pure development agency envisioning its mission almost exclusively as an agency to provide rural water supply infrastructure. This fact, together with a set of unclear institutional objectives in the Memorandum of Understanding between AID and RWSD, exacerbated the situation. Further, the fact that RWSD did not, as expected at the time of NTF's proposal, become an autonomous agency certainly did not improve the project's institutional development environment. Database: Water Resources Abstracts. OCLC: 54352569.

Laredo, David; Dawson, James W. Hashem, Mouna and Water and Sanitation for Health Project (U.S.). 1986. Small Rural Water Systems Project in the Yemen Arab Republic: A

Geology of Yemen

Midterm Evaluation. Arlington, Va: Water and Sanitation for Health Project. Page(s): 120. Descriptors: Water Supply -- Yemen. Notes: ix; maps; 28 cm. "Prepared for the USAID Mission to Yemen under WASH Activity No. 256." "September 1986." "Contract No. 5942-C-00-4085-00, Project No. 936-5942." Includes bibliographical references (p. 77-78). Responsibility: by David Laredo, James W. Dawson, Mouna Hashem. OCLC Accession Number: 54352569.

Laredo, David; Haratani, Joseph; McMullan, William G. and Water and Sanitation for Health Project (U.S.). 1986. Yemen Sana'a Basin Water Resources Assessment. Arlington, Va: Water and Sanitation for Health Project. Page(s): 157. Descriptors: Water Supply -- Yemen. Notes: xiii; ill., maps; 28 cm. Note(s): "Prepared for the USAID Mission to the Arab Republic of Yemen under WASH Activity No. 175." "June 1986." "Contract No. 5942-C-00-4085-00, Project No. 936-5942." Includes bibliographical references (p. 153-157). Responsibility: by David Laredo, Joe M. Haratani and William G. McMullan. OCLC Accession Number: 52965740.

Lauermann, John. 2010. Economic Space, Practice, and Identity: Business and Labor in the Qat Industry of Sana'a, Yemen. United States -- South Carolina: Geography. ProQuest Dissertations and Theses. Abstract: A legal, leafy stimulant traditionally consumed in Yemen, qat is a major element of Yemeni society (with over seventy percent of adult Yemenis reporting qat consumption in one recent survey) and economy (employing at least fourteen percent of the labor force). While a small body of literature explores qat consumption, and the qat industry in a macroeconomic sense, very little is written about the cultural economy surrounding qat production (qat farming, distribution, and retail) or the geographic dynamics of this same production. This thesis explores business and labor practices in the qat industry of the Sana'a metropolitan area, specifically focusing on the spaces of qat production. Drawing on semi-structured interviews with actors from across the qat supply chain (farmers, vendors, laborers, government and nongovernmental officials, etc.), I explore the practices of these actors, the relationships that they rely upon and construct, and the spaces which facilitate and are produced by these everyday business and labor practices and relationships. I ultimately argue that actors working in the industry use these various economic practices and relationships (produced and producing economic spaces of the industry) to site themselves within broader economic and cultural discursive frameworks, thereby fashioning hybrid cultural economic discourses and identities. This project contributes to existing literature on both the qat industry and on contemporary economy and culture in Yemen, while developing analytical frameworks (based on practice and relationality) for exploring questions of economic space, practice, discourse, and identity in Global South contexts. Geography; M.A. Database: ProQuest Dissertations & Theses.

Leckie, D. A. and Rumpel, T. 2003. "Tide-Influenced Sedimentation in a Rift Basin - Cretaceous Qishn Formation, Masila Block, Yemen: A Billion Barrel Oil Field." *Am. Assoc. Pet. Geol. Bull.* Volume 87, Issue 6, Pages 987-1013. Notes: Cited By (since 1996): 3. Abstract: The Lower Cretaceous Qishn Clastics Member in Masila Block 14, Hadhramaut region, Republic of Yemen, has estimated reserves of 1.1 billion bbl recoverable oil and has produced 600 million bbl of oil. Sedimentation took place in an elongate paleogulf of the Say'un-al Masila basin, with open-marine carbonates to the east. The Qishn Clastics Member unconformably overlies mixed carbonates and clastics of the Sa'af Member. Lower Qishn onlap resulted in deposition of brackish and tidal (likely macrotidal) estuarine to open-bay or gulf deposits. The middle portion of the lower Qishn Clastics Member shows evidence of arid nonmarine sedimentation, including debris-flow deposits, red beds, and shale-clast conglomerates, in turn, overlain by interfingering coastal and nonmarine deposits. The lower Qishn Clastics Member is

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truncated by a sequence boundary overlain by an extensive sandstone deposited in a low-accommodation braid plain close to the shoreline. A flooding surface is present at the top of the sandstone, over which progradational, tide-influenced deltaic strata were deposited. Delta progradation culminated in shallow-water clastic dolomitic deposits on the coastal plain. With subsequent transgression, a rising water table caused a nonmarine flooding surface with lakes and lacustrine deltas, overlain by tidal-flat deposits. Ongoing transgression resulted in wave ravinement overlain by shallow-shelf clastics and then deposition of slightly deeper shelf carbonates. The uppermost unit comprises bioturbated, clastic-shelf deposits related to a drop in relative sea level. Throughout much of the Qishn Clastics interval, accommodation was moderate, except for low accommodation associated with regional sheet sandstone at the base of the upper Qishn Clastics Member. Virtually all marine and brackish deposits show evidence of tidal sedimentation. Climate was arid and seasonally wet. Database: SCOPUS. ISSN: 0149-1423.

Leckie, Dale A., Rumpel, Tom and Chidsey, Thomas C., Jr (chairperson). 2003. "Tide-Dominated Sedimentation in an Arid Rift Basin; Cretaceous Qishn Clastics, Masila Block, Republic of Yemen; 2003 AAPG Annual Convention with SEPM." Annual Meeting Expanded Abstracts - American Association of Petroleum Geologists. American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists (AAPG), Tulsa, OK, United States: United States. Volume 12, Pages 101. Descriptors: Arabian Peninsula; Arabian Sea; arid environment; Asia; bars; carbonate rocks; clastic rocks; Cretaceous; deltaic environment; estuarine environment; Euphrates River; fluvial features; ground water; Indian Ocean; lithofacies; marine environment; Masila Block; Mesozoic; Middle East; modern analogs; nomenclature; Persian Gulf; petroleum; petroleum exploration; point bars; progradation; Qishn Formation; reserves; reservoir rocks; sandstone; sea-level changes; sedimentary rocks; sedimentation; shallow-water environment; shelf environment; terrestrial environment; tidal flats; Tigris River; transgression; water table; Yemen. Abstract: Cretaceous Qishn Clastics Member, Yemen, were deposited in a rift basin connected to the Paleo-Indian Ocean--an ideal set-up for tidal amplification and domination. Recoverable hydrocarbon reserves are 1.1 bbl. Facies associations are consistent with an estuarine system B sand shoals, tidally-influenced point bars, mud flats, etc. Lower Qishn onlap resulted in deposition of tidal estuarine to bay facies. A sequence boundary truncates the Lower Qishn at the base of the S3, a low-accommodation braidplain deposited close to the shoreline. A flooding surface at the top of the S3 heralds S2 progradational, tide-dominated deltaic deposits. Delta progradation culminated in clastic dolomitic deposits on the coastal plain. With subsequent transgression, S1C deposits show rising water table and a nonmarine flooding surface, overlain by tidal-flat/inlet deposits. Ongoing transgression resulted in wave-ravinement overlain by shallow shelf clastics and deeper shelf carbonates of the S1B. The overlying S1A comprises bioturbated, clastic shelf deposits related to a drop in sea level. Accommodation was relatively high, except for low accommodation associated with regional sheet sandstone of the S3. Qishn Clastic sediments meet the criteria of a macrotidal, tide-dominated estuary, yet a more appropriate analog is the Tigris-Euphrates River and delta flowing into the Arabian Gulf. Is the latter a tidally-influenced delta flowing into a gulf--or a large bayhead delta? Application of existing terminologies--estuaries, syn-rift clastics, deltaic, strait, Gulf, bay--is confusing to the practicing explorationist, particularly when attempting to convey a mental image of the environmental setting of the reservoir. Database: GeoRef. ISSN: 0094-0038.

Ledger, David. 1983. *Shifting Sands: The British in South Arabia*. London: Peninsular Publishing. Page(s): 232. Abstract: Ledger's book gives another first-hand political view as the

Geology of Yemen

author was on the staff of the High Commission up until the final evacuation having first experienced operations in Aden as an Intelligence Officer in the British Army. This latter fact probably accounts for the inclusion of information on the military aspects. Notes: 232 pages: ill. 22 cm. ISBN: 0907151086. OCLC Accession Number: 13157083.

Lee, ACM Sir David. 1978. *Flight from the Middle East: Being a History of the Royal Air Force in the Arabian Peninsula and Adjacent Territories 1945-1972*. London: Air Historical Branch. Page(s): 339. Abstract: The closest we have to an official history of the RAF's contribution to the Aden conflict is Lee's study of the RAF in the Middle East theatre post-1945. As the senior RAF commander in theatre in 1961 and later AOC of all RAF forces in the Arabian Peninsula, the author has a unique insight into the issues surrounding air operations in Aden during the 1960s and devotes much of his book to the Radfan campaigns and support for the Army in general. Notes: xvi, 341 p., [50] p. of plates: ill. (some col.); 23 cm. OCLC Accession Number: 34577793.

Lezine, AM, Tiercelin, JeanJ, Robert, C., et al. 2007. "Centennial to Millennial-Scale Variability of the Indian Monsoon during the Early Holocene from a Sediment, Pollen and Isotope Record from the Desert of Yemen." *Palaeogeogr. , Palaeoclimatol. , Palaeoecol.* 22 Jan. Volume 243, Issue 3-4, Pages 235-249. Descriptors: Article Subject Terms: Monsoons; Paleoclimates; Summer monsoon; Ocean-atmosphere system; Holocene; Lacustrine sedimentation; Deserts; Palaeo studies; Freshwater lakes; Palaeoclimate; Pollen; Article Geographic Terms: AN, North Atlantic; Yemen; Yemen. Notes: OD: Object Subject Terms: Age (yr); Carbon isotope measurements; Climbing-ripple laminations; Events of ice-rafted debris; Fresh-water gastropod shell; Globigerina bulloides; Indian monsoon indicators; Lacustrine sequence depth (cm); Lake-level fluctuations; Latitude (°); Lithostratigraphy plots; Longitude (°); Oxygen-isotope measurements; Radiocarbon age determinations; Radiocarbon measurements; Sedimentary facies assemblages; Sedimentological parameters; Semiquantitative plots; TR: CS0737153. Radiocarbon age determinations for the al-Hawa lacustrine sequence ... OD: Object Subject Terms; Lacustrine sequence depth (cm); Radiocarbon age determinations. Abstract: Lacustrine deposits of al-Hawa (15 super(o)52'N, 46 super(o)53'E, 710 m above sea level) document the climatic and environmental history of the inland desert of Yemen during the early to mid-Holocene. A freshwater lake expanded in one of the most arid areas of the world in response to increased Indian monsoon fluxes from 12,000 to 7500 cal B.P. Three dry intervals punctuated the lacustrine phase recording episodes of weaker summer monsoon activity over Arabia. Dry intervals were coeval with cold periods recorded in the North Atlantic, confirming the links between the Indian monsoon and the North Atlantic systems during the Holocene. We demonstrate that the regional vegetation remained of semi-arid character throughout the lacustrine period. Database: ProQuest Deep Indexing: Aquatic Sciences. ISSN: 0031-0182.

Lézine, Anne-Marie, Saliège, Jean-François, Robert, Christian, Wertz, Frédéric and Inizan, Marie-Louise. 1998. "Holocene Lakes from Ramlat as-Sab'Atayn (Yemen) Illustrate the Impact of Monsoon Activity in Southern Arabia." *Quatern. Res.* 11. Volume 50, Issue 3, Pages 290-299. Descriptors: Holocene; paleolakes; Yemen; Southern Arabia; sedimentology; clay mineralogy; isotope stratigraphy; palynology. Abstract: Paleocology and paleohydrology of the Ramlat as-Sab'atayn (Southern Arabia) are reconstructed from a comparative study including sedimentology, mineralogy, stable isotope ratios of carbonates, and palynology of lacustrine sediments recovered from the al-Hawa depression. The section dates from 8700 to 7200 yr B.P. and records an early phase of flooding followed by distinct lacustrine development from 7800 to 7200 yr B.P., coeval with maximum activity of the Indian monsoon. Comparison of the pollen

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record with modern pollen deposition suggests that regional vegetation was then already of desert type and was related to strong seasonal trade winds. ISSN: 0033-5894.

Library of Congress, Washington, DC, Congressional Research Service and Blanchard, Christopher M. 2009. "Islam: Sunnis and Shiites." 28 Jan. Page(s): 10 Report Number: CRS-7-5700 CRS-RS21745 XJ-CRS/DC Monitor Series: CRS/DC. Abstract: The majority of the world's Muslim population follows the Sunni branch of Islam, and approximately 10-15% of all Muslims follow the Shiite (Shi'ite, Shi'a, Shia) branch. Shiite populations constitute a majority in Iran, Iraq, Bahrain, and Azerbaijan. There are also significant Shiite populations in Afghanistan, Kuwait, Lebanon, Pakistan, Saudi Arabia, Syria, and Yemen. Sunnis and Shiites share most basic religious tenets. However, their differences sometimes have been the basis for religious intolerance, political infighting, and sectarian violence. This report includes a historical background of the Sunni-Shiite split and discusses the differences in religious beliefs and practices between and within each Islamic sect as well as their similarities. The report also relates Sunni and Shiite religious beliefs to discussions of terrorism and sectarian violence that may be of interest during the 111th Congress. Also see CRS Report RS21695, The Islamic Traditions of Wahhabism and Salafiyya, by Christopher M. Blanchard. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: View Full Text (pdf); File: /U2/a494842.pdf; Size: 136 KB; Congressional rept. Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA494842. URL: <http://handle.dtic.mil/100.2/ADA494842>.

Library of Congress, Washington, DC, Congressional Research Service and Blanchard, Christopher M. 2006. "Islam: Sunnis and Shiites." 11 Dec. Page(s): 7 Report Number: CRS-RS21745 XJ-CRS/DC Monitor Series: CRS/DC. Abstract: The majority of the world's Muslim population follows the Sunni branch of Islam, and approximately 10-15% of all Muslims follow the Shiite (Shi'ite, Shi'a, Shia) branch. Shiite populations constitute a majority in Iran, Iraq, Bahrain, and Azerbaijan. There are also significant Shiite populations in Afghanistan, Kuwait, Lebanon, Pakistan, Saudi Arabia, Syria, and Yemen. Sunnis and Shiites share most basic religious tenets. However, their differences sometimes have been the basis for religious intolerance, political infighting, and sectarian violence. This report includes a historical background of the Sunni-Shiite split and discusses the differences in religious beliefs and practices between and within each Islamic sect as well as their similarities. The report also relates Sunni and Shiite religious beliefs to discussions of terrorism and Iraq that may be of interest during the first session of the 110th Congress. This report will be updated as necessary. Related papers include CRS Report RS21432 and CRS Report RS21695. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: View Full Text (pdf); File: /U2/a460673.pdf; Size: 202 KB; Congressional rept. Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA460673. URL: <http://handle.dtic.mil/100.2/ADA460673>.

Library of Congress, Washington, DC, Congressional Research Service and Blanchard, Christopher M. 2005. "Islam: Sunnis and Shiites." 10 Feb. Page(s): 7 Report Number: CRS-RS21745 XJ-CRS/DC Monitor Series: CRS/DC. Abstract: The majority of the world's Muslim population follows the Sunni branch of Islam, and approximately 10-15% of all Muslims follow the Shiite (Shi'ite, Shi'a, Shia) branch. Shiite populations constitute a majority in Iran, Iraq, Bahrain, and Azerbaijan. There are also significant Shiite populations in Afghanistan, Kuwait, Lebanon, Pakistan, Saudi Arabia, Syria, and Yemen. Sunnis and Shiites share most basic religious tenets. However, their differences sometimes have been the basis for religious

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intolerance, political infighting, and violent confrontations. This report includes a historical background of the Sunni-Shiite split and the differences in religious beliefs and practices between and within each Islamic sect as well as their similarities. The report also relates Sunni and Shiite religious beliefs to current discussions of Islamic terrorist groups, Iraq, and other issues of interest to the 109th Congress. This report will not be updated. Related CRS products include CRS Report RS21432 and CRS Report RS21695. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: View Full Text (pdf); File: /U2/a476265.pdf; Size: 187 KB; Congressional rept. Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA476265. URL: <http://handle.dtic.mil/100.2/ADA476265>.

Library of Congress, Washington, DC, Congressional Research Service and King, Rawle O. 2008. "Ocean Piracy and its Impact on Insurance." 03 Dec. Page(s): 11 Report Number: CRS-R40081 XJ-CRS/DC Monitor Series: CRS/DC. Abstract: Many Members of Congress are concerned about the sharp rise in pirate attacks in the strategic waterways in the Gulf of Aden off the East coast of Africa. The hijacking of a Saudi Arabia-owned oil tanker, Sirius Star, off the coast of Kenya on November 17, 2008, by pirates was another in a series of seizures that have focused worldwide attention on economic and humanitarian threats posed by pirates to the global seafaring community and the smooth flow of international trade. Given the sharp increase in the number of pirate attacks, the cost of transporting cargo in international waters could rise dramatically because of the sharp increase in ocean marine insurance rates for ships transiting the Gulf of Aden. Commercial insurers, for example, could require a special war risk insurance premium costing an additional ten of thousands of dollars a day. In addition to proposals for military deterrence and diplomatic engagements, policymakers may elect to consider adjustments to the federal statute (Title XII of the Merchant Marine Act of 1936, as amended) that authorizes the federal government to underwrite marine war risk insurance in circumstances such as piracy. Title XII, administered by the U.S. Department of Transportation's Maritime Administration, authorizes the federal government to act as an insurer or reinsurer of last resort to facilitate waterborne commerce should private ocean marine insurance markets not be able to ensure that financial losses due to war risks (and piracy) will be largely covered. Policymakers may also elect to maintain the status quo on this statutory authority. The property and casualty insurance industry policyholder surplus is calculated to be approximately \$505 billion (as of June 2008). Vessel hull and war risk premiums in the U.S. market paid to insurers totaled approximately \$350 million in 2007, and the total value of cargo insurance premiums paid in that year was approximately \$833 million, according to industry data. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: View Full Text (pdf); File: /U2/a510020.pdf; Size: 162 KB; Congressional rept. Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA510020. URL: <http://handle.dtic.mil/100.2/ADA510020>.

Library of Congress, Washington, DC, Congressional Research Service and Lee Rensselaer, Perl Raphael. 2002. "Terrorism, the Future, and U.S. Foreign Policy." 30 May. Page(s): 21 Report Number: CRS-IB95112 XJ-CRS/DC Monitor Series: CRS/DC. Abstract: International terrorism has long been recognized as a foreign and domestic security threat. The tragic events of September 11th have dramatically re-energized the nation's focus and resolve on terrorism. This issue brief examines international terrorist actions and threats and the U.S. policy response. Available policy options range from diplomacy, international cooperation, and constructive engagement to economic sanctions, covert action, physical security enhancement,

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and military force. Questions relate to whether U.S. policy and organizational mechanisms are adequate to deal with state-sponsored terrorism and that undertaken by independent groups. Terrorist activities supported by sophisticated planning and logistics as well as possible access to CBRN weaponry raise a host of new issues. Some analysts' long-held belief that a comprehensive review of U.S. counterterrorism policy, organizational structure, and intelligence capabilities is needed has now become a mainstream view. U.S. policy toward international terrorism contains a significant military component as reflected in current U.S. operations in Afghanistan and the Philippines and in planned deployments of U.S. forces to Yemen and the former Soviet republic of Georgia. President Bush has expressed a willingness to provide military aid to governments everywhere in the fight against terrorism. A modern trend in terrorism is toward loosely organized, self-financed, international networks of terrorists. Another trend is toward terrorism that is religiously or ideologically motivated. Radical Islamic fundamentalist groups, or groups using religion as a pretext, pose terrorist threats of varying kinds to U.S. interests and to friendly regimes. A third trend is the apparent growth of cross-national links among different terrorist organizations, which may involve combinations of military training, funding, technology transfer, or political advice. Abstract Classification: Unclassified Technical Reports Collection. Congressional rept. Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA481135. URL: <http://handle.dtic.mil/100.2/ADA481135>.

Library of Congress, Washington, DC, Congressional Research Service and Ploch Lauren Blanchard Christopher M O'Rourke Ronald Mason R Chuck King, Rawle O. 2009. "Piracy Off the Horn of Africa." 28 Sep. Page(s): 40 Report Number: CRS-7-7500 CRS-R40528 XJ-CRS/DC Monitor Series: CRS/DC. Abstract: Pirate attacks in the waters off the Horn of Africa, including those on U.S.-flagged vessels, have brought new U.S. and international attention to the long-standing problem of piracy in the region. The International Maritime Bureau (IMB) recorded 111 attacks in the waters off the Horn of Africa in 2008, almost double the number in 2007. As of September 14, 2009, the U.S. State Department reported 156 attacks had occurred in those waters since January 2009, with 33 successful hijackings. Attacks remain concentrated in the Gulf of Aden between Yemen and the northern coast of Somalia and along Somalia's eastern coastline. However, in July 2009, the United Nations Secretary General warned that as a result of the military presence in the region, pirates have employed more daring operational tactics, operating further seawards, towards the Seychelles, and using more sophisticated weaponry. Pirate attacks continue to threaten commercial shipping and relief shipments bound for East Africa and the Horn, amid a regional humanitarian crisis that experts are calling the worst since 1984. The increase in pirate attacks off the Horn of Africa is directly linked to continuing insecurity and the absence of the rule of law in war-torn Somalia. The absence of a functioning government in Somalia remains the single greatest challenge to regional security and provides freedom of action for those engaged in piracy along the Somali coast. Some observers also have alleged that the absence of coastal security authorities in Somalia has allowed illegal international fishing and maritime dumping to occur in Somali waters, which in turn has undermined the economic prospects of some Somalis and may be providing economic or political motivation to some groups engaged in piracy. The apparent motive of many active Somali pirate groups is profit, and piracy has proven to be a lucrative activity for many thus far. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: View Full Text (pdf); File: /U2/a506650.pdf; Size: 681 KB; Congressional rept.

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Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA506650. URL: <http://handle.dtic.mil/100.2/ADA506650>.

Library of Congress, Washington, DC, Congressional Research Service and Prados Alfred B Sharp, Jeremy M. 2007. "Yemen: Current Conditions and U.S. Relations." 04 Jan. Page(s): 7 Report Number: CRS-RS21808 XJ-CRS/DC Monitor Series: CRS/DC. Abstract: Yemen, the only republic on the Arabian Peninsula, is the poorest country in that area. A presidential election deemed relatively fair was held in 2006 with President Ali Abdullah Salih winning reelection with 77% of the popular vote. Nevertheless, democratic institutions remain fragile. U.S.-Yemeni relations have generally been good, though marred occasionally by policy differences over Iraq and the Arab-Israeli conflict. Yemen has played a cooperative role in U.S. counter-terrorism efforts in the Red Sea and Arabian Peninsula, though overall U.S. economic and military assistance to Yemen remains modest. This report summarizes Yemen's domestic situation, foreign relations, and ties with the United States. It will be updated as significant developments occur. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: View Full Text (pdf); File: /U2/a464733.pdf; Size: 77 KB; Congressional rept. Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA464733. URL: <http://handle.dtic.mil/100.2/ADA464733>.

Library of Congress, Washington, DC, Congressional Research Service and Sharp, Jeremy M. 2009. "Yemen: Background and U.S. Relations." 07 Jul. Page(s): 21 Report Number: CRS-RL34170 XJ-CRS/DC Monitor Series: CRS/DC. Abstract: With limited natural resources, a crippling illiteracy rate, and high population growth, Yemen faces an array of daunting development challenges that some observers believe make it at risk for becoming a failed state in the next few decades. Between 2007 and 2008, it ranked 153 out of 177 countries on the United Nations Development Programme's Human Development Index, a score comparable to the poorest sub-Saharan African countries. Over 43% of the population lives below the poverty line, and per capita GDP is estimated to be between \$650 and \$800. Yemen is largely dependent on external aid from Persian Gulf countries, Western donors, and international financial institutions, though its per capita share of assistance is below the global average. As the country's population rapidly rises, resources dwindle, and terrorist groups take root in the outlying provinces, the Obama Administration and the 111th Congress are left to grapple with the consequences of Yemeni instability. Traditionally, U.S.-Yemeni relations have been tepid, as the lack of strong military-to-military ties, commercial relations, and cross cultural exchange has hindered the development of strong bilateral ties. During the early years of the Bush Administration, relations improved under the rubric of the war on terror, though Yemen's lax policy toward wanted terrorists has stalled large scale U.S. support. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: View Full Text (pdf); File: /U2/a503177.pdf; Size: 394 KB; Congressional rept. Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA503177. URL: <http://handle.dtic.mil/100.2/ADA503177>.

Lichtenhalter, Gerhard. 2003. Political Ecology and the Role of Water: Environment, Society and Economy in Northern Yemen. London: Ashgate. Page(s): 250. Descriptors:  cologisme -- Y men; Approvisionnement en eau -- Y men; Y men -- Conditions sociales. Notes: ill. 23 cm. Bibliography, pages 227-243. Index. ISBN: 0754609081; 9780754609087. OCLC Accession Number: 470493035.

Geology of Yemen

Lichtenthäler, G. Turton, Anthony; University of London; School of Oriental and African Studies and Water Issues Study Group. 1999. Water Demand Management, Natural Resource Reconstruction and Traditional Value Systems a Case Study from Yemen. London: School of African and Oriental Studies, University of London. Descriptors: Water resources management; Water-supply -- Political aspects -- Yemen (Republic); Water resources development -- Yemen (Republic); Yemen (Republic) -- Social conditions. Notes: System Info: Mode of access: World Wide Web. Note(s): "CIAO DATE: 7/99." "SOAS Water Issues Study Group." Includes bibliographical references. Description based on content as of: Feb. 5, 2002; title from title screen. Also available in print version. OCLC Accession Number: 48934187.

Lichtenthaler, Gerhard. 2010. "Water Conflict and Cooperation in Yemen." Middle East Research and Information Project. MER Report Number 254. See the site, accessed on September 13, 2011: <http://www.merip.org/mer/mer254/water-conflict-cooperation-yemen>

Lichtenthäler, Gerhard; King's College, London; University of London and School of Oriental and African Studies. 2003. Political Ecology and the Role of Water: Environment, Society and Economy in Northern Yemen. Aldershot: Ashgate, Projected Date: 200302. Descriptors: Water-supply -- Yemen -- Sa'dah Basin; Political ecology -- Yemen -- Sa'dah Basin; Sa'dah Basin (Yemen) -- Social conditions. Notes: 312 pages: ill., maps; rt. 22cm. Includes index. Bibliography. Responsibility: Gerhard Lichtenthäler. ISSN: 0754609081; 9780754609087. OCLC Accession Number: 316486108; 50520529.

Lichtenthäler, G. Turton, Anthony; University of London; School of Oriental and African Studies and Water Issues Study Group. 1999. Water Demand Management, Natural Resource Reconstruction and Traditional Value Systems a Case Study from Yemen. London: School of African and Oriental Studies, University of London. Descriptors: Water resources management; Water-supply -- Political aspects --; Yemen (Republic); Water resources development -- Yemen; (Republic); Yemen (Republic) -- Social conditions. Notes: System Info: Mode of access: World Wide Web. "CIAO DATE: 7/99." "SOAS Water Issues Study Group." Includes bibliographical references. Description based on content as of: Feb. 5, 2002; title from title screen. Also available in print version. OCLC Accession Number: 48934187.

Lichtenthäler, Gerhard. 2000. Environment, Society and Economy in the Sa'dah Basin of Northern Yemen: The Role of Water. London: Descriptors: Water supply -- Yemen (Republic) --; Sa'dah; Sa'dah (Yemen) -- Social conditions; Sa'dah (Yemen) -- Economic conditions; Sa'dah (Yemen) -- Rural conditions; Thesis/dissertation. Notes: 322 leaves: ill., maps. Dissertation: Thesis (Ph. D.)--SOAS, University of London, 2000. OCLC Accession Number: 451870858.

Liebhaber, Samuel J. 2007. Bedouins without Arabic: Language, Poetry and the Mahra of Southeast Yemen. United States -- California: University of California, Berkeley. ProQuest Dissertations and Theses. Abstract: The Mahri language of Southeast Yemen is one of the few remaining indigenous languages of the Arabian Peninsula. The geographic isolation of the Mahri language has ensured its survival to the present time; this isolation has also caused it to be overlooked in Arab-Islamic formulations of language and history. The Mahri language remains unwritten, despite the fact that it has roughly 100,000 speakers and is by most measures a vital language. However, as paved roads, cell phones and national governance have made their way to al-Mahra, Mahri speakers must now contend with political and linguistic configurations that challenge the traditional linguistic and social landscape of al-Mahra. Looking to reach an accommodation with national models of "Yemeni heritage," the Mahra have simultaneously embraced and eschewed their own, particularizing oral culture. This dissertation undertakes two primary tasks. The first is to offer a survey of Mahri oral culture with reference to traditional

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modes of poetic composition and sung performance. Like other tribal poetic traditions in Arabia, Mahri poetry is a complete suite of expression and the primary mode of communicating social order. Formal structure, musical accompaniment and even poetic vocabulary locate composer and performance in the rich world of intertribal and interpersonal networks. The second objective of this dissertation is to describe Mahri poetics in the post-revolutionary (1967) and post-unification (1990) eras. The leading phenomenon of this last period has been the coalescence of the “New School”: a group of poets and performers who have defined the Mahri stance vis à vis national ideas of culture and heritage. One important contribution of the “New School” has been the invention of a writing system for the Mahri language. The shift from oral performance to written text has entailed a restructuring of poetic grammar, syntax and lexicon. This is amply demonstrated in the Mahri-language Diwan of H[dotbelow]ag g Dak on, presented in its entirety in this dissertation. Between these two approaches, I hope to provide a holistic accounting of Mahri poetry and song from historical, linguistic and ethno-poetic perspectives. At the same time, the gathered corpus of 45+ poems will lay the groundwork for future analysis of the Mahri language and the oral culture of Southern Arabia. University of California, Berkeley: Ph.D. Database: ProQuest Dissertations & Theses.

Lisitsyn, Aleksandr Petrovich; Bogdanov, IU A. and Geologo-Mineralogicheskikh Nauk. 1987. *Geologiya Rifta Tadjhura: Nabludeniia Iz Podvodnykh Apparatov*. Moskva: “Nauka”. Page(s): 236. Descriptors: Rifts (Geology) -- Djibouti -- Tadjoura, Gulf of; Geology -- Djibouti -- Tadjoura, Gulf of; of; Submarine geology -- Aden, Gulf of --; Tadjoura Trough. Notes: ill. 22 cm. Note(s): At head of title: Akademiia nauk SSSR. Institut okeanologii im. P.P. Shirshova. One folded leaf inserted. Includes bibliographical references (p. 226-[231]). Responsibility: otvetstvennye redaktory A.P. Lisitsyn, IU.A. Bogdanov; [A.P. Lisitsyn ... et al. LCCN: 87-172705. OCLC Accession Number: 17628492.

Little, Tom. 1968. *South Arabia: Arena of Conflict*. London: Pall Mall Press. Page(s): 196. Abstract: Another offering from an Arab specialist is provided by Little’s. He was a newspaper correspondent who spent most of his career reporting on Arab events in the Middle East and his position perhaps gave him a more objective viewpoint of the British rule in Aden, although he was not privy to the internal politics in the same way as many of the previously cited authors. Notes: xi, 196 p. maps. 22 cm. OCLC Accession Number: 441083.

Livingston, Morna; Elker, Cuneyt; Bhattarai Upadhyay, Vibha; International Association for the Study of Traditional Environments; University of California, Berkeley and Center for Environmental Design Research. 2008. *Planning and Sustainability in Traditional Environments*. Berkeley, Calif: International Association for the Study of Traditional Environments. Descriptors: City planning -- Congresses; Vernacular architecture -- Congresses; Water-supply -- Yemen -- Congresses; Architecture and society -- Yemen -- Congresses; Transportation -- Turkey -- Ankara -- Planning -- Congresses; Urban policy -- Nepal -- Kathmandu Valley -- Congresses; Conference publication (cnp). Abstract: Cisterns in sanctuaries: sharing water in a tribal culture of violence / Morna Livingston -- Traffic policies for sustainable traditional environments: the case of Ankara Citadel / Cuneyt Elker -- Contemporary urban management system in the Kathmandu Valley, Nepal: a radical departure from the past / Vibha Bhattarai Upadhyay. Notes: 51 pages: ill. ans; 28 cm. Note(s): Cover title. Papers presented at the IASTE conference in Oxford, England in December 2008. “Center for Environmental Design Research ... University of California at Berkeley”--P. [1] of cover. Includes bibliographical references. Responsibility: Morna Livingston, Cuneyt Elker, Vibha Bhattarai Upadhyay. OCLC Accession Number: 320406283.

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Louisiana State Univ Baton Rouge Coastal Studies Inst and Inoue, Masamichi. 1998. "Observation and Modeling -- an Integrated Study of Transport through the Strait of Bab Al Mandam, Task B: Modeling." 15 Aug. Page(s): 4 Report Number: XB-ONR Contract Number: N00014-96-1-1227 Monitor Series: ONR. Abstract: A new bottom bathymetric data set with a resolution of 500 m was created based on the digitization of the nautical charts. A new curvilinear coordinate model grid was generated based on the digitized bathymetric data. The Princeton Ocean Model was configured to use the model grid with two open boundaries located along the northern boundary located in the Red Sea and the southern boundary located in the Gulf of Aden. Relaxation experiments were carried out, whereby the model stratification was initially set to some realistic stratification, and the model was then allowed to develop its own dynamics while applying the radiation open boundary conditions and relaxing the temperature and salinity values along the two open boundaries toward the initial boundary conditions. Summer and winter stratification profiles from Levitus climatology as well as the CTD data collected under Task A were used. The model develops a distinct two layer flow in the winter stratification, while a three layer flow would result in the summer stratification as observed previously. One prominent feature identified in the model is the time dependent nature of the flow with energetic oscillations with periods of 12-15 days especially in summer, similar to what has been noted during the field experiments under Task A. Abstract Classification: Unclassified Technical Reports Collection. Annual rept. 31 Aug 97-30 Aug 98. OCLC Accession Number: ADA352307. URL: <http://handle.dtic.mil/100.2/ADA352307>.

Louisiana State Univ Baton Rouge Coastal Studies Inst and Inoue, Masamichi. 1997. "Observation and Modeling -- an Integrated Study of Transport through the Strait of Bab Al Mandab Task B: Modeling." 15 Aug. Page(s): 3 Report Number: XB-ONR Contract Number: N00014-96-1-1227 Monitor Series: ONR. Abstract: The Princeton Ocean Model (POM), that already includes most of the model features described in the proposal, has been chosen for this modeling task. The latest version of the POM code has been installed and optimized to run on the 13M9672-R53 mainframe at LSU. Significant efforts have been devoted to developing and modifying various software to be used for the analysis of model output. After examining all the available bathymetric data sets of the region, it was decided to digitize the nautical charts published by the Defense Mapping Agency in order to resolve important hydrodynamic features at the Strait of Bab al Mandab. This task has been initiated, and it is expected to be completed in the next two months. Presently, we are testing the POM code configured for a preliminary test domain based on the ETOP03 data. This test domain extends from 11.5 to 14 deg N and from 42 to 44.5 deg E, and has at least 2 km horizontal resolution and 11 levels in the vertical. The initial test includes testing sensitivity of various open boundary conditions which could be used along the northern and the southern open boundaries located in the Red Sea and in the Gulf of Aden, respectively. Abstract Classification: Unclassified Technical Reports Collection. Annual rept. 31 Aug 96-30 Aug 97, DTIC Accession Number: ADA328931. URL: <http://handle.dtic.mil/100.2/ADA328931>.

1982. Lunt, Maj Gen J. D. "Why the Radfan?" British Army Review. August 1982. Issue No. 71, Pages 39-41. ISSN: 0952-4134.

Lyness, Lucien S., Parker, Thomas M., Dabrowski, Tadeusz L., Hardisty, Paul E. and Claridge, Frederic B. 1998. "Exploration and Evaluation of Groundwater Resources in Hadramout, Yemen; Proceedings of the Joint Meeting of the XXVIII Congress of the International Association of Hydrogeologists and the Annual Meeting of the American Institute of Hydrologists on Gambling with Groundwater; Physical, Chemical, and Biological Aspects of

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Aquifer-Stream Relations.” Proceedings of the Joint Meeting of the...Congress of the International Association of Hydrologists and the Annual Meeting of the American Institute of Hydrologists. American Institute of Hydrology, St.Paul, MN, International. Oct. Volume 28, Pages 425-432. Descriptors: aquifers; Arabian Peninsula; arid environment; Asia; exploitation; exploration; ground water; Hadramout Yemen; hydrodynamics; hydrology; mapping; protection; recharge; terrestrial environment; three-dimensional models; topography; water management; water quality; water resources; water supply; Yemen. Database: GeoRef.

Mahdi, Kamil A. Ed; Würth, Anna; Ed; Lackner, Helen and Ed. 2007. Yemen into the Twenty-First Century Continuity and Change. Reading, UK: Ithaca Press. Descriptors: Justice -- Administration -- Yémen -- 1990-. Développement économique -- Aspect de l'environnement -- Yémen -- 1990-.. Yémen -- Politique économique -- 1990-... Yémen -- Conditions sociales -- 1990-... Abstract: Part 1: Structural adjustment and the political economy of Yemen -- Part 2: The legal system -- Part 3: Environment, water and agricultural land tenure -- Part 4: Social and regional issues. Notes: 1 vol. (XXVIII- 464 p.): cartes. 24 cm. Note(s): Bibliogr. p. 431-454. Index. Other Titles: Yemen into the 21st century; Part 1: Structural adjustment and the political economy of Yemen. Part 2: The legal system. Part 3: Environment, water and agricultural land tenure. Part 4: Social and regional issues. Responsibility: edited by Kamil A. Mahdi, Anna Würth and Helen Lackne. ISBN: 0863722903; 9780863722905. OCLC Accession Number: 494504867.

Mahyoub H. Al Buhairi. 2010. “Analysis of Monthly, Seasonal and Annual Air Temperature Variability and Trends in Taiz City - Republic of Yemen.” Journal of Environmental Protection . Volume 1 (4), pages 401-409. Keywords: Air Temperature; Climate Change; Republic of Yemen; Taiz City; Mann–Kendall Test; Trends. Abstract: Climate change is one of the most important issues of today’s World. Climate scientists have concluded that the earth’s surface air temperature warmed by 0.6 to 0.2°C during the 20th century, accompanied by changes in the hydrologic cycle. Of all the climate elements, temperature plays a major role in detecting climate change brought about by urbanization and industrialization. This study focuses on the variability and trends of the mean annual, seasonal and monthly surface air temperature in Taiz city, Republic of Yemen, during the period 1979-2006. The results of the analysis of the whole period reveal a statistically significant increasing trend in practically all the months and seasons. A tendency has also been observed towards warmer years, with significantly warmer summer and spring periods and slightly warmer autumn and winter, an increase of 1.79°C and 1.18°C has been observed in the mean summer and mean winter temperature, respectively. Positive trends of about 1.5°C in the annual mean temperature were found for the whole period. The air temperature time series are analyzed, so that the variability and trends can be described. ISSN: 2152-2197.

Maktari, Abdulla M. A. 1971. Water Rights and Irrigation Practices in Lahj: A Study of the Application of Customary and Shari`ah Law in South-West Arabia. Cambridge: University Press. Descriptors: Irrigation; Yemen; Yemen (Republic); Lahij (Province); Islamic law; Water rights; Water-rights. Notes: VII, 202 S: Ill., Kt; 26 cm. Note(s): Bibliography: p. [191]-197. Responsibility: [by] A. M. A. Maktari. ISBN: 0521079306; 9780521079303. OCLC Accession Number: 299840655; 247415.

Malhotra, S.P. 1969. Southern Yemen: Irrigation and agricultural development planning: report to the government. 28 pages. 9 tab. Democratic Yemen; Agricultural Development; Irrigation; Planning; Economic Situation; Costs; Profit; Trade; Trade Policies; National

Geology of Yemen

Planning. UNDP TA PROJECT. Report No: ESE-UNDP/TA 2707. FAO Accession Number: 112572.

Malkin, Brendan. 2002. "Holman Forces Yemen Government to Back Down Over Pollution Claim." *Lawyer*. Centaur Communications: 11/11. Volume 16, Issue 45, Pages 11. Descriptors: Shipping; Terrorism; Yemen (Republic); Holman Fenwick Willan LLP; Compagnie Maritime Belge SA. Abstract: Reports that a campaign of political, diplomatic and legal pressure instigated by shipping-law firm Holman Fenwick & Willan has resulted in the Yemen government backing down over its claim against the owners of the Belgium ship attacked off Yemen by terrorists in October 2002. Dispute over Yemen's decision to seek compensation for pollution caused by the attack; Holman's action in behalf of the ship owner, Belgium's CMB Group. ISSN: 0953-7902.

Marcolongo, Bruno and Bonacossi, Daniele Morandi. 1997. "L'Abandon Du Système d'Irrigation Qatabanite Dans La Vallée Du Wadi Bayhan (Yémen): Analyse Géo-Archéologique." Translated title: "The abandonment of the irrigation system Qatabanite in the Valley of Wadi Bayhan (Yemen): Geo-Archaeological Analysis." *Comptes Rendus De l'Académie Des Sciences - Series IIA - Earth and Planetary Science*. 7. Volume 325, Issue 1, Pages 79-86. Descriptors: Télédétection; Géomorphologie; Néotectonique; Archéologie; Yémen; Systèmes d'irrigation antiques; Remote sensing; Geomorphology; Neotectonics; Archaeology; Yemen; Ancient irrigation systems. Abstract: Résumé. ISSN: 1251-8050.

Matloob, M. H. 2003. "Determination of Cadmium, Lead, Copper and Zinc in Yemeni Khat by Anodic Stripping Voltammetry." *East. Mediterr. Health J*. Volume 9, Issue 1-2, Pages 28-36. Notes: Cited By (since 1996): 3. Abstract: Trace element concentrations in khat were investigated as they can disturb trace element levels in the body. Cadmium (Cd), lead (Pb), copper (Cu) and zinc (Zn) levels in khat and 6 leafy vegetables commonly consumed in the Republic of Yemen were determined by differential pulse anodic stripping voltammetry after wet digestion of the organic matter. Khat had significantly higher concentrations of Cu and Zn than did the leafy vegetables, but similar amounts of Cd and Pb. The average daily intake of khat consumers of Cd, Pb, Cu and Zn from khat only was estimated to be 2.0-10.2 µg/day, 23.6-118.0 µg/day, 530-2654 µg/day and 662-3311 µg/day respectively. Although high, these values were within Food and Agriculture Organization/World Health Organization tolerance limits. Database: SCOPUS. ISSN: 1020-3397.

Matt, Silvia and Johns, William E. 2007. "Transport and Entrainment in the Red Sea Outflow Plume." *J. Phys. Oceanogr. American Meteorological Society*: 04/01; 2011/04. Volume 37, Issue 4, Pages 819-836. Abstract: The Red Sea outflow exhibits strong seasonal variability in outflow transport due to effects of monsoon winds and seasonal fluctuations in buoyancy forcing. As it descends the continental slope in the western Gulf of Aden, it entrains significantly less-dense near-surface water, which itself varies on seasonal time scales. High-resolution hydrographic and direct velocity data collected during the 2001 Red Sea Outflow Experiment (REDSOX) are used herein to characterize and quantify the pathways of the Red Sea Outflow Water (RSOW) and the associated entrainment of Gulf of Aden Water. The outflow transport exhibits a maximum in winter of about 0.29 Sv ($Sv \equiv 10^6 \text{ m}^3 \text{ s}^{-1}$) at the exit of the Bab-el-Mandeb and approximately doubles to 0.56 Sv as it descends into the Gulf of Aden and entrains ambient water. In summer, the outflow is much weaker, reaching about 0.06 Sv at the strait and about 0.18 Sv downstream. The outflow plume divides into three distinct branches in winter, consisting of descending branches along two bathymetrically confined channels (the "Northern" and "Southern" channels, respectively), and an adjusted intrusion layer at shallower depths in the water column. Estimates of transport of "pure" Red Sea Outflow Water through salt flux conservation show the general partitioning of the outflow between the individual plumes, where the Northern Channel

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(NC) accounts for 52% of Red Sea Outflow Water, the Southern Channel (SC) carries 31%, and the intrusion layer (IL) the remaining 17%. The results also indicate that the transport of Red Sea Outflow Water is subject to considerable synoptic temporal variability that is unresolved by the present study. ISSN: 0022-3670. URL: <http://journals.ametsoc.org/doi/abs/10.1175/JPO2993.1>.

Mattash, M. A., Wood, S. A., Vaselli, O., Minnisale, A., Selmo, E. and Shawki, M. N. 2004. "Rare-Earth Elements in Geothermal Waters from Yemen; Italia 2004; 32nd International Geological Congress; Abstracts." International Geological Congress, Abstracts = Congres Geologique International, Resumes. [International Geological Congress], [location varies], International; Abstracts = Congres Geologique International, Resumes. Aug. Volume 32, Part 2, Pages 1188. Descriptors: Arabian Peninsula; Asia; Cenozoic; chemical composition; chemical ratios; concentration; experimental studies; geochemistry; hydrochemistry; igneous rocks; La/Yb; lanthanum; metals; rare earths; Tertiary; thermal waters; volcanic rocks; water-rock interaction; Yemen; ytterbium. Notes: SP: IGC, International Geological Congress. Database: GeoRef.

Mattash, Mohamed Ali. 2008. "Fundamental Criteria for Exploring the Geothermal Resources of Yemen; 33rd International Geological Congress; Abstracts." International Geological Congress, Abstracts = Congres Geologique International, Resumes. [International Geological Congress], [location varies], International. Volume 33, Pages @Abstract 1287119. Descriptors: Arabian Peninsula; Arabian Sea; Asia; Cenozoic; exploration; geothermal energy; ground water; Gulf of Aden; heat flow; hot springs; Indian Ocean; Neogene; Quaternary; Red Sea; Red Sea region; seismicity; springs; Tertiary; thermal conductivity; thermal regime; thermal waters; volcanic fields; volcanism; Yemen. Notes: IGC, International Geological Congress. Abstract: A recent comprehensive investigation of Yemen indicates considerable geothermal potential for the country, especially in Western Yemen, based on six criteria. These include: 1) volcanic activity, 2) regional structural patterns, 3) hydrothermal activity, 4) active thermal features, 5) seismic activity and 6) high conductive heat flow. Eight major Miocene to Recent volcanic fields are known. Three are found in the western province of Yemen, four occur along the coastal plain of the Gulf of Aden and the Islands Group in the southern Red Sea has the active volcano of Jabal At-Tair Island. All the structural patterns displayed in the rift-related volcanic area, are associated with major tectonic components of the Red Sea and less commonly with the Gulf of Aden. NW-trending faults, frequently cutting across Cenozoic volcanic units are more or less parallel to the main Red Sea trend. Aeromagnetic surveys mapped large magnetic anomaly domains trending NW, W-NW, and E-W related to hydrothermal circulation cells associated with shallow intrusions capable of generating epithermal mineralization and geothermal systems. In excess of 100 thermal springs have recently been reported. Discharge temperatures of thermal springs range from 38 degrees C to boiling. In addition, fumaroles, condensates and hot well waters are recognized. The majority of thermal zones in the western province strike NW-SE parallel to the main Red Sea trend, whereas the thermal features along the southern coastal plain trend NE-SW parallel to the main Gulf of Aden trend. Several historic earthquakes have been reported in western Yemen, in particular between the sixth and nineteenth centuries. Most recently, earthquakes reported in the last three decades are concentrated in the Gulf of Aden, the Red Sea, Afar and the western continental province of Yemen. The present conductive heat flow in the Red Sea varies from 94 to 154 mW/m (super 2) and the geothermal gradient ranges from 49 to 77 degrees C/km, as indicated by temperature data obtained from several oil and gas wells drilled from the sixties to the present. In addition, the physical convective phenomenon beneath SW Yemen, detected by space imagery, is one of the most significant in terms of heat flow in the whole Afro-Arabian rift system. Such heat flow values

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have more or less affected the thermal equilibrium between the upper mantle and the crust. This has resulted in the formation of the relatively large and widely distributed epithermal alteration haloes, particularly throughout the Yemen Cenozoic volcanic areas and also, the occurrence of geothermal fields. It can be inferred that Yemen, the western part in particular is not a stable continental zone. It is characterized by some indications of elevated crustal magmas and thermal convective phenomena related to deep crustal fracture systems, as well as by several late Miocene-Recent volcanic fields and seismic activity. Together these factors have encouraged the search for geothermal resources. Database: GeoRef.

Mattash, Mohamed Ali. 2008. "Geology and Geochemistry of the Sedimentary-Hosted Lead-Zinc-Vanadium-Barite Prospects in Yemen; 33rd International Geological Congress; Abstracts." International Geological Congress, Abstracts = Congres Geologique International, Resumes. [International Geological Congress], [location varies], International; Abstracts = Congres Geologique International, Resumes. Volume 33, Abstract #1287218. Descriptors: Al-Masila Basin; Arabian Peninsula; Asia; barite deposits; geochemistry; geophysical surveys; host rocks; hydrothermal alteration; lead ores; lead-zinc deposits; metal ores; metasomatism; mineral deposits, genesis; ore minerals; sedimentary rocks; structural controls; surveys; vanadium ores; Wadi al Masilah; Yemen; zinc ores. Notes: SP: IGC, International Geological Congress. Abstract: The prospect area is located in the southeastern part of the so called Wadi Al-Masilah Basin. It is hydrothermally altered and totals 256 km (super 2) , in which lead-zinc-vanadium and barite mineralization occurs through an area of 16 km (super 2) . Prior to development of this prospect Mattash and his geologic team had reported discovery of vanadium, and commenced prospect development. They reported a fracture filling barite, galena, smithsonite, cerrusite, descloizite, and celestine mineralization, therefore, extensive field survey, guided by geological, geochemical and geophysical exploration was carried out and sponsored by Naine Minerals Company for the purpose of identifying ultimate economic resource. This terrain has undergone a complex geologic and structural history which was affected, in general, by the synrift and the postrift phases of the opening of the Gulf of Aden. Geology is composed of Jurassic limestone, Cretaceous undifferentiated materials including shale, marly limestone, dolomitic limestone, sandstone and clastic material. This is overlain by the Tertiary carbonate of Um Er-Rhaduma Formation. Within the prospect several small areas are covered by Quaternary basaltic lavas that erupted from the NW area, and extend along the southeastern part of the wadi. Structurally the area is controlled by W-NW faults and fractures. Geophysical survey indicates vertical and near-vertical faults that are filled with mineralization, in addition a number of cavities, which are formed as a consequence of the action of water are also filled with mineralization. Alteration is represented by limonitization and silicification which is common feature in the dolomitic limestone. Mineralization consists of barite, galena, smithsonite, cerrusite, descloizite, calcite, pyrolusite and celestine, as well as slightly anomalous Ag, Cd, Ga, Ge, and Mo. Geochemically, vanadium at the surface and within shallow depth indicates oxyphile affinity, where vanadium concentration shows similar mechanism to the formation of iron "laterite infiltration". One of these varieties is the oxidation zone of the polymetallic lead-zinc-vanadium-manganese occurrences, where errusite, smithsonite, descloizite, and pyrolusite, are concentrated as independent heavy metal minerals, and vanadium is found as V+5. Vanadium concentrations occur, either in association with lead-zinc as vanadate or in the fissures of silicified limestone and dolomite, and also as patches on the surface of mechanically formed limestone. Barite is formed as a result of hydrothermal process, and/or as the result of weathering zone, where Ba mainly reached the solution in the form of BaCl (sub 2) , but when reacts with SO (sub 4) -root,

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it forms barite immediately. Whatever the ultimate resource of the metallic and non-metallic raw materials, the ore minerals were formed and concentrated by the affect of hydrothermal process that caused by the Quaternary volcanic eruption extruded throughout the main trend of Wadi Al-Masila. Database: GeoRef.

Mattash, Mohamed Ali. 2008. "Rare Earth Elements in Geothermal Waters from Yemen; 33rd International Geological Congress; Abstracts." International Geological Congress, Abstracts = Congres Geologique International, Resumes. [International Geological Congress], [location varies], International; Abstracts = Congres Geologique International, Resumes. Volume 33, Pages @Abstract 1287254. Descriptors: Arabian Peninsula; Asia; geochemistry; ground water; heat flow; hot springs; hydrochemistry; igneous rocks; metals; rare earths; springs; thermal waters; volcanic rocks; water-rock interaction; Yemen. Notes: IGC, International Geological Congress. Abstract: Thermal springs and gas vents are widely distributed, but the majority is found in areas associated with igneous centers of Tertiary and Quaternary volcanic fields of the western Yemen province. Structurally these volcanic complexes are connected to N-NW faults that are parallel to the main Red Sea trend, and partially associated with relatively shallow Tertiary felsic intrusions. The western volcanic province is characterized by unusually high heat flow. Estimates of heat flow in this region range from 94-154 mWm (super -2) . In support of this claim, data are obtained from several oil and gas wells drilled since the sixties up to now. In addition, the physical convective anomaly beneath the southwestern Yemen that is detected by space imagery still is one of the most important in the whole region of the Afro-Arabian rift system. Results of geochemical analysis indicate that the Yemeni thermal waters have high variability in composition since they are Na (K)-Cl, Na-HCO (sub 3) , and Ca (Mg)-SO (sub 4) types. Most filtered and unfiltered samples have a relatively steep chondrite-normalized REE negative slope patterns. However, in contrast to the relatively steep distribution of the HREE, two water samples, which emerge from post Tertiary granite and from Cretaceous sandstone display the flattest HREE. The REE concentrations in the thermal waters from Yemen range from approximately 10 (super -3) to 10 (super -6) times chondrite. However, filtered water samples contain relatively less REE concentrations than the unfiltered samples, suggesting that much of the REE in the unfiltered samples is present as particulate matter. In some samples the difference between filtered and unfiltered samples is not significant. A marked observation is that the thermal waters from the metamorphic basement and volcanic areas, which have the highest pH and lowest total dissolved solids content, also have the highest REE content, in both the filtered and unfiltered aliquots. However, thermal waters from sedimentary cover area have the lowest pH and relatively the highest total dissolved solids content, have the lowest REE content. A notable finding is that both the volcanic rocks and the thermal waters emerging from them, all display similar LREE-to-HREE pattern with La/Yb average ratios between 10 and 18, suggesting that the REE patterns of the thermal waters follow the REE patterns of the reservoir rocks. However, waters from sedimentary cover area have La/Yb average ratio exceeding 20. Thermal waters emerging from the basaltic rocks indicate that the REE content increases from the southern part towards the northern part of the Tertiary volcanic province. A positive Eu anomaly was only displayed by thermal waters from areas overlain by sedimentary rocks. Such positive Eu anomalies may indicate higher reservoir temperatures, clearly confirm the presence of two types of reservoir, or ascribed to the high Ca content within the gypsum evaporitic deposit. Database: GeoRef.

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Matthews, Donald J. and Ellis, B. A. 1928. "The Ratio of Magnesium to Chlorine in the Waters of the Eastern Mediterranean and Gulf of Aden." ICES J. Mar. Sci. September 1. Volume 3, Issue 2, Pages 191-193. ISSN: 1095-9289.

McJunkin, Frederick E. 1969. "Community Water Supply in Developing Countries: A Quarter-Century of United States Assistance." 86 pages. Department of State Agency for International Development. Washington, DC. United States Public Health Service. Descriptors: Water Supply; Foreign Countries; Federal Government; Sanitation; Training; Foreign Research; Geographical Regions; Public Health; Economic Impact; Reviews; Regions; Social Impact; Foreign Aid; Brazil; East Pakistan; Thailand; Yemen. Abstract: the history and status of United States technical and capital assistance (a billion dollars since 1942) for water supply in developing countries are reviewed by region and country, including its context as part of foreign aid generally and its growth from early days (1942) in latin america to a global program and an important element of multilateral programs. The essential role of water supply in developing countries (why foreign aid for water supply) is reviewed with particular attention to health (500 million water-related illnesses annually), economic development, nutrition, population control, and political and social development. Current deficiencies and needs are outlined by region. Six projects from the hundreds undertaken are highlighted as examples of educational assistance (regional school of sanitary engineering for central america), development and strengthening of a national water supply program (brazil), institution-building (department of public health engineering in east pakistan), technological development (new handpump for wells), capital assistance (john f. Kennedy memorial water system in yemen), and rural water supply (thailand). Lessons and observations based on a quarter-century of experience include: (1) community water supplies in developing countries are still generally inadequate despite recent progress; (2) community water supplies are essential investments for community development and sustained economic growth, they encourage progressive forces, emphasize human progress, and stimulate self-help concepts; (3) a self-liquidating water supply system is a feasible goal for urban communities of even the poorest countries; (4) well-conceived, well-engineered water supply projects can attract international financing; (5) preventive health programs that ignore water supply are invariably failures; (6) deficiencies in personnel and in institutions are currently the critical factors in development of community water supplies, not technology and probably not capital--a realistic program for improvement will require attention to institution building and personnel training; (7) the major accomplishment of the community water supply program is not hardware but the progress to date in establishment or strengthening of water supply institutions; however technical assistance must be continued until these have ripened to full maturity. Notes: "[Prepared] for the Office of War on Hunger, United States Agency for International Development, under terms of a contractual agreement with the Office of International Health, United States Public Health Service." Imprint on cover: Washington: Dept. of State, Agency for International Development. Database: Water Resources Abstracts. OCLC: 21769941.

Medina, Jr, Miguel A. 2010. "Global Water Crisis and Climate Change." J. Hydrol. Eng. ASCE: March 2010. Volume 15, Issue 3, Pages 167-170. URL: <http://link.aip.org/link/?QHE/15/167/1>.

Mehari, A. Mehari, A. van Steenbergen, F. and Schultz, B. 2007. Water Rights and Rules, and Management in Spate Irrigation Systems in Eritrea, Yemen and Pakistan. Descriptors: Eritrea; Yemen; Pakistan; Water rights; Irrigation management; Spate irrigation; Bunds; Flood water. Abstract: Spate irrigation is a system of harvesting and managing flood water. In spate irrigation, flood water is emitted from *wadis* (ephemeral streams) and diverted to fields using

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earthen or concrete structures. By nature, flood water is unpredictable in occurrence, timing and volume, which puts special challenges to the farmers who use, co-share and co-manage the resource. Primarily based on the research conducted in spate irrigation systems in Eritrea, Yemen and Pakistan, this chapter discusses the interlinkage between local flood water management and water rights and rules, and the enforcement mechanisms in place. It assesses how formal national/provincial land and water laws affect local flood water management and argues that what matters most are the local rules for cooperation and sharing the resource and, hence, that formal water and land rights for spate irrigation should recognize local water rights and management. Notes: Genre/Form: Book/Monograph chapter; General Info: Source of Data: Comprehensive Assessment of Water Management in Agriculture Series 5. OCLC Accession Number: 671230236. URL: <http://publications.iwmi.org/pdf/H040690.pdf> .

Mehari, Abraham; van Steenberg, F. and Schultz, B. Water Rights and Rules, and Management in Spate Irrigation Systems. International workshop on 'African Water Laws: Plural Legislative Frameworks for Rural Water Management in Africa', 26-28 January 2005, Johannesburg, South Africa Descriptors: Eritrea; Yemen; Pakistan; Water rights; Spate irrigation; Flood water. Abstract: Spate irrigation is a floodwater harvesting and management system. Floodwater is unpredictable in occurrence and amount. It is emitted through wadis (ephemeral streams) and diverted to fields using earthen or concrete structures. Primarily based on the research conducted in some spate irrigation systems in Eritrea, Yemen and Pakistan, this paper discusses the impact on floodwater management of several water rights and rules, and the enforcement approaches used by various local organizations. It analyses if and how the water rights and rules have been tailored in response to changes in events in time, such as increase in irrigated area and structural modernizations; and how these affected the floodwater management. It assesses why national/provincial water laws became necessary for floodwater management following the modernization. The paper concludes by outlining what water rights and rules can achieve when applied in situations they were prepared for, and how negative their consequences can be otherwise. Notes: Genre/Form: Book / Monograph chapter. OCLC Accession Number: 671230366. URL: <http://publications.iwmi.org/pdf/H038760.pdf>.

Mekonnen, Ademe and Rossow, William B. 2011. "The Interaction between Deep Convection and Easterly Waves over Tropical North Africa: A Weather State Perspective." J. Climate. American Meteorological Society: 03/22; 2011/04. Abstract: The interaction between deep convection and easterly waves over tropical North Africa is studied using a weather state (WS) dataset from the International Cloud Climatology Project (ISCCP) and reanalysis products from the European Centre for Medium-Range Weather Forecast, as well as radiative fluxes from ISCCP and a precipitation dataset from the Global Precipitation Climatology Project. Composite analysis based on 21 yr of data shows that stronger latent and radiative heating of the atmosphere are associated with stronger, more organized, convective activity than with weaker, less organized, convective activity, implying that any transition from less to more organized and stronger convection increases atmospheric heating. Regression composites based on a meridional wind predictor reveal coherent westward propagation of WS and large-scale wind anomalies from the Arabian Sea into East Africa and through West Africa. The analysis shows that enhanced, but unorganized, convective activity, which develops over the Arabian Sea and western Indian Ocean, switches to organized convective activity prior to the appearance of the African easterly wave (AEW) signature. The results also suggest that low-level moisture flux convergence and the upper-tropospheric wind divergence facilitate this change. Thus, the upper-level easterly waves, propagating into East Africa from the Indian Ocean, enhance one form of convection, which interacts with the Ethiopian highlands to trigger another, more organized, form of convection that, in turn, initiates the low-level AEWs. ISSN: 0894-8755. URL: <http://journals.ametsoc.org/doi/abs/10.1175/2011JCLI3900.1>.

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Merabet, Z. 1984. "How the Yemen is Trying to Meet the Aims of the Water Decade." *Waterlines* 2.4 (1984): 7-12. Abstract: After reviewing the topography and water resources of the Yemen Arab Republic, measures being taken to improve the availability of safe water supplies, particularly for rural areas are described. There are no year-round sources of surface water, and the safest source of drinking water is groundwater obtained from shallow dug wells or boreholes. The problems of financing such projects are discussed. ISSN: 0262-8104.

Mettananda, Doluweera Changa Areendra. 2005. *Permeability Reduction in Qishn Sandstone Formation due to Produced Water Re-Injection*. Canada: University of Calgary (Canada). ProQuest Dissertations and Theses. Abstract: Produced water re-injection (PWRI) is seen as an effective technique to manage the large amount of water produced during oil recovery operations. Permeability reduction caused by the particles being retained within porous formations is a major problem that reduces the effectiveness of this process. This thesis presents an investigation carried out to investigate the mechanisms of clogging, and to estimate mathematical model parameters in relation to the water injection operations in Qishn sandstone formation, Masila block, Yemen. During the experimental investigation, a laboratory-synthesized particle suspension was injected into Qishn sandstone specimens at different flow rates and concentrations. Results indicated the existence of three retention mechanisms, namely, deposition, bridging and external cake formation. Permeability damage was distributed over the entire specimen. A phenomenological mathematical model was used to simulate the experimental results, and back calculate the model parameters. The model reasonably predicted the observations, but the variations of each parameter with flow velocity and injection concentration suggested the need to account for different retention mechanisms using different constitutive relationships. University of Calgary (Canada); M.Sc. Database: ProQuest Dissertations & Theses.

Metwali, R. 2002. "Groundwater Quality in Taiz City and Surrounding Area, Yemen Republic." *Arab Gulf Sci. Res.* Volume 20, Issue 1, Pages 50-54. Descriptors: Groundwater; Pollution; Taiz; Total coliform (TC) and Faecal coliform (FC); Yemen. Abstract: Fifty one water samples were collected from production wells used for human consumption from Taiz city and its surroundings, Yemen Republic. The water quality was investigated with respect to bacteriological and physico-chemical parameters. The achieved results revealed that most water samples, especially from private wells, contain a high number of total coliforms (TC) which exceed the permissible limit recommended by the World Health Organisation, WHO (1996). Also, faecal coliforms (FC) were recorded in the majority of polluted samples. A quantitative estimation was done for each of temperature (18-26°C), pH (6.12-8.79), total hardness (58-2200 mg/L), electrical conductivity (218-4600M.Mohs), total dissolved solids (117-3700mg/L), nitrate (10-187mg/L) and type of aquifer (rocky and alluvium). It is worthy to notice that from the total of fifty-one wells, there was pollution in (65%) of them. Recommendations were suggested for the treatment of the water of such polluted wells and rigid government control in a trial to prevent human and animal illness. Database: SCOPUS. ISSN: 1015-4442.

Metwali, R. M. 2003. "Water Quality of some Wells in Taiz City (Yemen Republic) and its Surroundings." *Folia Microbiol.* Volume 48, Issue 1, Pages 90-94. Notes: Cited By (since 1996): 2. Abstract: Bacteriological and physicochemical parameters were determined in water samples collected from fifty-one producing wells used for human consumption in Taiz City (Yemen Republic) and its surroundings. Most water samples, especially from private wells, contained a high concentration of total coliforms which greatly exceeded the permissible limits recommended by the World Health Organization in 1996. Faecal coliforms were found in the

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majority of polluted sampled waters (65% of the total of wells examined). Database: SCOPUS. ISSN: 0015-5632.

Mezhelovsky, Nickolay V (Mezhelovskiy, Nickolay V.), Korchuganova, Nelly I. and Mezhelovsky, Ilya N (Mezhelovskiy, Ilya N.). 2000. "The Geophysical and Neotectonic Application to Groundwater Research in the South Arabian Plate; Brazil 2000; 31st International Geological Congress; Abstracts Volume." International Geological Congress, Abstracts = Congres Geologique International, Resumes. [International Geological Congress], [location varies], International; Abstracts = Congres Geologique International, Resumes. Aug. Volume 31, Descriptors: aquifers; Arabian Peninsula; Arabian Plate; Arabian Sea; Asia; block structures; Cenozoic; clastic rocks; Cretaceous; electromagnetic methods; exploration; faults; geophysical methods; grabens; ground water; Gulf of Aden; igneous rocks; Indian Ocean; mapping; Mesozoic; neotectonics; NMR spectra; plate tectonics; Red Sea; Red Sea Rift; rifting; sandstone; sea-floor spreading; sedimentary rocks; spectra; systems; Taiz Yemen; Tawilah Group; tectonics; Tertiary; transient methods; volcanic rocks; Yemen. Database: GeoRef.

Miclea, Pavel. 1973. Republica Arabă Yemen. Ministerul Minelor, Petroleului și Geologiei. Bucharesti, Romania. A monograph on the geology and geography of Yemen. In Romanian. OCLC: 02948483.

Middendorp, U. G. 1969. "Observations on Native Medicine in North Yemen." *Acta Tropica*. Volume 26, Issue 1, Pages 1-14. Notes: Cited By (since 1996): 1. Database: SCOPUS. ISSN: 0001-706X.

Milanovic, Branko. 2008. "Qat Expenditures in Yemen and Djibouti: An Empirical Analysis." *J. Afr. Econ.* November 1. Volume 17, Issue 5, Pages 661-687. Abstract: Using household surveys from Yemen and Djibouti, the paper analyses determinants of qat consumptions in two countries. The results confirm huge importance of qat in daily life: with between one-half (in Djibouti) and 70% (in Yemen) of all households reporting at least one user. But in Yemen, qat consumption is remarkably flat across income groups, age, and between rural and urban areas. Qat is a normal good and there is no indication that its use substitutes for food. In Djibouti, however, qat consumption increases with income, and appears to act as a substitute for food consumption. In both countries however there is a strong gender bias in the use: men are much more likely to use qat than women. ISSN: 1464-3723.

Military Academy West Point NY Combating Terrorism Center and Brachman Jarret, Warius Abdullah. 2008. "CTC Sentinel. Volume 1, Issue 6, may 2008. Abu Yahya Al-Libi's Human Shields in Modern Jihad." May. Page(s): 26 Report Number: XA-MA/CTC Monitor Series: MA/CTC. Abstract: In the course of defending al-Qa'ida against charges of unjustly killing innocent Muslims during his April 2, 2008 open interview, Dr. Ayman al-Zawahiri reintroduced *Hukm al-Tatarrus* (the law on using human shields) into the debate. A relatively unfamiliar term to non-Muslims and Muslims alike, *al-Tatarrus* refers to God's sanctioning of Muslim armies that are forced to kill other Muslims who are being used as human shields by an enemy during a time of war. *Al-Tatarrus* is a religiously legitimate, albeit obscure, Islamic concept that al-Qa'ida ideologues have been increasingly using in order to exculpate themselves from charges of apostasy. The method in which al-Qa'ida is promoting *al-Tatarrus*, however, seeks to facilitate the sacrifice of Muslim lives in contravention of 14 centuries of religious teachings. For instance, both al-Qa'ida in the Arabian Peninsula and the al-Qa'ida Organization in Yemen hid behind the protections offered by *al-Tatarrus* in their justification of terrorist attacks that resulted in significant Muslim casualties, al-Qa'ida's use of *al-Tatarrus* was also at the heart of Sayyid Imam Sharif's recent attacks against al-Zawahiri and al-Qa'ida. Abstract

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Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: View Full Text (pdf); File: /U2/a493788.pdf; Size: 606 KB; Journal; Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA493788. URL: <http://handle.dtic.mil/100.2/ADA493788>.

Military Academy, West Point, NY, Combating Terrorism Center and Cook, David. 2006. "Paradigmatic Jihadi Movements." Jan. Page(s): 33 Report Number: XA-MA/CTC Monitor Series: MA/CTC. Abstract: In January 2005, veteran jihadi thinker, propagandist, and historian Abu Musab al-Suri released his 1,600 page study of the jihadi movement, *Dawat al-muqawama al-Islamiyya al-alamiyya* (The Call for Global Islamic Resistance). Suri hoped this book would stimulate the creation of a comprehensive jihadi curriculum for future generations of jihadi fighters, thinkers, and activists who could learn from the mistakes and successes of jihads past. In *The Call*, Suri identifies twenty-five paradigmatic jihadi movements, or particularly edifying historical cases, where jihadis have both succeeded and failed to rally supporters, defeat their opposition, or establish territorial control. However, many of these jihadi movements are very obscure, and, consequently rarely studied within the Western counterterrorism community. In order to better appreciate the jihadi movement's strategic objectives and mindset, the Combating Terrorism Center at West Point invited David Cook, an expert on Islamic history and jihad, to provide deeper background on four of Suri's identified paradigmatic jihads: 1. The experience of the *Harakat al-Shabiba* in Morocco (1969) 2. The experience of the *Harakat al-Dawla al-Islamiyya* in Algeria (1982-1987) 3. The experience of the Afghani Arabs in Lebanon under Abu A'isha al Lubnani 4. The experience of the Islamic Army of Aden Abyan in Yemen during the 1990s. Despite the factual errors Cook identifies throughout Suri's work, the latter's stature in the jihadi movement means that future jihadis will take his analysis seriously and model their strategies accordingly. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: View Full Text (pdf); File: /U2/a458498.pdf; Size: 279 KB; Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA458498. URL: <http://handle.dtic.mil/100.2/ADA458498>.

Military Academy West Point, NY, Combating Terrorism Center and Johnsen Gregory, D. Boucek Christopher. 2008. "CTC Sentinel. Volume 1, Issue 12, November 2008. the Dilemma of the Yemeni Detainees at Guantanamo Bay." Nov. Page(s): 29 Report Number: XA-MA/CTC Monitor Series: MA/CTC. Abstract: More than one-third of the remaining 255 detainees at the U.S. detention facility in Guantanamo Bay are Yemenis, representing the single largest national contingent. Since the detention facility opened in early 2002, Yemenis have consistently comprised a sizeable percentage of the population. Other countries, most notably Saudi Arabia, have successfully repatriated many of their nationals, but Yemen has been unable to convince the United States to release detainees into its custody. There is even widespread speculation in both the United States and Yemen that the Yemeni government does not actually want the detainees back and is content to let them remain in U.S. custody. The Yemeni government, however, maintains in private its stated, public goal to return the detainees to Yemen, charge those it has evidence against and release the rest. For the United States, this has been insufficient, and it has repeatedly sought assurances from the Yemeni government that it will set standardized restrictions before any individuals are released. Part of this hesitation stems from security concerns about what would happen to the detainees once they are returned to Yemen. This article seeks to examine the dilemma posed by the detention of Yemeni nationals at Guantanamo Bay. Abstract Classification: Unclassified Technical Reports Collection.

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Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA493761. URL: <http://handle.dtic.mil/100.2/ADA493761>.

Millington, Andrew C. and Crosetti, Michael. 1992. "Rapid Appraisal of Biomass Resources: A Case Study of Northern Yemen." *Biomass Bioenergy*. Volume 3, Issue 2, Pages 93-104. Descriptors: Yemen; woody biomass; inventory; rapid resource appraisal. Abstract: A reconnaissance survey of woody biomass stocks in the northern Governorates of the Republic of Yemen was undertaken in 1988. Sample sites for field measurements were selected in a stratified sample framework based on land-use zones. The data collected on trees and shrubs in the sample plots were used to estimate woody biomass stocks (both as total above-ground volume and wet weight) using equations developed for N. E. Africa. Wood productivity was estimated using a rainfall-productivity equation. These estimates were aggregated to provide a national estimate of woody biomass. Dead wood stocks were also estimated. A map of woody biomass supply areas and the main fuelwood supply routes was constructed from primary and secondary data. This map was used to place the results of the inventory in a spatial context, and to provide a qualitative means of validating the spatial variability in the woody biomass stock estimates. ISSN: 0961-9534.

Milton, Richard. 2001. "Hung Out to Dry." *Ecologist*. Dec2001. Volume 31, Issue 10, Pages 63. Descriptors: International economic assistance; Agriculture; Irrigation; Yemen (Republic). Abstract: Discusses the failure of international economic aid provided by the World Bank to agricultural development in Yemen. Comparison between the traditional Yemeni method of agriculture and the modern pumped irrigation methods; Investment in the construction of the Amera dam outside Taiz City; Philosophy of Western aid agencies. ISSN: 0261-3131.

Minissale, A. Mattash, M. Vaselli, O., et al. 2006. *Thermal Springs, Fumaroles and Gas Vents of Continental Yemen: Their Relation with Active Tectonics, Regional Hydrology and Country's Geothermal Potential*. 8th International Conference on the Geology of the Arab World (GAW 8). Database: COS Conference Papers Index.

Minissale, Angelo, Mattash, Mohamed A., Vaselli, Orlando, et al. 2007. "Thermal Springs, Fumaroles and Gas Vents of Continental Yemen: Their Relation with Active Tectonics, Regional Hydrology and the Country's Geothermal Potential." *Applied Geochemistry*. Apr. Volume 22, Issue 4, Pages 799-820. Descriptors: Bathing; Carbon Dioxide; Chemical composition; Fluctuations; Gulfs; Hydrology; Magma; Palaeo studies; Phylogeny; Recharge; Sampling; Spring; Springs; Tectonics; Thermal Springs; Water Supply; Yemen. Notes: TR: CS0818170. Abstract: Most thermal springs of continental Yemen (about 65 emergences at 48 sampling sites) and a couple of fumaroles and boiling water pools have been sampled and analyzed for chemical and isotopic composition in the liquid phase and the associated free-gas phase. Whatever the emergence, all the water discharges have an isotopic signature of meteoric origin. Springs seeping out from high altitudes in the central volcanic plateau show a prevalent Na-HCO₃-composition, clearly affected by an anomalous flux of deep CO₂ deriving from active hydrothermal systems located in the Jurassic Amran Group limestone sequence and/or the Cretaceous Tawilah Group, likely underlying the 2000-3000m thick volcanic suite. At lower elevations, CO₂ also affects the composition of some springs emerging at the borders of the central volcanic plateau. Although mixing to a limited extent with organic CO₂ infiltrating together with the meteoric recharge waters cannot be ruled out, all the CO₂-rich gas samples have a delta 13C-CO₂ signature that falls in the range of mantle CO₂ (-3 < delta 13C < -7 ‰ V-PDB). The relatively high 3He/4He (1 < R/Ra < 3.2) ratios measured in all the CO₂-rich springs and also some mixed N₂-CO₂ gas vents in the far east Hadramaut region support the presence of

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mantle magmas and related hydrothermal systems residing at the crust level in several areas of Yemen. This well agrees with the presence of Quaternary basaltic magmatic activity along the Gulf of Aden, as well as inside the central Yemen volcanic plateau. Presently, the thermal springs of Yemen are prevalently used for spas and/or bathing. Nevertheless, liquid- and gas-geothermometry and geological considerations suggest that there are at least three areas (Al Lisi, Al Makhaya and Damt) inside the Yemen volcanic plateau (around Dhamar) that may be promising prospects for the future development of geothermal energy in Yemen. Alternatively, they could be used as a source of energy for small-to-medium scale agriculture and/or industrial purposes. Moreover, most of the thermal water discharges have the chemical characteristics of potable waters and, in an arid country like Yemen, they have to be considered as long-term water supply resources if the country should face water shortages. Database: Water Resources Abstracts. ISSN: 0883-2927. URL: <http://dx.doi.org/10.1016/j.apgeochem.2006.11.009>.

Minissale, Angelo, Vaselli, Orlando, Mattash, Mohamed Ali, et al. 2004. "Geochemical Composition and Geothermometric Characters of the Thermal Fields of Yemen; Italia 2004; 32nd International Geological Congress; Abstracts." International Geological Congress, Abstracts = Congres Geologique International, Resumes. [International Geological Congress], [location varies], International; Abstracts = Congres Geologique International, Resumes. Aug. Volume 32, Part 2, Pages 1235. Descriptors: Arabian Peninsula; Asia; bedrock; characterization; chemical composition; chemically precipitated rocks; classification; evaporites; geochemistry; geologic thermometry; geothermal energy; geothermal fields; geothermal reservoirs; ground water; hot springs; hydrochemistry; isotope ratios; isotopes; O-18/O-16; oxygen; phase equilibria; reservoir rocks; sea water; sedimentary rocks; springs; stable isotopes; temperature; thermal waters; water-rock interaction; Yemen. Notes: IGC, International Geological Congress. Database: GeoRef. OCLC: 56945241.

Mock, Claire, Arnaud, Nicolas O., Cantagrel, Jean-Marie and Yirgu, Gezahegn. 1999. "40Ar/39Ar Thermochronology of the Ethiopian and Yemeni Basements: Reheating Related to the Afar Plume?" Tectonophysics. 12/30. Volume 314, Issue 4, Pages 351-372. Descriptors: 40Ar/39Ar thermochronology; Crustal thermal anomaly; Crystalline basement; Ethiopia; Mantle plume; Yemen. ISSN: 0040-1951.

Moench, M. 2002. "Water and the Potential for Social Instability: Livelihoods, Migration and the Building of Society." Nat. Resour. Forum. Volume 26, Issue 3, Pages 195-204. Descriptors: Adaptation; Entitlements; Groundwater; Migration; Poverty; Security; Sustainability; Transition. Notes: Cited By (since 1996): 4. Abstract: In much of the Third World, access to secure for irrigation, particularly groundwater, reduces vulnerability, stabilizes livelihoods, alleviates poverty and 'entitles' populations to education and other forms of capital accumulation. Water resource development can, as a result, be used as a key tool for addressing the social roots of instability. The reverse is also true- problems such as groundwater overdraft contribute to poverty and are often at the root of forced migration and the creation of underemployed and unstable displaced populations. Water is fundamental to regional as well as local security. The benefits of water resource development and the risks associated with unsustainable use patterns are particularly critical in arid regions. Patterns of water use that are unsustainable can play a positive role in the transition of populations from nomadic or migratory to stable communities, where people have access to education and asset accumulation. The exit is, however, as important as the entry. In many regions, the majority of the population now need to make the transition from agriculture to non-agricultural livelihoods. Many people, particularly the wealthy, may already be doing this. Understanding and enabling transition represents one of

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the most important policy challenges for coming decades. Using examples from India, Yemen, Saudi Arabia and other countries, this article documents some of the connections between water and security and clarifies the importance of effective solutions to water problems and to social transition in arid regions. Database: SCOPUS. ISSN: 0165-0203.

Moench, M. Coletto, Carmen; Huerga, Argimiro and Martinez Cortina, Luis. 2003. *Groundwater and Poverty; Exploring the Connections; Intensive use of Groundwater; Challenges and Opportunities*. Netherlands: A.A. Balkema Publishers, Lisse, Netherlands. Workshop on Intensively Exploited Aquifers, WINEX, Madrid. Spain Conference: Dec. 13-15, 2001. Descriptors: agriculture; aquifers; Arabian Peninsula; Asia; degradation; economics; ground water; irrigation; land use; models; natural resources; pollution; sustainable development; Tihama Aquifer; water management; water quality; water resources; water supply; water use; Yemen. References: 50; illus. incl. 5 tables. ISBN: 9058093905. Database: GeoRef.

Moench, Marcus. 2002. "Water and the Potential for Social Instability: Livelihoods, Migration and the Building of Society." *Natural Resources Forum*. Volume 26, Issue 3, Pages 195-204. Descriptors: Social aspects; Arid regions; Curricula; Developing countries; Groundwater; Irrigation; Sustainable development. Abstract: In much of the Third World, access to secure for irrigation, particularly groundwater, reduces vulnerability, stabilizes livelihoods, alleviates poverty and 'entitles' populations to education and other forms of capital accumulation. Water resource development can, as a result, be used as a key tool for addressing the social roots of instability. The reverse is also true- problems such as groundwater overdraft contribute to poverty and are often at the root of forced migration and the creation of underemployed and unstable displaced populations. Water is fundamental to regional as well as local security. The benefits of water resource development and the risks associated with unsustainable use patterns are particularly critical in arid regions. Patterns of water use that are unsustainable can play a positive role in the transition of populations from nomadic or migratory to stable communities, where people have access to education and asset accumulation. The exit is, however, as important as the entry. In many regions, the majority of the population now need to make the transition from agriculture to non-agricultural livelihoods. Many people, particularly the wealthy, may already be doing this. Understanding and enabling transition represents one of the most important policy challenges for coming decades. Using examples from India, Yemen, Saudi Arabia and other countries, this article documents some of the connections between water and security and clarifies the importance of effective solutions to water problems and to social transition in arid regions. ISSN: 0165-0203. URL: <http://dx.doi.org/10.1111/0165-0203.00021>.

Mohamed I. Al-Hamdi and Guy J. Alaerts. *Structure and Cost of the Water Supply Market in Sana'a City, Yemen. Building Partnerships*. Descriptors: Aquifers; Costs; Groundwater supply; Marketing; Municipal water; Water supply. Abstract: With an annual population growth rate of over 8%, Yemen's capital Sana'a, is facing an increasing pressure in all municipal service sectors. This pressure is greatest in municipal water supply since the city depends exclusively on a non-renewable groundwater aquifer that is being mostly utilized (mined) also for irrigation. The growing water deficit in the Sana'a Basin area is currently being satisfied from the fossil groundwater storage. The study examined, for water supply alternatives, the current cost to consumers and their capacity and willingness to pay for domestic water ('value to the users'). More specifically, this paper describes and analyzes the structure and cost of the domestic water supply market in Sana'a: (1) the coverage by the public and private water supply systems, their water quality, and the ensuing choices for consumers, (2) the cost and value of different types of domestic water supply, (3) the implications of present and future domestic

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water demand, and (4) alternatives for future water supply including social economic constraints to water transfer and reallocation. Notes: Building partnerships (2000 Joint Conference on Water Resources Engineering and Water Resources Planning & Management held in Minneapolis, Minnesota, July 30-August 2, 2000. sponsored by EWRI of ASCE.) *Reston, VA: ASCE, 2000, NA pp.* ISBN: 0-7844-0517-4. Database: ASCE.

Mohammed, Nagib. 2008. Drinking Water Quality Supplied by Local Corporation in Yemen. 2008 International Association of Hydraulic Engineering and Research Groundwater Symposium. Database: COS Conference Papers Index.

Mojarad, R. S. and Settari, A. 2008. "Velocity-Based Formation Damage Characterization Method for Produced Water Re-Injection: Application on Masila Block Core Flood Tests." *Petroleum Science & Technology*. Taylor & Francis Ltd: 05. Volume 26, Issue 7, Pages 937-954. Descriptors: Oil field brines; Formation damage (Petroleum engineering); Oil field flooding; Oil well drilling; Petroleum in submerged lands; Oil fields; Oil sands -- Permeability; Yemen (Republic); damage characterization; formation damage; injectivity decline; Masila block; permeability reduction. Abstract: With increasing environmental regulations, more and more produced water is being re-injected; however, water injection programs may have low efficiency due to formation damage around the injected wellbore. Traditionally, formation damage was treated as a deep bed filtration (DBF) type of process characterized by laboratory-based damage parameters. These parameters inquire expensive concentration measurement, and lab-scaled results are not usually applicable for field cases. Recent studies on formation damage are more attracted to history-based approaches using an empirical damage equation to capture the uniqueness of each case study. In our previous work, such empirical (velocity based) model was studied and shown to be more practical than (and equivalent to) the DBF model. A robust characterization method was developed to calculate the damage parameters explicitly, and it was successfully tested against offshore field data. In this work, the method has been applied for analysis of a series of core flood tests on cores from the Masila Block field in Yemen and compared with measured damage parameters. Good agreement with lab-measured values validates the characterization method. The accuracy of the method is comparable to the DBF approach, while it is simpler and more suitable for implementing in reservoir simulators. ISSN: 1091-6466.

Momin, Abdul-Malik. 2008. Proposed of a Solar Water Heater and its Application in Yemen. 7th International Conference: Role of Engineering Towards a Better Environment (RETBE 2008). *Global Environmental Changes: Challenges and Opportunities*. Alexander, Egypt. Database: COS Conference Papers Index. <http://retbe.alexeng.edu.eg>

Mondillo, N; Boni, M; Balassone, G; Grist, B. 2011. "In search of the lost zinc: A lesson from the Jabali (Yemen) nonsulfide zinc deposit." *Journal of Geochemical Exploration*. Volume 108 (3), pages 209-219. Abstract: The Jabali nonsulfide zinc deposit, located northeast of Sana'a (Yemen) contains a geological resource of 12.6 million tonnes of ore grading 8.9% zinc, 1.2% lead and 68 g/t silver, with a projected recovery of ca. 80% zinc. The primary sulfide deposit shows features of both Mississippi Valley and Carbonate Replacement types, and is believed to have been formed by circulating hydrothermal fluids, either associated with Mesozoic rifting, or generated from Tertiary igneous activity, developed in the area during the Red Sea crustal extension. An extension of this phenomenon should have also triggered the late uplift, which favored the oxidation of sulfides. Ore deposition has been accompanied by several dolomitization phases, some of which have been considered strictly hydrothermal. A complete quantitative (Rietveld) mineralogical and geochemical study of mineralized full-length core

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samples, carried out with the aim of possibly increasing zinc recovery, shows a discrepancy between the zinc grades recorded in the chemical assays, and those calculated from the sum of the ore minerals occurring in the same samples. The difference between the assayed and calculated zinc amounts in various parts of the deposit is due to the presence of Zn-rich dolomite phases (up to 20% Zn in the lattice), as well as of Mg-smithsonite (up to 12% Mg), both phases replacive of the earlier dolomites in the weathering environment. The Zn-enriched dolomite phases could be the "missing link" between pure dolomite and smithsonite. Zinc occurring in dolomite cannot be processed economically with today's methods. Analysis of the total zinc amount contained in Zn-dolomite, when compared with the zinc occurring in the processable ore minerals shows that there is a significant proportion of unrecoverable zinc. This explains why at Jabali the projected metallurgical recovery of around 80% is unlikely to be improved upon, due to the trapped zinc within the "supergene" dolomite phases. The extensive development of the Zn-dolomite bodies, which occur throughout the whole mining area, may be highly significant for the evaluation of nonsulfide zinc ores at Jabali and for the exploration philosophy of the region. The possible occurrence of Zn-dolomite has to be kept in mind when exploring for supergene Zn-nonsulfides in other mining districts where the ore is also dolomite-hosted, which may feature a significant non-recoverable phase. ISSN: 0375-6742.

Moric, Peter. 1997. "Questioning the Need for Spillways." Wilmington Publishing Ltd , Wilmington House, Church Hill, Wilmington, Dartford, Kent, UK. *International Water Power & Dam Construction*. Volume: 49, no. 1, page(s): 24-24-26. Abstract: The design of the two dam projects, the Murum Dam Project in Malaysia and the Marib Dam in Yemen, is discussed focusing on the necessity for spillways and how to determine their overall design. Challenges encountered, factors considered during the design process are discussed and the implications of rare flood conditions are described. Database: Technology Research Database. ISSN: 0306-400X.

Morris, B. L. 1979. *Yemen Arab Republic Montane Plains and Wadi Rima` Project: A Land and Water Resources Survey: Hydrogeology of Wadi Rima`*. Surbiton, England: Overseas Development Administration, Land Resources Development Centre. Page(s): 111. Descriptors: Hydrogeology -- Yemen (Republic) -- Rima` Wadi Region; Agricultural development projects -- Yemen (Republic) -- Rima` Wadi Region; Irrigation -- Yemen (Republic) -- Rima` Wadi Region; Water consumption -- Yemen (Republic) -- Rima` Wadi Region; Tihama (Saudi Arabia and Yemen); Government publication. Notes: xi; 54 leaves of plates (some folded): ill., maps (some col.); 30 cm. Note(s): One map on 1 folded leaf in pocket. "Project record 41." "YAR-01-47/REC-41/79." "In confidence, not for publication." Includes bibliographical references (p. 79-81). Report: YAR-01-47/REC-41/79; Other Titles: Montane Plains and Wadi Rima` Project; Land and water resources survey; Hydrogeology of Wadi Rima`; Responsibility: B.L. Morris. OCLC Accession Number: 53995692.

Morris, B. L. Yemen Arab Republic; Institute of Geological Sciences (Great Britain). Hydrogeology Unit and Great Britain. Land Resources Division. 1979. *Yemen Arab Republic Montane Plains and Wadi Rima` Project: A Land and Water Resources Survey. Hydrogeology of Wadi Rima`*. Surbiton: Ministry of Overseas Development. Page(s): 77. Descriptors: Yemen Arab Republic; Water resources development -- Yemen; Hydrogeology. Notes: ix; refs, appendices: ill, maps; 30cm. Responsibility: B.L. Morris. OCLC Accession Number: 704165716.

Morrison, J., Birse, A., Samuel, M. A., Richardson, S. M., Harbury, N. and Bott, W. F. 1997. "The Cretaceous Sequence Stratigraphy of the Socotran Platform, the Republic of

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Yemen.” *Mar. Pet. Geol.* 9. Volume 14, Issue 6, Pages 685-699. Descriptors: Cretaceous; carbonates; sequence stratigraphy; palaeogeographic; Socotran Platform; Yemen. Abstract: Outcrop studies combined with subsurface seismic and well data enable a detailed sequence stratigraphic analysis of the Socotran Platform during the Cretaceous. Palaeogeographic reconstructions for the Barremian-Aptian (Qishn Formation), Albian-Cenomanian (Fartaq Formation) and Maastrichtian (Sharwayn Formation) are presented. The palaeogeographic maps have been constrained by data from outcrop studies on Socotra and the adjacent islands of Samhah and Abd Al Kuri, as well as the Samhah-1A well which lies 60 km to the southwest of Samhah Island. Two major sequences can be recognised in the Qishn Formation, and can be further subdivided into systems tracts. An Upper Qishn highstand systems tract has been identified on a north-south seismic line with coastline-parallel facies belts. An interpretation of the reservoir facies and porosity development of the highstand systems tract is attempted using the good quality seismic data in the Socotran Platform. Three major sequences can be recognised in the Fartaq Formation and one in the Sharwayn Formation which are illustrated on a second east-west seismic line. ISSN: 0264-8172.

Morton, J. and Land Resources Development Centre (Great Britain). 1979. Yemen Arab Republic: Montane Plains and Wadi Rima’ Project: A Land and Water Resources Survey. Agricultural Marketing in the Yemen Arab Republic with Special Reference to the Montane Plains and Wadi Rima’. Surbiton: Ministry of Overseas Development. Page(s): 88. Descriptors: Agricultural development projects -- Yemen (Republic); Montane Plains and Wadi Rima Project; Government publication (gpb). Notes: ill., maps, tables; 30 cm. “YAR-01-45/REC-35/79.” Other Titles: Agricultural marketing in the Yemen Arab Republic with special reference to the Montane Plains and Wadi Rima’; Responsibility: J. Morton. OCLC Accession Number: 68706228.

Moseley, F. 1971. “Problems of Water Supply, Development and use in Audhali, Dathina, and Eastern Fadhli, Southern Yemen.” *Overseas Geology and Mineral Resources*. Great Britain, Institute of Geological Sciences, London. Volume 10, Issue 4, Pages 309-327. Descriptors: Arabian Peninsula; Asia; Audhali; Dathina; economic geology; Fadhli; ground water; resources; water resources; Yemen. Notes: illus. (incl. geol. map); Map Scale: 1:125,000. Type: geologic map. Database: GeoRef. ISSN: 0030-7467.

Moseley, F. *Overseas Geological Surveys and (Great Britain)*. 1971. Problems of Water Supply, Development and use in Audhali, Dathina, and Eastern Fadhli, Southern Yemen. London: HMSO. Descriptors: Water supply & management; Groundwater; Yemen People’s Republic. Notes: pages 309-327. Responsibility: F. Moseley. ISBN: X780026321. OCLC Accession Number: 704150078.

Moseley, Frank. 2000. “From Dowsing to Hydrogeology in the Royal Engineers 1939-70.” United Kingdom: Geological Society Publishing House, Bath. Descriptors: Africa; Arabian Peninsula; Asia; boreholes; Egypt; geologists; ground water; history; hydrogeology; Libya; military geology; North Africa; Oman; water supply; World War II; Yemen. References: 34; illus. incl. sect., geol. sketch maps. ISBN: 1862390657. Database: GeoRef.

Moshrif, Mohamed A. 1984. “Sequential Development of Hanifa Formation (Upper Jurassic) Paleoenvironments and Paleogeography, Central Saudi Arabia.” *J. Pet. Geol.* Volume 7, Issue 4, Pages 451-460. Descriptors: Petroleum Geology; Geology - Stratigraphy. Abstract: The Hanifa Carbonate lithofacies (Upper Jurassic) started to develop during Early Kimmeridgian time, when an extensive area in central Arabia was covered by relatively deep marine waters. These rock units were formed along a shoreline, resulting in successive lagoonal and tidal-flat

belts, the deposition of pelleted and laminated calcilutites and gypsum, and a restricted fauna. The open shelf lay east of the lagoon zone, accounting for the development of oolites, coral reef and calcarenites, and a diversified fauna on the deeper shelf. At its maximum extent, the Hanifa Sea reached west nearly as far as the city of Riyadh in central Saudi Arabia, and extended NE and east, covering Kuwait, Iraq, Oman and Iran. South of Riyadh, the Hanifa lithofacies may be traced towards the SE over the Rub-al-Khali area, and SW over Yemen and the Aden Protectorates. North and NW of Riyadh, these same Upper Jurassic shallow-marine rock units developed over Jordan, Syria, Lebanon, Palestine and northern Sinai, and most probably extended over northern Africa. ISSN: 0141-6421.

Mostafa, A. R., Al-Alimi, A. K. A. and Barakat, A. O. 2009. "Metals in Surface Sediments and Marine Bivalves of the Hadhramout Coastal Area, Gulf of Aden, Yemen." *Mar. Pollut. Bull.* Volume 58, Issue 2, Pages 308-311. Descriptors: Gulf of Aden; Marine bivalves; Metals; Sediments; Yemen. Database: SCOPUS. ISSN: 0025-326X.

Mostafa, Alaa R., Wade, Terry L., Sweet, Stephen T., Al-Alimi, Abdel Kawi A. and Barakat, Assem O. 2009. "Distribution and Characteristics of Polycyclic Aromatic Hydrocarbons (PAHs) in Sediments of Hadhramout Coastal Area, Gulf of Aden, Yemen." *J. Mar. Syst.* 8. Volume 78, Issue 1, Pages 1-8. Descriptors: Polycyclic aromatic hydrocarbons (PAHs); Marine sediments; Gulf of Aden, Yemen. ISSN: 0924-7963.

Mostafa, AR, Al-Alimi, AKA and Barakat, AO. 2009. "Metals in Surface Sediments and Marine Bivalves of the Hadhramout Coastal Area, Gulf of Aden, Yemen." *Mar. Pollut. Bull.* Feb. Volume 58, Issue 2, Pages 308-311. Descriptors: Article Subject Terms: Sediments; Mollusks; Metals; Water Pollution; Gulfs; Marine Environment; Marine molluscs; Coastal zone; Marine pollution; Article Geographic Terms: Yemen; Yemen, Hadhramout; Marine. Notes: OD: Object Subject Terms: Copper concentration; Heavy metal concentration; Iron concentration; Iron content; Marine bivalves; Nickel concentration; Nickel content; Rocky oyster soft tissue; Shell length; Surface sediments; Surfaces sediments; TR: CS0918291. Heavy metal concentration; Iron concentration; Nickel concentration; Rocky oyster soft tissue. Database: ProQuest Deep Indexing: Aquatic Sciences. ISSN: 0025-326X.

Mostafa, AR, Wade, TL, Sweet, ST, Al-Alimi, AKA and Barakat, AO. 2007. "Assessment of Persistent Organochlorine Residues in Sediments of Hadramout Coastal Area, Gulf of Aden, Yemen." *Mar. Pollut. Bull.* Jul. Volume 54, Issue 7, Pages 1053-1058. Descriptors: Assessments; Chlorine compounds; Coastal zone; Gulfs; Marine Environment; Marine pollution; Organic Compounds; Organochlorine compounds; Pollutant persistence; Residues; Sediments; Water Pollution; Yemen; Marine. Notes: TR: CS0838611. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0025-326X.

Mothana, R. A., Lindequist, U., Gruenert, R. and Bednarski, P. J. 2009. "Studies of the in Vitro Anticancer, Antimicrobial and Antioxidant Potentials of Selected Yemeni Medicinal Plants from the Island Soqatra." *BMC Complement. Altern. Med.* Volume 9, Notes: Cited By (since 1996): 1. Abstract: Background: Recent years have witnessed that there is a revival of interest in drug discovery from medicinal plants for the maintenance of health in all parts of the world. The aim of this work was to investigate 26 plants belonging to 17 families collected from a unique place in Yemen (Soqatra Island) for their in vitro anticancer, antimicrobial and antioxidant activities. Methods: The 26 plants were extracted with methanol and hot water to yield 52 extracts. Evaluation for in vitro anticancer activity was done against three human cancer cell lines (A-427, 5637 and MCF-7) by using an established microtiter plate assay based on cellular staining with crystal violet. Antimicrobial activity was tested against three Gram-positive

bacteria, two Gram-negative bacteria, one yeast species and three multiresistant *Staphylococcus* strains by using an agar diffusion method and the determination of MIC against three Gram-positive bacteria with the broth micro-dilution assay. Antioxidant activity was investigated by measuring the scavenging activity of the DPPH radical. Moreover, a phytochemical screening of the methanolic extracts was done. Results: Notable cancer cell growth inhibition was observed for extracts from *Ballochia atro-virgata*, *Eureiandra balfourii* and *Hypoestes pubescens*, with IC₅₀ values ranging between 0.8 and 8.2 µg/ml. The methanol extracts of *Acanthospermum hispidum*, *Boswellia dioscorides*, *Boswellia socotrana*, *Commiphora ornifolia* and *Euphorbia socotrana* also showed noticeable antiproliferative potency with IC₅₀ values 15 mm and MIC values ≤ 250 µg/ml. In addition, the methanolic extracts of *Acacia pennivenia*, *Boswellia dioscorides*, *Boswellia socotrana* and *Commiphora ornifolia* showed good antioxidant potential at low concentrations (more than 80% at 50 µg/ml). Conclusion: Our results show once again that medicinal plants can be promising sources of natural products with potential anticancer, antimicrobial and antioxidative activity. The results will guide the selection of some plant species for further pharmacological and phytochemical investigations. Database: SCOPUS. ISSN: 1472-6882.

Mothana, R. A. A. and Lindequist, U. 2005. "Antimicrobial Activity of some Medicinal Plants of the Island Soqatra." *J. Ethnopharmacol.* Volume 96, Issue 1-2, Pages 177-181. Descriptors: Antimicrobial/antibacterial activity; Medicinal plants; Soqatra; Yemen. Notes: Cited By (since 1996): 30. Abstract: Twenty-five selected plants belonging to 19 families were collected from different localities of the island Soqatra, dried and extracted with the solvents chloroform, methanol and hot water to yield 80 extracts. The extracts were tested for their antimicrobial activity against several Gram-positive and Gram-negative bacteria and against one yeast species using agar diffusion method. Antibacterial activity was demonstrated especially against Gram-positive bacteria including multiresistant *Staphylococcus* strains. The greatest activity was exhibited by the methanolic extracts of *Boswellia elongata*, *Boswellia ameero*, *Buxus hildebrandtii*, *Commiphora parvifolia*, *Jatropha uncostata*, *Kalanchoe farinacea*, *Pulicaria stephanocarpa*, *Punica protopunica*, *Withania adunensis* and *Withania riebeckii*. Only the methanolic extract of *Buxus hildebrandtii* displayed significant antifungal activity. Database: SCOPUS. ISSN: 0378-8741.

Mothana, Ramzi A. A., Abdo, Salah A. A., Hasson, Sidgi, Althawab, Faisal M. N., Alaghbari, Sama A. Z. and Lindequist, Ulrike. 2010. "Antimicrobial, Antioxidant and Cytotoxic Activities and Phytochemical Screening of some Yemeni Medicinal Plants." *Evidence-Based Complementary & Alternative Medicine (eCAM)*. 09. Volume 7, Issue 3, Pages 323-330. Descriptors: Medicinal plants; Anti-infective agents; Phytochemicals; Antioxidants; *Staphylococcus*; Gram-negative bacteria; Yemen (Republic); antibacterial; cytotoxicity; radical scavenging; Yemen. Abstract: The traditional medicine still plays an important role in the primary health care in Yemen. The current study represents the investigation of 16 selected plants, which were collected from different localities of Yemen. The plants were dried and extracted with two different solvents (methanol and hot water) to yield 34 crude extracts. The obtained extracts were tested for their antimicrobial activity against three Gram-positive bacteria, two Gram-negative bacteria, one yeast species and three multiresistant *Staphylococcus* strains using agar diffusion method, for their antioxidant activity using scavenging activity of DPPH radical method and for their cytotoxic activity using the neutral red uptake assay. In addition, a phytochemical screening of the methanolic extracts was done. Antibacterial activity was shown only against Gram-positive bacteria, among them multiresistant bacteria. The highest

antimicrobial activity was exhibited by the methanolic extracts of *Acalypha fruticosa*, *Centaurea pseudosinaica*, *Dodonaea viscosa*, *Jatropha variegata*, *Lippia citriodora*, *Plectranthus hadiensis*, *Tragia pungens* and *Verbascum bottae*. Six methanolic extracts especially those of *A. fruticosa*, *Actiniopteris semiflabellata*, *D. viscosa*, *P. hadiensis*, *T. pungens* and *V. bottae* showed high free radical scavenging activity. Moreover, remarkable cytotoxic activity against FL-cells was found for the methanolic extracts of *A. fruticosa*, *Iris albicans*, *L. citriodora* and *T. pungens*. The phytochemical screening demonstrated the presence of different types of compounds like flavonoids, terpenoids and others, which could be responsible for the obtained activities. ISSN: 1741-427X.

Mothana, Ramzi A. A., Kriegisch, Sabine, Harms, Manuela, Wende, Kristian and Lindequist, Ulrike. 2011. "Assessment of Selected Yemeni Medicinal Plants for their in Vitro Antimicrobial, Anticancer, and Antioxidant Activities." *Pharm. Biol.* 02. Volume 49, Issue 2, Pages 200-210. Descriptors: Medicinal plants; Anti-infective agents; Antineoplastic agents; Antioxidants; Cancer cells; Antibacterial agents; Traditional medicine; Yemen (Republic); Antibacterial; cytotoxic; folk medicine; radical scavenging; Yemen. Abstract: Context: The role of natural products as a source for remedies has been recognized since the beginning of mankind. Nevertheless, a minority of folklorically used medicinal plants have been evaluated for their pharmacological activities. Objectives: The purpose of this study is to evaluate 33 selected Yemeni plants for their in vitro anticancer, antimicrobial, and antioxidant activities. Materials and methods: The plants were extracted with methanol and hot water. The obtained 66 extracts were tested for their in vitro cytotoxic activity using the neutral red uptake assay against two cancer cell lines (5637 and MCF-7). The antimicrobial activity was determined using the agar diffusion method and MIC-determination. The DPPH radical method was used for the determination of antioxidant activity. Results: Interesting cytotoxic activity was observed for *Hypoestes forskalei* (Vahl) R. Br. (Acanthaceae), *Lycium shawii* Roem. & Schult. (Solanaceae), *Pergularia tomentosa* L. (Asclepiadaceae), *Psiadia punctulata* (DC.) Vatke (Compositae), *Pulicaria petiolaris* Jaub. & Spach (Compositae) and *Rosmarinus officinalis* L. (Labiatae) (IC₅₀ values < 50 µg/mL). Antimicrobial activity with MIC values ≤ 125 µg/mL was exhibited against Gram-positive bacteria by *Chrozophora oblongifolia* (Del.) A.Juss. ex Spreng. (Euphorbiaceae), *Myrtus communis* L. (Myrtaceae), *Phragmanthera regularis* (Steud. ex Sprague) M.G. Gilbert (Loranthaceae) and *R. officinalis*. Antioxidant activity was observed for *C. oblongifolia*, *M. communis*, and *P. regularis*. Conclusion: The results justified the use of some investigated plants in the Yemeni ethnomedicine. These findings demonstrated that some of the investigated plants could be a source of new cytotoxic and antibiotic compounds; however, further work is needed. ISSN: 1388-0209.

Mothana, Ramzi A. A. and Lindequist, Ulrike. 2005. "Antimicrobial Activity of some Medicinal Plants of the Island Soqatra." *J. Ethnopharmacol.* 1/4. Volume 96, Issue 1-2, Pages 177-181. Descriptors: Antimicrobial/antibacterial activity; Medicinal plants; Soqatra; Yemen. Abstract: Twenty-five selected plants belonging to 19 families were collected from different localities of the island Soqatra, dried and extracted with the solvents chloroform, methanol and hot water to yield 80 extracts. The extracts were tested for their antimicrobial activity against several Gram-positive and Gram-negative bacteria and against one yeast species using agar diffusion method. Antibacterial activity was demonstrated especially against Gram-positive bacteria including multiresistant *Staphylococcus* strains. The greatest activity was exhibited by the methanolic extracts of *Boswellia elongata*, *Boswellia ameero*, *Buxus hildebrandtii*, *Commiphora parvifolia*, *Jatropha unicostata*, *Kalanchoe farinacea*, *Pulicaria stephanocarpa*,

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Punica protopunica, *Withania adunensis* and *Withania riebeckii*. Only the methanolic extract of *Buxus hildebrandtii* displayed significant antifungal activity. ISSN: 0378-8741.

Mounir Arbach. 2011. « La situation politique du Jawf au I^{er} millénaire avant J.-C. » *Chroniques yéménites* [En ligne], 11. 2003, mis en ligne le 10 septembre 2007, Consulté le 11 octobre 2011. Abstract: La région du Jawf, située à une centaine de kilomètres au nord-est de Sanaa, possède un nombre important de sites archéologiques sudarabiques. Les plus importants sont, du sud-est au nord-ouest: Barâqish, l'antique Yathill, dont l'enceinte est l'ouvrage défensif le mieux conservé parmi les sites préislamiques; Ma'în, l'antique Qarnaw, capitale du royaume de Ma'în; Kharibat Hamdân, l'antique Haram; Kamna, l'antique Kaminahû; al-Sawdâ', l'antique Nashshân; et al-Baydâ', l'antique Nashq. La découverte de la plupart de ces sites, attribuable à Joseph Halévy, remonte au dernier quart du XIX^e siècle. Elle a été complétée par les expéditions du milieu du XX^e siècle dirigées par M. Tawfiq, A. Fakhry et M. Geukens, respectivement en 1944, 1947 et 1954. Dans les années 1980, ces sites ont fait l'objet de fouilles ponctuelles et de prospections archéologiques et épigraphiques, notamment dans le cadre de la Mission archéologique française en République arabe du Yémen (MAFRAY). Jusqu'à ce jour, peu de fouilles archéologiques systématiques ont été réalisées sur les sites du Jawf. Seuls deux temples ont été dégagés. Le premier, un temple *extra-muros* sur le site d'al-Sawdâ', fut dégagé en 1988 par la Mission archéologique française. Le second, le temple de Nakrah à Barâqish, fut mis au jour par une mission italienne en 1990. Il a fait l'objet d'une importante opération de restauration dans le cadre de la Mission archéologique italienne en République du Yémen durant l'automne 2003. Outre les temples *extra-* et *intra-muros*, ces sites étaient, pour la plupart, munis d'enceintes et abritaient sans doute des bâtiments publics (palais, temples) et privés (habitations et autres), dont les vestiges affleurent encore. URL : <http://cy.revues.org/146>

Mucha, I. Fara, M. and Anonymous. 1991. Overexploitation of Groundwater Resources in Wadi Hadramaut; XXIII Congreso Internacional Sobreexplotacion De Acuiferos; Actas; Ponencias, Comunicaciones y Resumenes De Posters. XXIII International Congress on Aquifer Overexploitation; Proceedings; General Papers, Extended Abstracts and Posters. Spain: Asociacion Internacional de Hidrogeologos, Grupo Espanol, Spain. XXIII Congreso Internacional Sobreexplotacion De Acuiferos. Canary Islands, Spain Conference: 1991. Descriptors: aquifers; Arabian Peninsula; Asia; clastic rocks; cross sections; drawdown; exploitation; fluvial features; ground water; pump tests; recharge; sandstone; sedimentary rocks; Wadi Hadramaut; wadis; water resources; Yemen. References: 6; 3 tables. ISBN: 8440491328. Database: GeoRef.

Mucha, I. Paulikova, E. and Anonymous. 1991. Groundwater Exploitation in Hard Rock Wadi; XXIII Congreso Internacional Sobreexplotacion de Acuiferos; Actas; Ponencias, Comunicaciones y Resumenes De Posters. XXIII International Congress on Aquifer Overexploitation; Proceedings; General Papers, Extended Abstracts and Posters. Spain: Asociacion Internacional de Hidrogeologos, Grupo Espanol, Spain. XXIII Congreso Internacional Sobreexplotacion De Acuiferos. Canary Islands, Spain Conference: 1991. Descriptors: aquifers; Arabian Peninsula; Asia; bedrock; cross sections; exploitation; fluvial features; ground water; potentiometric surface; recharge; Wadi Markhah; wadis; Yemen. References: 4; 1 table, sketch maps. ISBN: 8440491328. Database: GeoRef.

Mucha, I. and Paulikova, E. 1991. "Ground Water Exploitation in Hard Rock Wadi." *Acta Geologica et Geographica Universitatis Comenianae: Geologica*. [publisher unknown], Bratislava, Slovak Republic. Volume 47, Pages 57-62. Descriptors: aquifers; Arabian Peninsula; arid environment; Asia; deserts; eolian features; exploitation; fluvial features; geochemistry;

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ground water; hydrochemistry; hydrodynamics; hydrology; rivers and streams; terrestrial environment; transmissivity; wadis; water resources; water wells; wells; Yemen. References: 3; illus. Database: GeoRef. ISBN: 8008015780.

Muhayriz, `Abd Allah Ahmad. 1987. Saharij `Adan. `Adan, Jumhuriyat al-Yaman al-Dimuqratiyah al-Sha`biyah: `Dar al-Hamadani, Place: Yemen; Aden. Page(s): 101. Descriptors: Dams -- Yemen (Republic) -- Aden; Water -- Storage -- Yemen (Republic) -- Aden; Water-supply -- Yemen (Republic) -- Aden. Notes: ill., maps; 24 cm. Note(s): Includes bibliographical references (p. 95-100). Responsibility: `Abd Allah Ahmad Muhayriz. OCLC Accession Number: 46112141.

Mukhamed, Nabil` Abdulrahman. 1992. "Perspektivy Ispol`Zovaniya Podzemnykh Vod Vadi Khadramaut (Yyemenskaya Respublika). Translated title: The Prospects for Utilization of Ground Water from the Hadramaut Depression, Yemen Republic." *Uzbekiston Geologiya Zhurnali = Uzbekskiy Geologicheskiy Zhurnal*. Izdatel'stvo "Fan" Uzbekskoy SSR, Tashkent, Uzbekistan. Apr. Volume 1992, Issue 4, Pages 83-86. Descriptors: aquifers; Arabian Peninsula; arid environment; Asia; clastic rocks; conglomerate; exploration; ground water; Hadramaut Depression; sedimentary rocks; terrestrial environment; utilization; water quality; water resources; Yemen. Database: GeoRef. ISSN: 0042-1693.

Mukhammad, Nabil Abdulrahman (Muhammad, Nabil Abdulrahman). 1991. "Usloviya Formirovaniya Podzemnykh Vod Doliny Khadramaut (Yyemenskaya Respublika). Translated title: Ground-Water Genesis in the Hadhramaut Valley, Yemen." *Uzbekiston Geologiya Zhurnali = Uzbekskiy Geologicheskiy Zhurnal*. Izdatel'stvo "Fan" Uzbekskoy SSR, Tashkent, Uzbekistan. Volume 1991, Issue 3, Pages 67-72. Descriptors: alluvium aquifers; aquifers; Arabian Peninsula; Asia; chemical composition; fluvial features; geochemistry; ground water; Hadhramaut Valley; hydrochemistry; multiple aquifers; plateaus; recharge; wadis; Yemen. References: 3; sketch map. Database: GeoRef. ISSN: 0042-1693.

Mullick, MA. 1983. "North Yemen grasps the Decade nettle." *World Water*. Volume 6 (2). (1983). Pages: 23,25 and 27. Abstract: The problems faced by North Yemen in its attempt to meet the targets of the U.N. International Drinking Water Supply and Sanitation Decade are discussed, including the difficulties of bringing water from the valleys to the traditionally remote hill-top communities, the shortage of money, a falling water table, the complete lack of proper sewage treatment facilities, and the shortage of trained manpower. Current projects, which are being helped along by trained U.N. volunteers, are outlined.

Mullick, M. A. Hussein. 1987. *Socio-Economic Aspects of Rural Water Supply and Sanitation: A Case Study of the Yemen Arab Republic*. Sussex, England: Book Guild. Page(s): 252. Descriptors: Water-supply, Rural -- Social aspects -- Yemen, North; Water-supply, Rural -- Economic aspects -- Yemen, North; Sanitation, Rural -- Social aspects -- Yemen, North; Sanitation, Rural -- Economic aspects -- Yemen, North. Notes: ill., map; 24 cm. Note(s): Bibliography: p. [242]-246. Responsibility: M.A. Mullick. ISBN: 0863322301; 9780863322303. LCCN: 90-162506. OCLC Accession Number: 18206497.

Mullick, M. A. 1988. "Rural Water Supply and Sanitation in Yemen." *Water & Wastewater International* 3.5 (1988): 21,23,25. Abstract: The socio-economic problems of water supply and sanitation in Yemen are discussed. A modified form of the Investment Priority Index Formula devised by the Pan American Health Organization was used to describe development in areas dependent on drilled or dug wells. The basic needs approach to economic growth and development giving priority to basic education, primary health care and clean water and sanitation is described. Aqualine.

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Mundy, M. 1989. "Irrigation and Society in a Yemeni Valley: On the Life and Death of a Bountiful Source." *Peoples Mediterraneans, Mediterranean Peoples*. Volume 46, Pages 97-128. Abstract: Begins by describing the ecology, the lie of the land and the social management of a precious resource, a small perennial stream. The description draws on observations made in the 1970s. The gradual creation of the tradition of irrigation has occurred at the meeting of local community and national leadership; it extends over centuries when the technology not of production but of political domination was changing and concludes in the 1970s when the technology of irrigation itself was suddenly transformed. Finally, discusses the character of the local communal organization and the manner of articulation between the locality and the politics and economy of the nation. Database: SCOPUS. ISSN: 0399-1253.

Murdock, H. 2009. "Yemen's capital running out of water." (November 15, 2009) *Washington Times*. Washington, D.C. Abstract: Water shortages can be felt in every corner of Yemen's capital. Gardens are dry, and water trucks crisscross the city to deliver to households that can afford it. Those who cannot send women and children to line up at mosque spigots. With well levels dropping as much as 65 feet a year, many Yemenis and outside specialists predict that San'a will become the first capital city to run out of groundwater. The shortages pose a special challenge in an impoverished nation that is already fighting two insurgencies and al Qaeda. "The problem is not in the future," said Saleh Aziz, a Yemeni farmer who heads the Hamdan Water Association. "We are suffering now." Ten years ago, there was 20 percent more rainfall in San'a — 9.84 inches per year compared to 7.87 inches now, according to a water resource specialist at San'a University, Abdullah Al-Numan. Other parts of Yemen receive less than a third of the water they received a decade ago, dropping from 11.81 inches a year on average to 3.93 inches, he said. When rain does come, the timing is unpredictable and the concentration so heavy that the water's value is lost, he said. In some areas, the entire yearly rainfall can now happen in a matter of days. Last year 58 people were killed and 20,000 people fled their homes in October floods. The drought extends into East Africa and is the worst in the region since 2000, according to the *Economist* magazine. Yemen is among about 50 countries, mostly in the Middle East and Africa, that are facing water shortages owing largely to population increase and climate change. One in six people on the planet do not have enough clean water to drink. By 2025, the United Nations predicts, about two-thirds of the world's population will live in areas where water is scarce. URL: <http://www.washingtontimes.com/news/2009/nov/15/yemens-capital-running-out-of-water/>

"The Muslim World." 1995. *GeoJournal*. Akademische Verlagsgesellschaft, Wiesbaden, Federal Republic of Germany. Sep. Volume 37, Issue 1, Pages 195. Descriptors: Africa; Arabian Peninsula; Asia; Bahrain; East Africa; ecology; interpretation; Jordan; Middle East; Saudi Arabia; Sudan; urbanization; water resources; Yemen. Notes: Individual papers within scope are cited separately; illus. incl. tables, geol. sketch maps. Database: GeoRef. ISSN: 0343-2521.

Muthanna, G. and Amin, MSM. 2005. "Irrigation Planning using Geographic Information System: A Case Study of Sana's Basin, Yemen." *Manage. Environ. Qual.* Volume 16, Issue 4, Pages 347-361. Descriptors: Agriculture; Alfalfa; Arid environments; Available Water; Basin Irrigation; Basins; Case Studies; Crop Yield; Crops; Deserts; Environmental Quality; Evapotranspiration; Geographic information systems; Geographical Information Systems; Irrigation; Irrigation Effects; Irrigation Engineering; Irrigation Scheduling; Irrigation Water; Leaching; Maps; Onions; Planning; Profiles; Remote sensing; Salinity; Soil Profile; Soil Types; Storage; Sustainable development; Tolerance; Training; Water Demand; Water Requirements;

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Water Use; Water resources; agriculture; data storage; salinity tolerance; soil; tree crops; values; water balance; Article Taxonomic Terms: *Allium cepa*; *Lycopersicon esculentum*; Vitaceae; Article Geographic Terms: Yemen. Abstract: Purpose - The purpose of this paper is to present a procedure to estimate the total irrigation water requirement for a command area of 2,500 hectares in an arid environment under various crops and soil types using GIS for data storage, analysis and visualization of results. Design/methodology/approach - Bani Al-Harith agricultural area in Sana'a basin, Yemen was chosen for the study. ArcView GIS was used to plan for suitable crops and estimate the irrigation water requirements based on the farmer's preference and soil types. Using the available soil maps, the soil characteristics such as salinity, texture and suitable crop types were overlaid to produce the crop blocks map. The water balance equation was used to produce the crop water requirement map considering the crop coefficient for different crop stages. The total water demand for each irrigation block was calculated by summing the three components, namely percolation loss through the soil, maximum evapotranspiration of the crop and leaching requirement (LR) to maintain an acceptable salinity level. Findings - The case study is an example of using GIS as an effective tool in irrigation planning. GIS facilities to acquire, store, analyze and display spatial data were used to produce the soil class map, soil profile map, crop map and water requirement map. The profile EC sub(e) values for the chosen crops is within the crop salinity tolerance for 100 percent yield except for blocks 4 and 5 where grape and coffee respectively are suggested to be grown. The profile EC sub(e) values are 18.37 dS/m in block 4 and 3.27 to 7.88 dS/m in block 5. The tolerance threshold of 100 percent yield for grape is 1.5 dS/m and for coffee is 3 to 6 dS/m. The salinity of the irrigation water was 2.08 dS/m. From the crop blocks map, the salinity tolerance level for 100 percent yield of onion for block 1 is 1.2 dS/m, tomato for block 2 is 2.5 dS/m, alfalfa for block 3 is 2 dS/m, grape for block 4 is 1.5/dS/m, and the salinity tolerance level for 100 percent yield of coffee for block 5 is 5 dS/m. Leaching requirements were obtained by taking EC sub(w) value of 2.08 and EC sub(e) of 1.2, 2.5, 2, 1.5 and 5 for onion, tomato, alfalfa, grape and coffee respectively. The peak total water requirement occurred in May and was found to be 5,595 m³/ha, or 560 mm. The design irrigation water requirement for every block is shown in a map for easy visualization and manipulation to produce the best combination of soils, crops and water use. Research limitations/implications - This method of determining the total irrigation water requirement is dependent on the selected irrigation system and crops whether shallow-rooted, deep-rooted or tree crops. The use of water in agriculture should be judicious, precise and sustainable. Application of GIS can be a useful tool in irrigation management since it provides rapid access to underlying information of crop suitability. The designer can try out various combinations of crops, to suit the soils and available water. Practical implications - This methodology is useful for training irrigation engineers and water resource planners on the use of GIS technique to plan irrigation projects in arid areas. Originality/value - This technique has never been applied to the study area. Database: Water Resources Abstracts. ISSN: 1477-7835.

Myntti, Cynthia. 1988. "Hegemony and Healing in Rural North Yemen." Soc. Sci. Med. Volume 27, Issue 5, Pages 515-520. Descriptors: Yemen; Islamic world; Arabic medicine; medical pluralism. Abstract: This article examines medical pluralism by considering how people in a village in North Yemen respond to unusual and to ordinary ailments. The resort to care is explained against a backdrop of increasing economic differentiation and religious orthodoxy in the community. ISSN: 0277-9536.

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Nabil', Abdulrahman Mukhammad (Nabil, Abdulrahman Muhammad). 1990. "Osobennosti Raspredeleniya Podzemnykh Vod Doliny Khadramaut (Narodno-Demokraticeskaya Respublika Yemen). Translated title: Ground-Water Distribution in the Hadhramaut Valley, Peoples Democratic Republic of Yemen." *Uzbekiston Geologiya Zhurnali = Uzbekskiy Geologicheskii Zhurnal*. Izdatel'stvo "Fan" Uzbekskoy SSR, Tashkent, Uzbekistan. Oct. Volume 1990, Issue 5, Pages 53-57. Descriptors: aquifers; Arabian Peninsula; artesian waters; Asia; Cenozoic; clastic rocks; confined aquifers; Cretaceous; ground water; Hadhramaut; hydrogeology; irrigation; Mesozoic; reservoir rocks; sandstone; sedimentary rocks; Southern Yemen; surveys; Upper Cretaceous; Yemen. Database: GeoRef. ISSN: 0042-1693.

Nabil, AA-S. 2008. "N-Alkane Distribution in Surficial Sediments from the Aden City Coast, Yemen." *Nat. Environ. Pollut. Technol. Sep.* Volume 7, Issue 3, Pages 429-433. Descriptors: Article Subject Terms: Carbon; Coastal zone; Coasts; Crude oil; Distribution Patterns; Ecological distribution; Fossils; Geochemistry; Hydrocarbons; Introduced species; Microorganisms; N-Alkanes; Oil; Oil Pollution; Petroleum; Pollution; Recent sediments; Saturated hydrocarbons; Sediment Contamination; Sediment Distribution; Sediment pollution; Sediments; Urban areas; petroleum hydrocarbons; Article Geographic Terms: Kuwait; Yemen. Notes: TR: CS0873523. Abstract: The paper presents the N-alkanes distribution in recent sediments of Aden city coast. The results are the first of their kind for the region and should serve as baseline for future studies. The concentration of N-alkanes in sediment samples ranged from 3 to 1805 ng/g dry weight, expressed as Kuwait crude oil equivalent it is evident that all the sites are contaminated to some extent with N-alkanes. N-alkanes generally constitute the major fraction of saturated hydrocarbons, and their distribution patterns are characterized by carbon-number ranges and predominance, depending on the nature of the source material and its microbial or geochemical alteration. In this respect it has been recognized that distributions exhibiting odd carbon-number predominance in the C sub(15)-C sub(21) and C sub(25)-C sub(31) ranges are characteristic of autochthonous and allochthonous natural inputs respectively, whereas slight even carbon-number predominance or smooth distribution in the C sub(20)-C sub(30) range have been invoked for reduction or bacterial diagenetic processes. Finally, fossil (petroleum) N-alkanes are characterized by a low carbon preference distribution generally concurrent with an unresolved complex mixture of branched and cyclic saturated hydrocarbons. Database: Water Resources Abstracts. ISSN: 0972-6268.

Nadwat Al-Idarah Al-Mutakamilah Lil-Mawarid Al-Maiyah Fi Al-Yaman, San`a 9-11 Disimbir 1996. 1996. San`a: al-Jumhuriyah al-Yamaniyah, Riasat Majlis al-Wuzara, al-Hayah al-`Ammah lil-Mawarid al-Maiyah: al-Bank al-Duwali, Ma`had al-Tanmiyah al-Iqtisadiyah. Page(s): 22. Descriptors: Water-supply -- Yemen (Republic) -- Congresses; Water resources development -- Yemen (Republic) -- Congresses; Conference publication. Notes: 105; ill., maps; 31 cm. Other Titles: Seminar on Integrated Water Resources Management in Yemen, Sana'a 9-11 Dec. 1996. OCLC Accession Number: 123758589.

Nadwat Al-Idarah Al-Mutakamilah Lil-Mawarid Al-Maiyah Fi Al-Yaman, San`a 9-11 Disimbir 1996: Mulkhas Al-Wathaiq Wa-Al-Tawsiyat. 1996. San`a: al-Jumhuriyah al-Yamaniyah, Riasat Majlis al-Wuzara, al-Hayah al-`Ammah lil-Mawarid al-Maiyah: al-Bank al-Duwali, Ma`had al-Tanmiyah al-Iqtisadiyah. Page(s): 12. Descriptors: Water-supply -- Yemen (Republic) -- Congresses; Water resources development -- Yemen (Republic) -- Congresses; Conference publication. Notes: 52; 21 cm. Other Titles: Seminar on Integrated Water Resources

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Management in Yemen (abstracts), Sana'a 9-11 Dec. 1996. OCLC Accession Number: 86115500.

Nagi, M. A. M. 2005. "Evaluation of a Programme for Control of Schistosoma Haematobium Infection in Yemen." *East. Mediterr. Health J.* Volume 11, Issue 5-6, Pages 977-987. Notes: Cited By (since 1996): 2. Abstract: An intervention study was conducted in Khamir, north of Sana'a, for control of urinary schistosomiasis using chemotherapy and health education. The validity and cost-effectiveness of reagent strips as a rapid diagnostic tool to screen for Schistosoma haematobium infection was also assessed along with visible haematuria. Prevalence of S. haematobium infection 14 months post-intervention fell from 58.9% to 5.8% and frequency of heavy infection from 40.0% to 18.9%. Health education sessions resulted in significant decrease in the frequency of contact with water sources and greater adherence to preventive measures. Mass chemotherapy plus health education is a feasible and effective method for reducing S. haematobium infection in Yemen. Reagent strips and visible haematuria could be cost-effective in remote areas with limited access to health services. Database: SCOPUS. ISSN: 1020-3397.

Naji, J. A. 2000. "Shortcomings in Road Accident Data in Developing Countries, Identification And Correction: A Case Study." *IATSS Research. International Association of Traffic and Safety Sciences: Japan.* Volume 24, Issue 2, Pages 66-74. Descriptors: Accidents; Data banks; Developing countries; Fatalities; Injuries; Yemen. Notes: References (11). Abstract: This paper reports on some aspects of the findings of a recent piece of research into road traffic accidents in Yemen. The aim of the research was to provide a better understanding of road accident problems in Yemen by investigating its real dimensions. This includes the identification of the shortcomings in road accident data and to develop a method that can be adopted to adjust (correct) the official data. Two field surveys were employed to check the shortcomings in the official records. The main findings obtained are presented as follows: The actual size of the road accident problem in Yemen is much greater than it appears in the official fixtures. In 1993, the registered accidents accounted for only about 13.3% of estimated accidents and injuries accounted for only about 30% of estimated injuries. The registered fatalities account for only about 48% of the actual number of fatalities using the 30 days definition. The 30 days definition for road accident fatalities is not adopted in Yemen and the relevant agencies are not implementing this definition properly. Methods of adjusting road accident data were adopted in this study. It is believed that this method can adjust the road accident data with an acceptable degree of satisfaction. It is hoped that the findings of this research will help both researchers in their future work and decision makers in the field of road safety to encourage suitable safety programmes to be adopted which are consistent with the actual size of the problem. Knowledge of the true picture of the road accident problem will be useful for the purpose of negotiating adequate funding for road safety activities. Estimating the actual percentage of unreported data in road accidents and casualties is very useful for any further research in road accidents and safety in Yemen. It will also help in dealing with official data and results from previous studies. Database: TRIS. ISSN: 0386-1112. Availability: <http://worldcat.org/issn/03861112>.

Naji, Jamil A. and Asi, Ibrahim M. 2008. "Performance Evaluation of Asphalt Concrete Mixes Containing Granular Volcanic Ash." *Journal of Materials in Civil Engineering.* Volume 20, Issue 12, Pages 754-761. Descriptors: Admixtures; Asphalt concrete; Asphalt pavements; Creep; Fatigue (Mechanics); Hot mix paving mixtures; Performance measurement; Suburbs; Tensile strength; Urban areas; Volcanic aggregates; Volcanic ash; Waste management. Notes: Figures (10); Illustrations (1); References (24); Tables (6). Abstract: Granular volcanic ash

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material is spread over considerable areas of Yemen including urban and suburban areas. Due to the inferior properties of this material in its natural state, it cannot be used in base and subbase layers. It is common practice, when faced with such material, to replace it with superior properties filling material. Excavated volcanic ash is disposed off by transporting it to landfill sites. Such practice is becoming increasingly costly and continuously necessitates allocation of scarce and valuable new landfill sites. The problem in some urban areas is becoming an environmental issue due to the massive buildup of disposed volcanic ash material. The main objectives of this study are twofold: one to investigate the merits of utilizing waste volcanic ash as a cheap alternative to aggregate for road construction and consequently this contributes toward an efficient waste management of this undesirable material and reduces its environmental impact. The effects of using granular volcanic ash material, as a partial replacement of conventional aggregate on the properties of hot-mix asphalt (HMA), were studied. Four different aggregate replacement proportions were used specifically at 0, 10, 20, and 30% of total weight of dry aggregate. The 0% volcanic ash content mix was used as the reference mix. Experimental results indicated that the mechanical properties of all mixes containing volcanic ash aggregate, up to 20%, were within the specification limits of the Marshall mix design method. In addition, it was found that the use of volcanic ash aggregate improved the HMA creep resistance properties. HMA with a 10% volcanic ash aggregate replacement gave optimum results in terms of stripping resistance, creep resistance, fatigue, and resilient modulus. Database: TRIS. ISSN: 0899-1561. URL: <http://link.aip.org/link/?QMT/20/754/1>.

Nakhal, HA. 1987. "Comparison between the Groundwater Quality in an Intermountainous and a Coastal Plain in Yemen Arab Republic." Irrigation and Water Allocation. International Association of Hydrological Sciences Press. Institute of Hydrology, Wallingford. IAHS Publication no. 169, Pages 4 ref. Descriptors: Groundwater quality; Yemen Arab Republic; Coastal plains; Water chemistry; Geochemistry; Water quality; Mountains; Irrigation water; Domestic use; Saline water intrusion; Comparison studies. Abstract: Groundwater qualities of the Sana'a and Hudaydah areas, which represent an intermountainous and a coastal plain, respectively, are compared. The quality of the groundwater of both areas was evaluated for irrigation and domestic use by applying the Wilcox (1955) and the Doneen (1961) methods as well as the standards accepted by the World Health Organization (WHO) (1971). The results of the evaluation based on total dissolved solids, electrical conductivity, pH, anions, and cations show that the quality of Sana'a water is much better than that of Hudaydah. All samples collected from the Sana'a area are suitable for domestic use, whereas all of the Hudaydah samples proved unsuitable according to WHO standards. The poor quality of Hudaydah groundwater is attributed to its contamination with seawater and to the low rate of the Hudaydah annual rainfall. Database: Water Resources Abstracts. ISBN: 0947571310.

Narayanan, M. R. United Nations Development Programme and Food and Agriculture Organization of the United Nations. 1970. Report to the Government of the Yemen Arab Republic on Minor Irrigation. Rome: Food and Agriculture Organization of the United Nations. Page(s): 37. Descriptors: Irrigation -- Yemen (Republic); Water-supply -- Yemen (Republic); Government publication; International government publication. Notes: iii; ill., map; 28 cm; Other Titles: Minor irrigation; Responsibility: based on the work of M. R. Narayanan. OCLC Accession Number: 85230535.

Nasr, Mamdouh. 1999. "Assessing Desertification and Water Harvesting in the Middle East and North Africa; Policy Implications." ZEF - Discussion Papers on Development Policy. Zentrum fuer Entwicklungsforschung, Bonn, Germany. Volume 10, Pages 59. Descriptors:

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Africa; Arabian Peninsula; arid environment; Asia; desertification; Egypt; Jordan; Libya; Middle East; mitigation; monitoring; Morocco; North Africa; public policy; remote sensing; satellite methods; subtropical environment; Syria; terrestrial environment; Tunisia; water management; water use; Yemen. Notes: illus. incl. 9 tables. Database: GeoRef. ISSN: 1436-9931.

Nasr, SM, Okbah, MA and Kasem, SM. 2006. "Environmental Assessment of Heavy Metal Pollution in Bottom Sediments of Aden Port, Yemen." *Int. J. Oceans Oceanogr.* Volume 1, Issue 1, Pages 99-109. Descriptors: Article Subject Terms: Absorption; Absorption spectroscopy; Assessments; Desalination plants; Domestic Wastewater; Environmental assessment; Heavy Metals; Industrial wastes; International standardization; Marine pollution; Oceanography; Oceans; Oil Pollution; Oil refineries; Oil spills; Pipes; Power plants; Refineries; Sediment Contamination; Sediment Distribution; Sediment pollution; Spectrophotometers; Textile industry; Wastewater; Zinc; Article Geographic Terms: Yemen; Marine. Notes: TR: CS0732064. Abstract: The aim of the present study is investigate the distribution of heavy metals (Mn, Zn, Cu, Pb, Co, Cr and Ni) and to evaluate the contamination levels of the Aden Port sediments. In this study, the concentrations of heavy metals were measured, using Atomic Absorption Spectrophotometer (AAS) for 21 sediment samples collected at different stations in Aden Port during 2004. The range and average concentrations measured in $\mu\text{g g}^{-1}$ were 138.23 - 658.87 (335.5) for Mn, 21.85 - 263.49 (128.59) for Zn, 8.06 - 111.00 (19.89) for Cu, 14.8 - 138.06 (77.28) for Pb, 13.8 - 33.64 (23.97) for Co, 17.00 - 233.93 (82.19) for Cr and 16.17 - 48.07 (34.54) for Ni. To evaluate the levels of sediment contaminations, the background values of the different elements were defined, depending on the international standards. In case of Pb, Cr, Zn and Co at most of sites, their concentrations in the sediments exceeded the background levels. However, the average values for Cu, Ni and Mn were less than the background values. It is noted that the contamination factors in the investigated sediments were 0.31-3.39 for Zn, 0.4-5.55 for Cu, 0.74-6.9 for Pb, 1.06-2.59 for Co, 0.57-7.80 for Cr, 0.43-1.27 for Ni and $\text{Cr} > \text{Zn} > \text{Co} > \text{Ni} > \text{Cu} > \text{Mn}$. The relatively high levels of Pb, Cr, Zn and Co in the sediments of the Aden Port are due to the discharges of untreated wastewater of desalination plant, electrical power station, refinery plant, textile industry, oil spills from the oil pipes, as well as domestic wastewater. Database: Water Resources Abstracts. ISSN: 0973-2667.

National Climatic Center Asheville N C. 1974. "U.S. Naval Weather Service Command Summary of Synoptic Meteorological Observations - East African and Selected Island Coastal Marine Areas. Volume 3. Area 13 - Gulf of Aden, SW, Area 14 - Gulf of Aden, SE, Area 15 - Somali Coast, NE, Area 16 - Somali Coast East, Area 17 - Somali Coast, SE, Area 18 - Somali Coast South." Jun. Page(s): 483. Abstract: The data contained in these tables were obtained from tape data Family 11 (TDF-11), Marine Surface observations. TDF-11 was primarily funded by the Naval Weather Service Command and selected by NWSERD Asheville as the most comprehensive collection of marine surface observations from which to develop a series of coastal marine summaries. Abstract Classification: Unclassified Technical Reports Collection. DTIC Accession Number: AD0780314.

National Climatic Center Asheville N C. 1974. U.S. Naval Weather Service Command Summary of Synoptic Meteorological Observations - East African and Selected Island Coastal Marine Areas. Volume 3. Area 13 - Gulf of Aden, SW, Area 14 - Gulf of Aden, SE, Area 15 - Somali Coast, NE, Area 16 - Somali Coast East, Area 17 - Somali Coast, SE, Area 18 - Somali Coast South. Ft. Belvoir Defense Technical Information Center: Descriptors: Meteorology; Marine meteorology; Coastal regions; Africa; Meteorological phenomena; Air water interactions; Climate; Atmospheric precipitation; Fog; Cloud cover; Visibility; Ocean waves;

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Atmospheric temperature; Tables(data); Aden Gulf; Somali Republic. Abstract: The data contained in these tables were obtained from tape data Family 11 (TDF-11), Marine Surface observations. TDF-11 was primarily funded by the Naval Weather Service Command and selected by NWSERD Asheville as the most comprehensive collection of marine surface observations from which to develop a series of coastal marine summaries. Notes: 483 p. Note(s): See also Volume 1, AD-780 313; General Info: APPROVED FOR PUBLIC RELEASE. OCLC Accession Number: 227588910.

National Climatic Center, Asheville, N C. 1974. U.S. Naval Weather Service Command Summary of Synoptic Meteorological Observations - East African and Selected Island Coastal Marine Areas. Volume 1. Area 1 - Kuria Muria Islands, Area 2 - West Arabian Sea, Area 3 - Qamr Bay, Area 4 - Socotra Island, Area 5 - Gulf of Aden, NE, Area 6 - Gulf of Aden, NW. Ft. Belvoir Defense Technical Information Center: Descriptors: Meteorology; Marine meteorology; Coastal regions; Africa; Indian ocean islands; Meteorological phenomena; Air water interactions; Climate; Atmospheric precipitation; Fog; Cloud cover; Visibility; Ocean waves; Atmospheric temperature; Tables(data); Kuria Muria Islands; Arabian Sea; Qamr Bay; Socotra Island; Aden Gulf. Abstract: The data contained in these tables were obtained from tape data Family 11 (TDF-11), Marine Surface observations. TDF-11 was primarily funded by the Naval Weather Service Command and selected by NWSERD Asheville as the most comprehensive collection of marine surface observations from which to develop a series of coastal marine summaries. Notes: 482 p. Note(s): See also Volume 3, AD-780 314. General Info: Approved For Public Release. DTIC Accession Number: AD-780 313 and AD0780662.

National Defense Univ Washington Dc Center For Counter-proliferation Research and Esposito, John L. 2000. "Political Islam and the West." Jan. Page(s): 8 Report Number: XD-JCS Monitor Series: JCS. Abstract: At the dawn of the 21st century political Islam, or more commonly Islamic fundamentalism, remains a major presence in governments and oppositional politics from North Africa to Southeast Asia. New Islamic republics have emerged in Afghanistan, Iran, and Sudan. Islamists have been elected to parliaments, served in cabinets, and been presidents, prime ministers, and deputy prime ministers in nations as diverse as Algeria, Egypt, Indonesia, Jordan, Kuwait, Lebanon, Malaysia, Pakistan, and Yemen. At the same time, opposition movements and radical extremist groups have sought to destabilize regimes in Muslim countries and the West. Americans have witnessed attacks on their embassies from Kenya to Pakistan. Terrorism abroad has been accompanied by strikes on domestic targets such as the World Trade Center in New York. In recent years, Saudi millionaire Osama bin Laden has become emblematic of efforts to spread international violence. The phenomenon known as political Islam is rooted in a contemporary religious resurgence in private and public life. On one hand, many Muslims have become more observant with regard to the practice of their faith (prayer, fasting, dress, and family). On the other, Islam has reemerged as an alternative to the perceived failure of secular ideologies such as nationalism, capitalism, and socialism. Islamic symbols, rhetoric, actors, and organizations have become sources of legitimacy and mobilization, informing political and social activism. The governments of Afghanistan, Egypt, Iran, Libya, Malaysia, Morocco, Pakistan, Saudi Arabia, and Sudan have made appeals to Islam to enhance their legitimacy and to mobilize popular support for programs and policies. Islamic movements span the religious and political spectrum from moderate to extremist. This article reviews the events that acted as catalysts for political Islam, the evolution of political Islam, Islam as a threat or clash of civilizations, democracy and Islam, and the Western response. 7 Abstract

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Classification: Unclassified Technical Reports Collection. Journal article. DTIC Accession Number: ADA426734. URL: <http://handle.dtic.mil/100.2/ADA426734>.

National Geographic Society (États-Unis) and Cartographic Division. 1972. "Peoples of the Middle East Moyen-Orient." Washington, D.C: National Geographic Society. Descriptors: Afghanistan; Arabie-Saoudite; Carte; Egypte; Empire; Est; Golfe-Persique; Histoire; Irak; Iran; Koweit; Libie; Mer-Rouge; Moyen-Orien; Musulman; Orien; Population; Qatar; Relief; Route; Turquie; Ville; Yemen. Notes: Description: 14 cartes sur 1 feuille recto-verso: coul. 55 X 87 cm. Genre/Form: Documents cartographiques. Map Info: Echelle 1:7096000. Note(s): Comprend des ill., du texte et 2 cartons. Other Titles: Cultural map of the Middle East; Where water sets the place; Responsibility: compiled and drawn in the Cartographic Division of the National Geographic Society for The National Geographic Magazine. OCLC Accession Number: 299595897.

National Institute of Oceanography of Great Britain; Royal Geographical Society (Great Britain) and Experimental Cartography Unit. 1968. "The Bathymetry of the Gulf of Aden." London, England: Royal Geographical Society. Descriptors: Cartes bathymetriques; Aden, Gulf of -- Bathymetric maps; Aden, Gulf of -- Maps; Arabie saoudite. Notes: Description: 1 map: col. 85 x 75 cm. Map Info: Scale 1:2,000,000. Note(s): Depths shown by contours. "This is the first map that the Experimental Cartography Unit of the Royal College of Art has produced by automatic cartography." Includes location diagram. Responsibility: bathymetric contours and soundings compiled by the National Institute of Oceanography; automatic cartography by the Royal College of Art, London. OCLC Accession Number: 21460267.

National War College, Washington, DC and Dahlstrom, Eric L. 2003. "From Reconnaissance to Surveillance: Intelligence Transformation in the New Millennium." Jan. Page(s): 13. Report Number: XD-NDU/NWC Monitor Series: NDU/NWC. Abstract: Bruce Berkowitz The vehicle moved steadily along a dusty road 175 kilometers east of the capital city of Sana'a. The American pilot received permission to engage and, peering at his video screen, centered the crosshairs of his Hellfire missile directly over the target. A few moments later, the sedan carrying six al-Qaeda terrorists dissolved into a mass of fire and debris. What makes this mission unique compared to the thousands of others flown during Operation ENDURING FREEDOM is that this pilot is not a military officer. In fact, the CIA pilot is not even aboard his aircraft, a 1,500-pound Predator drone. He is flying this mission from a command trailer located hundreds of miles from the battlefield. This one event represents a major turning point in America's military evolution. It highlights the changing nature of the threat to the United States and showcases the emerging capabilities required to successfully defend our country in the new millennium. Transnational terrorist groups, willing to conduct suicide missions and eager to obtain weapons of mass destruction, pose a difficult problem for militaries geared to combat conventional foes. Because groups such as al-Qaeda operate in the midst of civilian populations and strike non-military targets, it is nearly impossible to defend the homeland without drastically changing our way of life. As such, the new National Security Strategy proposes that the United States not wait to be attacked, but should preempt terrorist groups before they can strike. The American military will need specific and timely intelligence if it is going to take the fight to the terrorists. The intelligence community, in turn, must significantly change the way it processes information and move from a collection paradigm dominated by reconnaissance to one geared toward persistent surveillance on demand. Abstract Classification: Unclassified Technical Reports Collection. Distribution Statement: Approved for public release; distribution is

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unlimited. DTIC Accession Number: ADA441598. URL:
<http://handle.dtic.mil/100.2/ADA441598>.

National Water Resource Authority (NWRA) of Yemen. 2007. Drops- NWRA's Quarterly Magazine. Issue No. 1 March 2007. Accessed Online: May 2010
<http://www.nwrayemen.org>

Naval Environmental Prediction Research Facility, Monterey, Calif and Brody, L, R. 1977. "Meteorological Phenomena of the Arabian Sea," Mar. Page(s): 184 Report Number: NEPRF-AR-77-01. Abstract: This document, the product of extensive literature research, provides a single and comprehensive reference text for the operational forecaster in the Arabian Sea and Gulfs of Aden and Oman. It contains extensive climatological information, descriptions of significant meteorological phenomena and relevant forecasting aids, discussions of meteorological conditions affecting various regional ports, and a representative assortment of typical weather sequences depicted by both satellite imagery and conventional data. General information on the large-scale Asian monsoon and its relationship to the Arabian Sea region is presented. Also discussed are the significant meteorological phenomena associated with time and space variations in the Arabian Sea monsoon; forecasting aids and typical weather sequences are provided. Seasonal progressions of weather events are discussed; variations from normal conditions are described in first-hand reports from observers in the field. (Author) Abstract Classification: Unclassified Technical Reports Collection. DTIC Accession Number: ADA046542.

Naval Intelligence Division. 1946?. "Western Arabia and the Red Sea." Geographical Handbook Series. [Oxford?]: Naval Intelligence Division, [1946] (Oxford: Printed under the authority of H.M.S.O. at the University Press): Descriptors: Arabian Peninsula; Red Sea Coast (Saudi Arabia); Saudi Arabia; Aden (Protectorate); Yemen; Arabian Peninsula -- Description and travel; Red Sea Coast (Saudi Arabia) -- Description and travel; Saudi Arabia -- Description and travel; Aden (Protectorate) -- Description and travel; Yemen -- Description and travel; Added Author Scott, Hugh, 1885-; Marshall, Mary; Mason, Kenneth, b. 1887; Great Britain. Naval Intelligence Division. Notes: xix, 659 p., [88] p. of plates (some folded): ill., maps (some col.); 23 cm. "Prepared by the Oxford sub-centre of the Naval Intelligence Division under the direction of ... K. Mason"--P. iv."June 1946."Folded map in pocket."This volume has been written mainly by Dr. Hugh Scott ... and by Professor Kenneth Mason and Miss Mary Marshall"--P. [619]. Includes bibliographical references (p. 620-627) and index. Abstract: Produced during the Second World War for the use of commanding officers, this work is a complete guide to Western Arabia. Sections on geology, geography, the coasts, climate, vegetation, history, administration, people, public health, agriculture, economy, ports and towns offer readers a unique military perspective on this important region. The text is supplemented by hundreds of maps, photographs and figures. ISBN: 071031034X; 9780710310347. OCLC: 27033079.

Naval Ocean Research and Development Activity, Stennis Space Center, MS, and Fenner, Don F and Cronin Jr, William J. 1978. "Bearing Stake Exercise: Sound Speed and Other Environmental Variability." Sep. Page(s): 72 Report Number: NORDA-18 XB-NOSC Monitor Series: NOSC. Abstract: The BEARING STAKE exercise was conducted at five sites in the northwest Indian Ocean during January through April 1977 (northeast monsoon). Oceanographic data from the exercise consisted mainly of expendable bathythermograph (XBT) observations that were converted to sound speed using the equation of Wilson (1960) and a salinity field derived from exercise deep ocean station data. At all exercise sites except site 4 (Somali Basin), acoustic propagation was bottom-limited in respect to the high frequency (about 18-m) and low

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frequency (about 91-m) sources. Although site 4 was bottom-limited in respect to the high frequency source, at least 200 m of depth excess occurred for the low frequency source. At site 4 and throughout the western Somali Basin, interleaving of intrusive water masses (including Red Sea and Antarctic Intermediate Waters) caused complex and highly variable sound speed profiles to depths of at least 1800 m. At site 1B (Gulf of Oman) sound speed profiles were up to 5 m/sec lower than those observed one month earlier (site 1A), probably due to increased northeast monsoon upwelling after the site 1A occupation. Maximum temporal and spatial sound speed variability throughout the exercise area occurred between about 100 and 150 m, just below the depth of the low frequency source. At all sites, wind speeds and sea/swell heights were low to moderate and should not have markedly influenced ambient noise levels above 200 Hz. Abstract Classification: Unclassified Technical Reports Collection. Final rept. Jan-Apr 1977; Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADC017390. URL: <http://handle.dtic.mil/100.2/ADC017390>.

Naval Ocean Research and Development Activity, Stennis Space Center, MS, and Oriol Ramon A and Arnone, Robert A. 1990. "Seasonal Optical Properties Derived from Coastal Zone Color Scanner Satellite Data Along the Somali Coast and the Gulf of Aden." Apr. Page(s): 39 Report Number: NORDA-244 XN-NORDA Monitor Series: NORDA. Abstract: Optical water properties of the world's oceans can be obtained from data collected with Coastal Zone Color Scanner (CZCS) aboard Nimbus-7. Our understanding of the spatial and temporal variability of surface optical properties is greatly improved from synoptic images from visible channel satellites. Current satellite data processing techniques can eliminate the atmospheric contamination that contributes 90% of the visible channel signal. The remaining signal, which constitutes the ocean color, is directly related to the diffuse attenuation coefficient (K) at 490 nanometers for the upper surface waters. Calculation and geographic registration of K can be performed on each sqm image-pixel of the CZCS data, and results show that the accuracy is within 92% of ship measurements. Regional costal optical atlases are required for planning bathymetric surveys using the Airborne Bathymetric System, CZCS data provide a method of deriving temporal and spatial variability of costal optical properties in regions where limited ship measurements are available. This report presents a demonstration of the capability of a regional optics data base generated using CZCS data. A series of CZCS images of the eastern Somali cost and the Gulf of Aden has been processed for the diffuse attenuation coefficient and have been used to define a regional optical database. This data base exists in digital image form and clearly defines optical variability in response to continental winds, monsoon wind, and coastal upwelling. Keywords: Ocean color, Ocean optics, Satellites, Multispectral, Image processing. Abstract Classification: Unclassified Technical Reports Collection. Notes: Final rept. DTIC Accession Number: ADA226301. URL: <http://handle.dtic.mil/100.2/ADA226301>.

Naval Oceanographic Office Nstl Station MS and Beatty III William H Bruce John G Guthrie, Robert C. 1981. "Circulation and Oceanographic Properties in the Somali Basin as Observed during the 1979 Southwest Monsoon." Jun. Page(s): 88 Report Number: NOO-TR-258 XB-NOO Monitor Series: NOO. Abstract: Shipboard expendable bathythermograph (XBT), salinity-temperature- depth (STD), and sea surface temperature and salinity observations were taken from USNS WILKES (T-AGS 33) from 16 August until 5 September 1979 in the area of the Somali Current off the coast of Northeast Africa. Analysis of the data indicated the presence of two large anti-cyclonic gyres. The larger of the two gyres, called the Great Whirl or Prime Eddy, was centered at about 7 N and 55 E with a diameter of approximately 350 nautical miles. The smaller gyre, known as the Socotra Eddy, was centered at approximately 12 N and 57 E with

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an approximate diameter of 200 nautical miles. The two eddies were separated by a trough of cold water advected from the region of upwelling off the Somali coast between 9 N and 11 N. Studies of TIROS-N satellite infrared photographs and XBT cross-sections taken from tankers transiting the area during July and early August 1979 indicated the presence of a southern eddy separated from the Great Whirl by a trough of cold, upwelled water between 3 N and 5 N. During the early part of the WILKES survey, the southern eddy and the Great Whirl coalesced. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: View Full Text (pdf); File: /U2/a276238.pdf; Size: 3 MB; Technical rept. Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA276238. URL: <http://handle.dtic.mil/100.2/ADA276238>.

Naval Oceanographic Office, Nstl Station MS, and Tressler, Willis L. 1963. "Oceanographic Stations Taken in the Indian Ocean by Usccg Eastwind (WAGB-279) in 1961." Jul. Page(s): 84 Report Number: NOO-TR141 Monitor Series: TR141. Abstract: During late March and April 1961, the USCGC EASTWIND (WAGB-279) occupied 30 oceanographic stations in the Indian Ocean. Three sections were made, one running from off Cape Leeuwin, Australia west as far as 78 E. longitude, a second continuing north from this point to 40 N. latitude, and the third which continued west to just south of Socotra Island. Measurements were made of temperature, salinity, and dissolved oxygen; and from these data density, sound velocity, and percentage of saturation of dissolved oxygen were derived. Transparency was determined by Secchi disc, and the Deep Scattering Layer was observed. Continuous recording of bottom depths by echo sounder was carried out through a region where few soundings had hitherto been reported. Northward reaching tongues of Antarctic Intermediate water are shown on the southern profile and on the southnorth profile along the 78 E. meridian. In mid-Indian Ocean, these masses push up toward the surface causing a divergence which is apparent in the salinity and dissolved oxygen profiles. Also delineated are high salinity waters with very low oxygen content which come from the Arabian and Red Seas. The Deep Scattering Layer disappears in mid-Indian Ocean and reappears again to the north, following a similar pattern to that already observed in the Pacific Ocean. (Author) Abstract Classification: Unclassified Technical Reports Collection. Notes: Technical rept. DTIC Accession Number: AD0433272.

Naval Oceanographic Office, Washington, DC and FennerDon, F. BuccaPaul J. 1972. "The Sound Velocity Structure of the North Indian Ocean." Dec. Page(s): 104 Report Number: N00-TR-231 NORDA-TN-65 Monitor Series: TN-65. Abstract: All available sound velocity data in the North Indian Ocean (north of 10 degrees S latitude) were analyzed in terms of annual areal extent and depth of perturbations above deep axial depth, annual average depth and velocity of the deep sound channel and critical depth for the northeast and southwest monsoons. The vertical extent of these and other sound velocity features is shown on six north-south and six east-west cross-sections that extend to a maximum depth of 5000 meters. These analyses indicate that highly saline Red Sea Intermediate Water (RSIW) is the major factor controlling sound velocity structures in the North Indian Ocean. Mixing of RSIW with low salinity water masses causes either sporadic perturbations or an essentially isovelocity layer above deep axial depth. In relatively high concentrations, RSIW causes an anomalously deep (greater than 1700 meters) and narrow sound channel with velocities greater than 1493 meters/second (Gulf of Aden, Arabian Sea, and Arabian Basin. (Author) Abstract Classification: Unclassified Technical Reports Collection. Notes: Technical rept., DTIC Accession Number: AD0759352. URL: <http://handle.dtic.mil/100.2/AD759352>.

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Naval Oceanographic Office, Washington, DC and Lisitsyn, A. F. 1966. "The Processes of Recent Sediment Formation in The Southern and Central Parts Of The Indian Ocean." Jan. Page(s): 26 Report Number: Tran-225 TT-66-61845 Monitor Series: 66-61845. Abstract: The paper discusses the composition of sediments and rate of sedimentation in (1) the arid and (2) the tropical humid zones. Also the distribution of bottom sediments along meridional cross sections transecting the Indian Ocean are given. The meridional distribution of sediments is based on three cross sections: (1) from the Shaekeleton Ice Shelf to the Ganges, (2) from Antarctic Continent (Station 188) to the Bay of Aden, and (3) from the Antarctic Continent to the southern tip of Africa. The data are based on investigation conducted during the 4 cruises of the Antarctic expeditions organized by the Academy of Sciences of USSR from 1955 to 1959. Six diagrams and two tables present numerical and grafical data on the distribution of sediments and the relief of ocean floor. The influx and role of major Asian rivers in the formation of sediments in various parts on the Ocean is pointed out, giving also climatological data which affect the sedimentation process. (Author) Abstract Classification: Unclassified Technical Reports Collection. DTIC Accession Number: AD0636139.

Naval Oceanographic Office, Washington, DC and MuromtsevA, M. 1964. "Notes on the Hydrology of the Red Sea (K Gidrologii Krasnogo Morya)," Jan. Page(s): 8 Report Number: NOO-Tran-226. Abstract: The hydrological conditions with regard to the heat and water budget of the Red Sea are analysed on the basis of data gathered during the 'Voyeykov' expedition in the Red Sea, Bab el Mandeb Strait, and the Gulf of Aden. The employment of 18 deepwater stations in the trench of the sea, the strait, and the gulf lead to findings about temperature, salinity, and oxygen variations with depth. On the basis of these data the existing surface, intermediate and deep layers were established, and the horizontal and vertical water movements were traced. Abstract Classification: Unclassified Technical Reports Collection. DTIC Accession Number: AD0689694.

Naval Oceanographic Office, Washington, D C and Seryiv, V. 1973. "On the Water Exchange between the Red Sea and the Gulf of Aden (O Vodoobmene Mezhdru Krasnym Morem i Adenskim Zalivom)," Jan. Page(s): 11 Report Number: NOO-Tran-546. Abstract: The paper is based on data collected during a 3-year period by Vladimir Vorob'yev (1961-1964) along a cross section at the northeastern limit of Bab el Mandeb (Strait). Indirect methods permitted definition of sharp seasonal intensity variations of deep water flowing from the Red Sea into the Gulf of Aden, as well as the causes of these variations. Thermohaline and hydrochemical properties of Red Sea water change during the year in proportion to the degree of transformation of the water in Bab el Mandeb (Strait). (Modified author abstract) Abstract Classification: Unclassified Technical Reports Collection. DTIC Accession Number: AD0761566.

Naval Oceanography Command Detachment, Asheville, NC. 1982. "Climatic Study of the Red Sea South and Gulf of Aden." Sep. Page(s): 157. Abstract: This climate study consists of monthly charts and tables of (1) clouds, (2) visibility-tables, (3) ceiling-visibility (mid-range), (4) wind-visibility-cloudiness, (5) Scalar mean wind speed, (6) wind speed or = 11 and or = 34 knots, (7) wind speed 11-21 and 22-33 knots, (8) air and sea temperature, (9) surface wind roses, (10) wave height-isopleths, (11) wave height-tables and (12) surface currents (seasonal). Abstract Classification: Unclassified Technical Reports Collection. Notes: Reference rept. DTIC Accession Number: ADA121003.

Naval Postgraduate School, Monterey, CA and Al-Hajjri, Ibrahim. 2007. "The New Middle East Security Threat: The Case of Yemen and the GCC." Jun. Page(s): 87 Report Number: XB-NPS Monitor Series: NPS. Abstract: Since Yemen has a history of border disputes

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with Saudi Arabia, this addresses the question of Yemen's role in the security of the Arabian Peninsula. Yemen suffers from a weak economy and a number of security issues of its own. Through the borders shared with its GCC neighbors, Yemen has become plagued by a nexus of terrorism, arms smuggling, and drug trafficking. Yet Yemen is unable to effectively combat these threats because of weak border control and poor cooperation with its regional neighbors, which points to the issues of border control and transnational cooperation within the GCC as an important area of research. The scope of the research will encompass and scrutinize the role of borders and how terrorism flourishes through the Peninsula. That way, we can observe what has been done to solve this security threat, and what could be done. The thesis will examine potential solutions to the problems created by border security and a lack of cooperation, and will argue that a viable solution can be found by Yemen joining the GCC in a united force. This would help insulate the Arabian Peninsula from the internal threats facing it. Abstract Classification: Unclassified Technical Reports Collection. Master's thesis; Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA469931. URL: <http://handle.dtic.mil/100.2/ADA469931>.

Naval Postgraduate School, Monterey, CA and BarnsWilliam, Flemming. 1980. "Conflict and Commitment: The Case of the Yemens." March. Page(s): 171. Abstract: This thesis examines the relationship between the USSR and the People's Democratic Republic of Yemen from a systemic aspect; the intent, to gauge the potential for the South Yemeni to undertake specific tactical operations in a Soviet-surrogate manner. This work analyzes the Soviet-Yemeni military export relationship. In making this assessment, the internal political dynamics with the effects of a colonial legacy and a repressive imamate-turned-republic in South and North Yemen respectively have been explored; the results of these predicated the Soviet involvement. This effort includes an assessment of Sino-Soviet competition there. Additionally, the United States' counter-commitment and arms transfers to the YAR (with the deployment of a naval carrier task force to the Arabian Sea in light of the March 1979 PDRY-YAR border war specifically) are analyzed. (Author) Abstract Classification: Unclassified Technical Reports Collection. Notes: Master's thesis, DTIC Accession Number: ADA084904.

Naval Research Center, Constanta (Romania), and Radu Ovidiu; Slamnoiu Georgica; Zarnescu Liviu and Cosereanu Liviu. 2006. "Harbor Protection Against Terrorist Threats: Difficulties and Possible Solutions." 01 Sep. Page(s): 25 Report Number: X5-X5 Monitor Series: X5. Abstract: Ships play an important part on the scene of current conflicts. This is why they must be protected both in their home port and in other operating harbors. Also, because they are a symbol, an extension of a state's territory, they are a potential target for terrorists, fact that was demonstrated in 2000 by the action against USS Cole in Yemen, or in 1995 against the Sri Lanka Navy. An integrated harbor protection system must be prepared early on so that it permanently supplies information that will lead to reducing adverse actions effects, and increasing the global performance of the reaction force. A complex of detection technologies is needed so that the information is redundant and it ensures a false alarm rate as low as possible, and target tracking to be done accurately and automatically. From this point of view, designing such a system implies conducting studies about threat and sensor characteristics, data fusion, complex systems architecture, etc. Abstract Classification: Unclassified Technical Reports Collection. Distribution Statement: Approved for public release; distribution is unlimited. NATO. DTIC Accession Number: ADA485049. URL: <http://handle.dtic.mil/100.2/ADA485049>.

Naval Research Lab, Stennis Space Center, MS, Oceanography Division and Jarosz, E Blain, C A Murray, S.P., Inoue, M. 2005. "Barotropic Tides in the Bab El Mandab Strait --

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Numerical Simulations.” Jan. Page(s): 24 Report Number: NRL/JA/7320-04-0010 XB-ONR Contract Number: N00014-02-WX-20834 N00014-94-C-1037 Monitor Series: ONR. Abstract: A two-dimensional barotropic finite element model with the grid resolution varying between 0.2 and 2km and forced by eight principle constituents (Q1 O1, P1, K1, N2, M2, S2, and K2) was used to compute tidal elevations and currents in the Bab el Mandab Strait. Good agreement is achieved with the available observations for both diurnal and semidiurnal tidal currents and diurnal elevations; however, the model performs less satisfactorily for the semidiurnal elevations mainly due to the errors between the observed and computed phases in the region where there are amphidromic points for the M2, S2, and N2 constituents in the Strait. The results indicate that the largest amplitudes of the tidal elevations and the strongest currents are present in the southern part of the Strait. Residual circulation induced by the barotropic tides is rather weak in the major part of the Strait, and its contribution to the Red Sea water transport is small. The model results also show that barotropic energy fluxes are not very large and their direction depends on the constituent. All diurnal and one semidiurnal (N2) constituent have one major source of energy, which is the flux from the Gulf of Aden, while there are two sources of energy for the M2, S2, and K2 components: one from the Gulf and another from the Red Sea. Very small energy fluxes from the Strait to the adjacent basins indicate that almost all tidal energy is dissipated within the Strait. The distribution of the rate of energy dissipation due to bottom friction implies that the major area of dissipation is located between Perim Narrows and the Assab-Mocha line. Abstract Classification: Unclassified Technical Reports Collection. Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA449278. URL: <http://handle.dtic.mil/100.2/ADA449278>.

Naval Underwater Systems Center Newport R I and Browning, David G Jones, Everett, N. Thorp, William H. 1973. “Low-Frequency Sound Attenuation in the Gulf of Aden.” 05 Mar. Page(s): 22 Report Number: NUSC-TR-4501. Abstract: With the support of the French Navy, a low-frequency sound propagation experiment was conducted to obtain attenuation coefficients in the Gulf of Aden for the frequency range of 200 to 10,000 Hz. The experiment was conducted along a 500-kyd track, which was characterized by a broad sound channel with an axis depth of 250 m. The results are compared with previous measurements in the Red Sea and Atlantic Ocean. The attenuation coefficients agree with previous open ocean sound channel experiments and thus support the conclusion that attenuation for the frequency range of 200 to 10,000 Hz is independent of the experimental site. (Author) Abstract Classification: Unclassified Technical Reports Collection. Notes: Technical rept. DTIC Accession Number: AD0757664.

Naval Underwater Systems Center, Newport R I and Jones, Everett, N. Thorp, William H. 1971. “Operation Ghubbet: Outline of Experimental Phase.” 19 Nov. Page(s): 11 Report Number: NUSC-TM-TA13-242-71. Abstract: Operation Ghubbet was conducted between 7 and 25 September 1971 jointly with Naval Underwater Systems Center, New London and the French Navy based at Djibouti, T.F.A.I. The principal objectives of the project were to investigate the acoustic properties and the associated water characteristics in the area of the sill separating the Red Sea from the Gulf of Aden. Because of the unusual oceanographic properties in the Strait of Bab-El-Mandeb and in the vicinity of the Hanish Islands, part of the project (Phase I) was devoted to determining, in detail, parameters that would influence sound propagation. Phase II used two ships to measure sound propagation in four different experimental situations. Abstract Classification: Unclassified Technical Reports. Notes: Technical memo. DTIC Accession Number: AD0780842.

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Naval War College, Newport, RI, Joint Military Operations Department and Nakamura, Michelle. 2009. "Piracy Off the Horn of Africa: What is the most Effective Method of Repression." 04 May. Page(s): 28 Report Number: XB-NWC/JMO Monitor Series: NWC/JMO. Abstract: The U.S. National Security Council Partnership and Action Plan for Countering Piracy off the Horn of Africa states that its objective is to, repress piracy off the Horn of Africa in the interest of the global economy, freedom of navigation, Somalia, and the regional states. This paper describes the extent of the problem and how it emerged, as well as the military structure, civilian initiatives, policies and guidance directed at this problem. The paper then analyzes the effectiveness of the current initiatives and draws conclusions for how the effort should be resourced, supported, organized, and directed. Finally, it provides recommendations for how to enact the proposed plan. Abstract Classification: Unclassified Technical Reports Collection. Notes: Final rept. Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA503032. URL: <http://handle.dtic.mil/100.2/ADA503032>.

Naval War College, Newport, RI, Joint Military Operations Dept and Peppel, Christopher D. 2009. "Building the Right Framework for Effective Multinational Anti-Piracy Operations in the Gulf of Aden." 04 May. Page(s): 21 Report Number: XB-NWC/JMO Monitor Series: NWC/JMO. Abstract: As worldwide awareness of the maritime piracy dilemma increases, pressure mounts on the international maritime organizations to engineer a quick and effective solution. Numerous United Nations Security Council resolutions have been published pressing for international response, yet not many have offered specific guidance regarding what this response should look like. This paper looks generally at high-level UN guidance and shows at the theater-strategic and operational levels what the response(s) have been to date. It further analyzes what pieces of these responses have a place in the ideal, long-term solution and where these pieces would fit into an overall, integrated international solution. Finally, the paper draws conclusions on the maritime facet of the fight against piracy and proposes interface points for U.S. combatant commanders and their subordinates. Abstract Classification: Unclassified Technical Reports Collection. Final rept. Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA503068. URL: <http://handle.dtic.mil/100.2/ADA503068>

Nazemosadat, MJ and Ghaedamini, H. 2010. On the Relationships between the Madden-Julian Oscillation and Precipitation Variability in Southern Iran and the Arabian Peninsula: Atmospheric Circulation Analysis. American Meteorological Society. J. Clim. Volume: 23, no. 4, page(s): 887-887-904. Abstract: The influence of the Madden-Julian oscillation (MJO) on daily, monthly, and seasonal precipitation was investigated for southern Iran and the Arabian Peninsula using November-April data for the period of 1979-2005. The positive MJO phase is considered to be the periods for which the enhanced convection center was placed over the south Indonesian-north Australian region. On the other hand, the convection center shifts over the western Indian Ocean tropics and most of the study area as the negative MJO phase prevails. Seasonal precipitation and the frequency of wet events were significantly increased during the negative phase. The ratios of the precipitation amount during the negative phase to the corresponding values during the positive phase were about 1.75-2.75 and 2.75-4.00 for the southwestern and southeastern parts of Iran, respectively. This ratio reached to about 3.00 for Riyadh, 4.20 and 5.50 for Masqat and Doha, 2.10 for Kuwait, and 1.20 for Bahrain. The results of the seasonal and monthly analysis were generally found to be consistent, although because of the smaller sample size the outcomes of the monthly investigations were less statistically significant. While the negative MJO phase does not have a consistent effect on March

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precipitation over some parts of southern Iran, it has consistently enhanced precipitation over the eastern and southern coasts of the peninsula in Oman, Yemen, and Saudi Arabia. During the negative MJO phase, while enhanced low-level southerly winds transfer a substantial amount of moisture to the study area, upward motion increases in the middle layers of the atmosphere. Synchronized with the prevalence of these rain-bearing southerly winds, the existence of a strong horizontal wind speed gradient at the exit region of the North Africa-Arabian jet enhances precipitation. The jet exit, which was mostly located over Egypt in November, moved westward into the study area in Iran and Saudi Arabia during the rainy period of January-March. The direction of near-surface wind anomalies changed from mostly southeasterly in November to southwesterly in March and April, influencing precipitation pattern during various months of the rainy season. In contrast to the negative phase, an enhanced low-level dry northerly wind and suppressed horizontal wind speed gradient at the jet exits are the main characteristics of atmospheric circulation over the study area during the positive MJO phase. Furthermore, an increased downward air motion at the middle levels of the atmosphere and a significant shortage in precipitation are the other climatic components of the southwest Asian region during such a period. ISSN: 0894-8755. Database: Technology Research Database. URL: <http://dx.doi.org/10.1175/2009JCLI2141.1>.

Negenman, T. 1997. Evolution of water resources management in Yemen. In In Schrevel, A. (Ed.), 1997. Groundwater management: Sharing responsibility for an open access resource - Proceedings of the First Wageningen Water Workshop, 13-15 October. Wageningen, Netherlands: ILRI, pp. 65-80. OCLC: 66863233.

Netherlands; Ministerie van Buitenlandse Zaken and Inspectie Ontwikkelingssamenwerking en Beleidsvaluatie. 2008. Support to Rural Water Supply and Sanitation in Dhamar and Hodeidah Governorates. The Hague, Netherlands: Ministry of Foreign Affairs. Page(s): 182. Descriptors: Water-supply, Rural -- Yemen (Republic) -- Dhamar (Province); Water-supply, Rural -- Yemen (Republic) -- Hudaydah (Province); Sanitation, Rural -- Yemen (Republic) -- Dhamar (Province); Sanitation, Rural -- Yemen (Republic) -- Hudaydah (Province); Government publication; National government publication. Notes: ill. 24 cm. "October 2008." Includes bibliographical references (pages 179-182). Responsibility: Policy and Operations Evaluation Dept. OCLC Accession Number: 356712217.

Nettleton, W. D. and Chadwick, O. A. 1996. "Late Quaternary, Redeposited Loess-Soil Developmental Sequences, South Yemen." *Geoderma*. Volume 70, Issue 1, Pages 21-36. Notes: Cited By (since 1996): 12. Abstract: Episodic desert loess and paleosol sequences in South Yemen provide a late Pleistocene to Holocene record of climatic change and soil development. At Sana, one paleosol based on its thickness and development formed during mid or early Holocene time in approximately four thousand years. The 2Akb horizon sample of this paleosol has a ^{14}C age of 7750 ± 300 years. At Ibb the 2ABtb horizon of another paleosol has a ^{14}C age of $>33,100$ years. Deposition (silt + very fine sand + clay) for the Sana site calculates to average $110 \text{ g m}^{-2} \text{ yr}^{-1}$ and includes 3.3 g or less of $\text{CaCO}_3 \text{ m}^{-2} \text{ yr}^{-1}$. This rate of desert loess and carbonate deposition is probably 2 to 5 times greater than that in the Lahontan Basin of the United States during the last 13 kyr, and about 2 to 5 times higher than that in the southwestern United States today. It is about the same as the 12 cm kyr^{-1} ($170 \text{ g m}^{-2} \text{ yr}^{-1}$) estimated for central North Iran and the 10 cm kyr^{-1} (0.1 mm yr^{-1}) estimated for the Netivot section of the Negev of Israel but some 7 to 9 times less than the rate estimated for Wisconsinan loess in Iowa. Thickness of desert loess examined and the calculated rate of deposition indicate that the crater has been receiving desert loess for at least 15 kyr, and that the crater is pre Holocene. Pedogenic

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development of the Camborthids and Haplargids in the ground soils and that of the argillic horizons in the Sana paleosols suggest that these soils formed in a somewhat more humid phase than the present warm-tropical, semi-arid environment. The occurrence of mollic epipedons in the Sana paleosols, but not in the ground soils is evidence of a more humid past climate (mid or early Holocene). The Ibb paleosol, which formed at least partly during a more humid part of the late Pleistocene, is even more strongly developed than the mid or early Holocene Sana paleosols. Database: SCOPUS. ISSN: 0016-7061.

Neumann-Redlin, Christian. 1995. "Hydrogeological Investigations in the Al Mahwit Province of Yemen. A Contribution to Rural Regional Development." Natural Resources and Development. Institut fuer Wissenschaftliche Zusammenarbeit: Bundesanstalt fuer Bodenforschung, Tubingen, Germany. Volume 42, Pages 79-91. Descriptors: age; alluvial plains; Arabian Peninsula; Asia; basin range structure; BGR Hanover; carbonate rocks; case studies; clastic rocks; consumption; crystalline rocks; ephemeral streams; faults; fluvial features; formula; fractures; geochemistry; ground water; ground-water provinces; hydrochemistry; hydrogeology; hydrologic cycle; hydrology; igneous rocks; limestone; lithostratigraphy; recharge; sandstone; sedimentary rocks; springs; streams; volcanic rocks; water balance; water management; water quality; water resources; water storage; water use; Yemen. References: 4; illus. incl. 1 table, geol. sketch map. Database: GeoRef in Process. ISSN: 0340-2797.

Neumann-Redlin, Christian. 1992. "Hydrogeologische Untersuchungen in Der Provinz Al Mahwit/Jemen; Ein Beitrag Zur Laendlichen Regionalentwicklung. Hydrogeological Investigations in the Al Mahwit Province, Yemen; a Contribution to Rural Development." Zeitschrift Fuer Angewandte Geologie. Akademie-Verlag, Berlin, Federal Republic of Germany Federal Republic of Germany. Volume 38, Issue 1, Pages 4-10. Descriptors: absolute age; age; agriculture; Al Mahwit Yemen; aquifers; Arabian Peninsula; Asia; basin management; C-14/C-12; carbon; chemical composition; dates; drainage basins; drinking water; fractures; geochemistry; ground water; hydrochemistry; hydrogen; international cooperation; irrigation; isotopes; joints; radioactive isotopes; recharge; springs; stable isotopes; style; surface water; tritium; water balance; water quality; water supply; Yemen. References: 4; illus. incl. 1 table, geol. sketch map. Database: GeoRef in Process. ISSN: 0044-2259.

New TransCentury Foundation. 1984. An Unsolicited Proposal for the Extension of TransCentury's Cooperative Agreement #AID/NE-CA-1647 for the Execution of Yemen Rural Water Project #279-0044. Washington, D.C: New TransCentury Foundation. Page(s): 179. Descriptors: Water-supply, Rural -- Yemen (Republic). Notes: v; 28 cm. Cover title. Includes bibliographical references (p. 176-179). OCLC Accession Number: 13344245.

New York State College of Agriculture and Life Sciences. *Yemen General Soil Map*. [Ithaca, N.Y.]: The Department, 1983. 1 map: col.; 110 x 84 cm. Notes: Produced by the Department of Agronomy of the New York State College of Agriculture and Life Sciences at Cornell University, in cooperation with the Yemen Arab Republic Ministry of Agriculture and the United States Agency for International Development. "Completed 1983." Relief shown by contours. In upper margin: Yemen Arab Republic. "Base map information adapted from the British topographic series." "This map is for general planning. It shows only the major soils and does not contain sufficient detail for operational planning." Includes outline map of northern Yemen showing administrative boundaries (governates) 1983. OCLC: 32860183.

Nikiforov, L. G. and Korotayev, V. N. 1982. "Geomorfologiya Poberezh'Ya O. Sokotra. Translated title: Coastal Geomorphology of Socotra Island; Morskiye Berega. Seacoasts." *Voprosy Geografii. Izdatel'stvo "Mysl"*, Moscow, USSR. Volume 119, Pages 160-173.

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Descriptors: Arabian Peninsula; Asia; beachrock; carbonate rocks; erosion; geomorphology; Gubbat Shu'b; landform evolution; sedimentary rocks; shore features; Socotra; Southern Yemen; Tamarida Bay; water erosion; Yemen. Notes: VGMOA3; illus. incl. sects. Database: GeoRef. ISSN: 0372-5758.

Noman, A. 2007. Status of Water Resources Development and Management in Yemen. IAHS-AISH Publ.317, page(s): 186-190. Reducing the Vulnerability of Societies to Water Related Risks at the Basin Scale - 3rd International Symposium on Integrated Water Resources Management. Bochum Conference: 26 September 2006 through 28 September 2006.

Descriptors: IWRM; NWSSIP; Yemen. Abstract: Yemen is facing one of the most complex development problems and its most serious challenge, namely the problem of water resources scarcity and over-exploited aquifers. As a result, the water shortage is worsening one year after another, aggravated by the continued imbalance between annual recharge and the growing water demand. This has led to the alarming depletion of groundwater in a number of basins, wiping out agricultural production and investments in some of these areas. Integrated water resources management (IWRM) is generally seen as a solution to water management problems. In Europe, the European Water Framework Directive is a means to implement IWRM in order to improve the water quality of surface waters. In the water-scarce Republic of Yemen, IWRM is seen as a method to improve water use and thus to better balance water supply and demand. IWRM should, however, not be seen as a magic solution that creates more water. This paper focuses on the status of water resources and management in Yemen and implementation of IWRM approaches through a National Water Sector Strategy and Investment Plan (NWSSIP), which aims at streamlining the strategies and investments in all water related issues in the Republic of Yemen. Notes: Conference code: 73933. ISBN: 9781901502299. Database: SCOPUS.

Noman, AA and Al-Jailani, J. 2007. "Investigation of the Potential of Fogwater Harvesting in the Western Mountainous Parts of Yemen." Arab Gulf J. Sci. Res. March-June 2007. Volume 25, Issue 1-2, Pages 50-58. Descriptors: Drinking Water; Elevation; Fog; Gulfs; Irrigation; Potable Water; Relative Humidity; Standards; Wadi; Article Geographic Terms: Red Sea; Yemen. Abstract: The Republic of Yemen is located in an arid to semi-arid region. Rainfall rates range from none at certain parts of the country to about 400 mm/yr in its mountainous parts. Rainfall has been harvested and collected in cisterns existed in the mountainous region for generations. In the dry season (October - February), and after the stored water is consumed, people, mainly women and children, have to travel long distances down wadis to fetch water from the nearest water source, which is often not suitable for human consumption. This is the case in the western mountainous region, namely Hajja Governorate, which heavily depends on rainwater for drinking, animal watering, domestic uses and irrigation. However, during the dry season this region experiences foggy conditions. This has prompted conducting a fog collection field study in this region to investigate the potential of providing an alternative source for water supply during the dry season. The study consisted of installing 26 standard fog collectors (SFC) of one m super(2) of polypropylene mesh at 19 sites in Hajja, and measuring the daily fogwater amounts collected during the period from 1 January to 31 March, 2003. The results indicated that fog collectors located closest to the red sea with an elevation ranged between 2,000-2,200 meters above sea level and winds from the west direction have produced the highest water output, reaching a maximum of about 4.5 liters per square meter of mesh per day over the three winter months period. The conclusion drawn is that though this technique is cheap, simple and promising, more investigations are still needed on the various parameters contributing to fog

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collection, such as, relative humidity, temperature, and SFCs technologies. Database: Water Resources Abstracts. ISSN: 1015-4442.

Noman, Abdulla. 2007. Status of Water Resources Development and Management in Yemen. Bochum, Germany: IAHS Press. 317, page(s): 186-190. Reducing the Vulnerability of Societies to Water Related Risks at the Basin Scale - 3rd International Symposium on Integrated Water Resources Management, September 26, 2006 - September 28. Conference: 2006. Descriptors: Investments; Aquifers; Competition; Economics; Groundwater; Groundwater resources; Hydrogeology; Information management; Management; Problem solving; Water management; Water quality; Water supply. Abstract: Yemen is facing one of the most complex development problems and its most serious challenge, namely the problem of water resources scarcity and over-exploited aquifers. As a result, the water shortage is worsening one year after another, aggravated by the continued imbalance between annual recharge and the growing water demand. This has led to the alarming depletion of groundwater in a number of basins, wiping out agricultural production and investments in some of these areas. Integrated water resources management (IWRM) is generally seen as a solution to water management problems. In Europe, the European Water Framework Directive is a means to implement IWRM in order to improve the water quality of surface waters. In the water-scarce Republic of Yemen, IWRM is seen as a method to improve water use and thus to better balance water supply and demand. IWRM should, however, not be seen as a magic solution that creates more water. This paper focuses on the status of water resources and management in Yemen and implementation of IWRM approaches through a National Water Sector Strategy and Investment Plan (NWSSIP), which aims at streamlining the strategies and investments in all water related issues in the Republic of Yemen. ISSN: 0144-7815.

Noman, Abdulla Abdulkader. 2001. Erosionsmodell Fuer Semi-Aride Einzugsgebiete Am Beispiel Jemenitischer Wadis. Translated title: Erosion model for semi-arid catchments: the example of Yemeni wadis. Federal Republic of Germany Leichtweiss Institut fuer Wasserbau der Technischen Universitaet Braunschweig, Brunswick, Federal Republic of Germany; Techn. Univ., Braunschweig. Mitteilungen - Leichtweiss Institut Fuer Wasserbau Der Technischen Universitaet Braunschweig. Volume: 151, Descriptors: Arabian Peninsula; Asia; atmospheric precipitation; case studies; dissertation; ephemeral streams; erosion; influence; models; relief; semi-arid environment; simulation; slopes; soil protection; soils; strategy; streams; terrestrial environment; theoretical studies; theses; tilt; vegetation; water erosion; Yemen. ISSN: 0343-1223. Database: GeoRef in Process.

Norman Allyn, Michael Quick, Ed Condon, Jan Lisztwan, and Eric Morris. 2004. Breakwater for Service Harbour, Gulf of Aden. Descriptors: Breakwaters; Harbors; Middle East. Abstract: The Ash Shihr harbour, on the Gulf of Aden was built by Canadian Nexen Petroleum Yemen (CNPY) in 1992/1993 to provide service support to a Single Buoy Mooring (SBM) used for oil tanker loading. The orientation of the harbour was originally designed to minimize wave agitation at the berth. As a result, the entrance to the harbour was placed on the eastern side to provide shelter from monsoon generated waves traveling from the southwest. Immediately after construction, sediment began accreting in the harbour entrance which necessitated maintenance dredging and sand bypassing to allow continued operations in the harbour. Delft Hydraulics performed a study of sedimentation in the harbour in 1998. The results of this study indicated that the harbour is built on a coastline with substantial longshore sediment transport, with a net rate estimated at 260,000 m³ per year westward. The study also examined solutions to the problem including dredging, relocating the harbour entrance, and constructing a breakwater to

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the east of the harbour to trap sediment. The sand trap breakwater option was found to result in the lowest maintenance dredging requirements and the lowest total cost. CPNY authorized the detailed design of the sand trap breakwater in 1999. Construction of the breakwater was completed by Yemen based contractors in June 2000. Notes: Ports 2004: Port development in the changing world (proceeding of the conference, may 23-26, 2004, houston, texas; sponsored by ports and harbors technical committee of the coasts, oceans, ports, and rivers institute (COPRI) of ASCE, U.S. section of the permanent international association of navigation congresses (PIANC); co-sponsored by port of houston authority, dredging contractors of america, international association of ports and harbors, canadian society of civil engineers, and japan society of civil engineers) by Stephen A. Curtis, (editor). ISBN: 0-7844-0727-4. Database: ASCE.

Nouh, M. 2006. "Wadi Flow in the Arabian Gulf States." Hydrol. Process. John Wiley and Sons Ltd: Volume 20, Issue 11, Pages 2393-2413. Descriptors: Surface waters; Arid regions; Catchments; Computer simulation; Floods; Forecasting; Probability distributions; Random processes. Abstract: Real data on wadi flood flows from Saudi Arabia, Yemen, Oman, Kuwait, UAE, Bahrain and Qatar were used to develop methodologies for the prediction of annual maximum flows and average monthly flows in the Arabian Gulf states. For the prediction of annual maximum floods, three methods have been investigated. In the first method, regional curves were developed and used together with the mean annual flood flow, estimated from the characteristics of the drainage basin, to estimate flood flows at a location in the basin. The second method fits data to various probability distribution functions, with a developed methodology introduced to account for floods generated by more than one system of climate, and the best fitted function was used for flood estimates. In the third method, only floods over a threshold, which depends on characteristics of the drainage basin, were considered and modelled. For the prediction of average monthly flows, stochastic simulation approaches of flood frequency analysis were used. Each of the prediction methods was verified by being applied in 40 different drainage basins. Based on the results obtained, recommendations were made on the best method to be applied (at present) by design engineers in the Arabian Gulf states. ISSN: 0885-6087. URL: <http://dx.doi.org/10.1002/hyp.6051>.

Noussier, Ameen. 2005. Property and Water Rights in an Islamic Context: An Economic and Institutional Analysis with Application to Water Rights and Pricing in Yemen. United States -- Washington: Washington State University. Descriptors: Right of property -- Yemen, North -- Religious aspects; Water rights -- Yemen, North -- Religious aspects; Water-supply -- Yemen, North -- Management -- Religious aspects. Abstract: Yemen is a water scarce country. Like many other developing countries, it is constrained by a lack of natural resources and finds it difficult to secure sufficient water for human consumption and for agricultural irrigation. This raises the question of how to design actions and policies to meet the existing and future water needs of the people of Yemen. An understanding of water institutions is a necessary prerequisite to successful design and implementation of any such actions. This dissertation studies how traditional water rights priorities and allocation mechanisms work in Yemen and it investigates whether these rules conform to Islamic principles. Water rights in traditional agricultural rural regions of Yemen are based on customary institutions including traditional laws or Urrf. Religion, the Islamic law, Sharria'a, is an extremely influential institution shaping traditional communities and their way of life. In Yemen, and similar countries, changes in both formal and informal laws covering the allocation of water will continue to be tested against the general principles of Sharria'a. This investigation is based on a comparative case study of the

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experiences surrounding the construction of new dams and reservoirs on seasonal streams in rural areas of Yemen. The construction of these new dams and reservoirs provides a natural experimental setting to analyze water institutions. One hypothesis is that these traditional unwritten laws, having evolved under different water use circumstances, might no longer be applicable to either the new reservoirs or the increased national scarcity of water. An example of the later concerns whether water can be traded among uses and “owners” and/or moved to urban locations. To collect the empirical information, an intensive field survey were designed and implemented. Around 31 dam/reservoir managers were comprehensively interviewed. The dissertation reviews the literature regarding traditional and Islamic water laws. It presents findings from the survey describing many features of the new dam and reservoir projects. Two chapters focus more specifically on the water rights issues and water prices. Survey results reveal people’s perceptions of water rights dimensions including, priority rules, protection, enforcement and conflict resolution processes. Through a detailed analysis, the study was able to explain the powerful role of traditional institutions in water rights allocation and priorities. The results and analysis help understand changes in informal, traditional institutions, and raise the potential for developing new, formal institutions, rules and laws. Analysis suggests some ways in which traditional institutions can be modified to achieve local community, social, and government objectives. Among key factors are water pricing, water allocation rules and the role of the government and local participation, including the cooperation of local Sheikhs. We find that a new physical action (i.e., the new dams and reservoirs) may permit the alteration of traditional water rights rules and laws as long as the changes conform to accepted change mechanisms. A menu of recommendations and policies are described to help decision-makers address the water scarcity problem. In discussing policy implications we emphasize access to water by the marginalized section of the rural communities, the poor people, landless and women. Washington State University; Ph.D. Database: ProQuest Dissertations & Theses. OCLC Accession Number: 65661817.

Novaky, B. -M, Ahmed, A. -Y -A and Ahmed, A. -S. 1998. “Annual Mean Runoff and its Areal Distribution in the Republic of Yemen.” *Vizugyi Kozl.* Volume 80, Issue 2, Pages 335-351. Descriptors: Precipitation assessment; Rainfall-runoff modeling; Spatial distribution; Yemen. Abstract: Options of mapping annual mean (specific) runoff are shown for the severely data lacking situation of Yemen. The climate of Yemen is dry tropical/subtropical and moderately warm sub-humid in the mountain ranges of West-Yemen. On the basis of classification using the ratio of precipitation to potential evaporation $P/E(pot)$ the following areas were specified: hyper-arid ($P/E(pot)0.03$); arid ($0.03 E(pot)0.25$) and semiarid ($0.25 E(pot).50$) (Figure 1.). There are 19 monitoring stations in the country the data of whose can be used for estimating the annual mean runoff (Table I.). Reliability of these estimates is, however, low, due to the shortness of the records and the statistical homogeneity cannot be analyzed. Decreasing trend can be observed (Figure 2.) in the time series of annual runoff of the Wadi Zabid. This can be explained by the decreasing precipitation and increasing irrigation. Annual mean discharge varies with the size if the catchment area (Figure 3.). 13 regions can be distinguished on the basis of the relationship and considering the areal differences of the climate. The annual mean discharge is well related to the size (order) of the stream section as calculated by the Shreve method (Figure 4.). The relationship was determined on the basis of the data of wadies Surdud and Zabid and on that of the Hungarian river Zala, considered as analogous one. The relationship is suitable for estimating the hydrological profile of annual runoff as well (Figure 5.). The precipitation vs. runoff relationship is linear for precipitation lower than 500 mm. In this domain

the runoff coefficient is constant and its value is 5%. The linear relationship in this domain is supported by the Schreiber-Budiko (2) formula. The aridity coefficient $a/P(a)$ of this formula shows random variation and is not dependent on precipitation (Figure 6.). The average value of the aridity index is 2.90 and the Schreiber-Budiko formula can be rewritten as shown in Eq.5. The linear character of this equation is obvious. For the higher domain of precipitation data the precipitation vs. runoff relationship is generally non-linear, as suggested by the data of the relevant literature. The Schreiber-Budiko formula was used for describing this relationship. This relationship was used for calculating runoff and evaporation, defined as the difference between precipitation and runoff, for three values of the potential evaporation r/L (2,000, 2,500 and 3,000 mm). Figure 7 shows the distribution of precipitation among evaporation and runoff (the structure of the water budget) for three selected values of the potential evaporation. The water budget structure characteristic to Hungarian watersheds is also shown for two temperature values (-6 and +10°C). In Yemen the annual mean temperature is 20-25°C in the areas with potential evaporation of 2,000-3,000 mm. The non-linear Schreiber-Budiko formula substantially underestimates the value of runoff in the precipitation range 0.00-500 mm, independently of the selected r/L value. The precipitation-runoff relationship was finally accepted, after certain speculative considerations, as shown in Figure 8. In the precipitation range lower than 550 mm the linear relationship, as derived on the basis of measurement data, was accepted, while the Schreiber-Budiko formula was used above 1000 mm precipitation, fixing the potential evaporation value as 2,500 mm. In the precipitation domain of 550-1,000 mm the transitional part of the curve between the linear and non-linear ranges was estimated by interpolation. The precipitation-runoff relationship of Figure 8 was used for the construction of the map of annual specific runoff (Figure 9.), making use of the map of mean annual precipitation. This runoff map is most likely the first of its kind in Yemen. Database: SCOPUS. ISSN: 0042-7616.

Nozaily, FA and Alaerts, G. 2002. "Performance of Duckweed-Covered Sewage Lagoons in Sana'a, Yemen, Depending on Sewage Strength." *Aqua - Journal of Water Supply: Research and Technology*. May. Volume 51, Issue 3, Pages 173-182. Descriptors: Algae; Aquatic macrophytes (Lemnaceae); Biochemical oxygen demand; Chemical oxygen demand; Denitrification; Duckweed; Effluents; Environmental conditions; Experimental Data; Growth; Growth Rates; Growth rate; Harvesting; Lagooning; Lagoons; Limiting Factors; Load Distribution; Nitrogen Removal; Nutrients; Performance Evaluation; Phytoplankton culture; Plant Growth; Plant culture; Plants (see also Aquatic macrophytes); Ponds; Sewage; Sewage ponds; Temperature; Temperature effects; Waste Load; Waste water; Wastes; Wastewater; Wastewater Lagoons; Wastewater Treatment; Wastewater aquaculture; Water supplies; pH; pH effects; Article Taxonomic Terms: Algae; Lemna gibba; Article Geographic Terms: Yemen; Yemen, Sana'a. Notes: TR: CS0214155. Abstract: The performance of a duckweed (*Lemna gibba*) sewage lagoon (DSL) was investigated in non-continuous batch system reactors using high strength sewage under natural environmental conditions in Sana'a. Wastewater effluent from the anaerobic ponds of the Sana'a waste stabilization ponds (WSPs) was used with dilution factors (DF) of 0, 2, 3 and 4. The initial COD concentration range applied was 254-600 mg COD l⁻¹ super(-1) (150-250 mg BOD l⁻¹ super(-1)) and NH⁺ sub(4) of 25-100 mg N l⁻¹ super(-1), while the duckweed stock density used was 500 g wet weight m⁻² super(-2). The duration of the experiments was 10 days with a harvesting frequency of 5 days. NH⁺ sub(4) in this very concentrated Sana'a sewage was possibly the most important limiting factor for growth of *L. gibba*. High pH near the end of the reaction time and lower temperatures at night-time probably also contributed to slower growth. Relative growth rate (RGR) decreased from 0.17 plus or

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minus 0.04 d super(-1) at an NH super(+) sub(4) concentration of 23-40 mg N l super(-1) to around 0.00 d super(-1) at a concentration of 100 mg N l super(-1). Fresh wastewater helped to grow duckweed, especially at NH super(+) sub(4) <50 mg N l super(-1), while after 5 days, algae proliferation and probably the exhaustion of other essential nutrients started to inhibit duckweed growth. COD removal correlated strongly with the applied initial surface loading. At a higher initial COD loading (λ sub(s)) of 869 kg COD ha super(-1), the removal loading (λ sub(r)) was 710 kg COD ha super(-1) 10 day super(-1), while at a lower initial COD loading of 344 kg ha super(-1), the removal loading was 210 kg COD ha super(-1) 10 day super(-1). Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0003-7214.

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Q

Oates, P. M. Great Britain and Land Resources Division. 1979. Yemen Arab Republic Montane Plains and Wadi Rima (MPWR) Project: A Land and Water Resources Survey: Socioeconomic Survey of Wadi Rima: Methods and Data. Surbiton: Ministry of Overseas Development. Descriptors: Agricultural development projects -- Yemen (Republic); Government publication. Abstract: Vol. 2 appendices. Other Titles: Montane Plains and Wadi Rima Project. Responsibility: P.M. Oates. OCLC Accession Number: 40239047.

2006. Obura, David. "Impacts of the 26 December 2004 Tsunami in Eastern Africa." *Ocean Coast. Manage.* Volume 49, Issue 11, Pages 873-888. Descriptors: Coastal oceanography; Coastal zone management; Earthquakes; Fishing vessels; Ocean floor; Surges; Tsunamis; Universal time; Warning systems; Wave amplitude; Article Geographic Terms: Japan, Honshu, Chiba Prefect., Tateyama, Banda, Indonesia, Indonesia, Aceh, Thailand; Africa; India; Indian Ocean; Indian Ocean, Maldives; Indian Ocean, Mauritius; Indian Ocean, Seychelles; Somalia; Sri Lanka; Tanzania; Yemen, Socotra; Kenya; Marine. Notes: TR: CS0705283. Abstract: The tsunami of 26 December 2004 was the largest ever recorded in the Indian Ocean, triggered by the 3rd largest earthquake in 100 years measuring 9.2 moment magnitude. The epicenter of the earthquake was off Banda Aceh on the Indian Ocean coast of the island of Sumatra in Indonesia, centered at 3.316 perpendicular, 95.854 eta. A sudden upward movement of the seafloor that averaged 6 m occurred along almost 1300 km of the north-east Indian Ocean plate at 0059 Coordinated Universal Time (UTC) and lasted 8 min. Because of the lack of preparedness and absence of warning systems in the Indian Ocean the tsunami spread silently across the ocean over a span of 8 h causing massive destruction including the deaths of over 250,000 people, with maximum damages occurring in Indonesia, Thailand, Sri Lanka, India and the Maldives. Moderate to low damages were recorded in the Seychelles, Socotra (Yemen) and Somalia, though in the latter a highly vulnerable town was impacted resulting in over 300 deaths. Most of eastern Africa was spared massive damages from the waves due to (a) distance from the epicenter (>6000 km), (b) the dissipation of energy of the tsunami by shallow banks in the middle of the Indian Ocean (the Seychelles banks, Saya de Malha and Cargados Carajos Shoals) and (c) at least for Kenya and Tanzania, the first and largest waves hit at low tide. In Kenya and Tanzania these factors resulted in the waves being experienced as tidal surges of 1-1.5 m amplitude lasting 5-10 min. Damages recorded for eastern Africa include 11 deaths in Tanzania and 1 in Kenya, of people walking and swimming over shallow intertidal flats being trapped by the advancing and receding tidal surges, damage to boats anchored in shallow water and inundation in Mauritius and Rodrigues. Official information, warning and response networks were nonexistent, and even when an official response was generated in Kenya the public demonstrated no faith or willingness to act on warnings from officials such as the police. Importantly, information on the tsunami and the generation of an official response was dependent on two technologies, satellite television and mobile telephony, and these should be built into future warning systems as key mechanisms and backups to official information and warning networks. Database: Meteorological & Geostrophysical Abstracts. ISSN: 0964-5691.

Oches, Eric A. and McCorrison, Joy. 1999. "Middle Holocene Sedimentation, Fires, and Landscape Modification in Wadi Shumylya, Southern Yemen; Geological Society of America, 1999 Annual Meeting." Abstracts with Programs - Geological Society of America. Geological Society of America. Volume 31, Issue 7, Pages 253. Descriptors: absolute age; agriculture; Arabian Peninsula; Arabian Sea; archaeology; artifacts; ash; Asia; C-14; carbon; Cenozoic; charcoal; climate change; dams; dates; fires; fluvial features; geomorphology; Holocene; Indian

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Ocean; isotopes; landscapes; middle Holocene; moisture; monsoons; outcrops; paleoclimatology; processes; Quaternary; radioactive isotopes; sedimentation; sediments; species diversity; technology; vegetation; Wadi Shumylya; wadis; Yemen. Abstract: The geomorphic response to changing mid-Holocene (ca. 7,000-4,000 years B.P.) climate appears to have had a dramatic influence on emerging agricultural technologies and human societies in the southern Arabian peninsula. As the Arabian Sea monsoon system progressively weakened during that period, less moisture penetrated into the Arabian interior, resulting in desertification of the landscape and a decline in vegetation abundance and diversity in southern Yemen. That occurred at a time when previously hospitable, though marginal, climatic conditions allowed for the development of irrigation technologies which supported the cultural shift from foraging to agrarian societies. Geoarchaeological research investigating the timing and magnitude of the climatic shift and its impact on surficial processes in the region has yielded abundant evidence for agricultural activity and natural and human-induced landscape modification near the mouth of Wadi Shumylya, a small drainage into one of the southern tributaries to the extensive Wadi Hadramout of southern Yemen. Within the four meter thickness of sediments filling the formerly broad wadi channel, as many as four burned layers have been identified and correlated across discontinuous outcrops through visual description and magnetic susceptibility measurements. Burned horizons comprised of ash, charcoal, and baked sediment are traceable to numerous discrete hearths scattered laterally across more than 100 meters of sediment exposure created by downcutting of the active wadi channel. Charcoal samples collected from the hearths and burned layers have been radiocarbon dated from about 6,100-5,700 yr B.P. (uncalibrated). On the surface stratigraphically above the burned layers, a rock structure tentatively identified as a water control check dam is interpreted to have been constructed in order to trap silt and create a surface for cultivation. Lithic artifacts collected from that surface suggest an age of as much as 5,000 years old. Overall, dated materials suggest that aggradation of sediment within the wadi channel, possibly associated with agricultural activity during a period of enhanced moisture, occurred prior to the time of the monsoon decline, and downcutting has been the dominant process since about 5,000 years ago. Database: GeoRef. ISSN: 0016-7592.

Oches, Eric A., McCorriston, Joy, Harrower, Michael and DeVogel, Stephen. 2001. "Middle Holocene Human-Environment Interactions in Southern Arabia; Geological Society of America, 2001 Annual Meeting." Abstracts with Programs - Geological Society of America. Geological Society of America. Volume 33, Issue 6, Pages 295. Descriptors: agriculture; Arabian Peninsula; archaeology; arid environment; Asia; Cenozoic; channels; fluvial features; Holocene; human activity; land management; middle Holocene; monsoons; paleoclimatology; paleoecology; paleoenvironment; paleohydrology; Quaternary; terrestrial environment; vegetation; Wadi Idim; Wadi Sana; wadis; water management; Yemen. Abstract: Changing middle-Holocene climatic patterns in southern Arabia forced people in the early stages of developing agricultural subsistence economies to adapt cultivation technologies and water management practices to an increasingly arid landscape. RASA (Roots of Agriculture in Southern Arabia) Project fieldwork has provided significant data toward understanding the human-environmental interactions in the remote highlands of southern Yemen during the early Holocene moist phase (ca. 10,000-6,000 years ago), characterized by larger population and land management under wetter climate and denser vegetation than today. This period of enhanced activity was followed by settlement abandonment in the increasingly arid mid-late Holocene. A chronology of paleoenvironments and human activities has been constructed in Wadi Sana and Wadi Idim in the highlands of southern Yemen. Surface scatters of 9000-year-old lithic artifacts

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signal the arrival of people into the Wadi Sana region. A younger lithic assemblage associated with cattle bones and caprine dung was recovered from numerous hearths dated between 7400-5800 14C yr BP. During that time people occupied four large rock shelters adjacent to Wadi Sana. Subsequent people left remains of pit houses, which were abandoned by 5600 14C yr BP, and water management structures built during the middle Holocene phase of enhanced monsoonal precipitation. Preliminary dating of fossil spring deposits in Wadi Idim, ca. 50 km west of Wadi Sana, suggests that there was a gradual southward drying of springs and associated marsh-lacustrine environment beginning as early as 7700 14C yr B.P. However, remnants of that system remain today in the oasis village of Saa', which may have served as a refugium when much of the region became too arid to support agriculture. Overall, dated materials suggest that aggradation of sediment within the Wadi Sana channel, possibly associated with agricultural activity during a time of enhanced moisture, occurred prior to the middle Holocene monsoon decline, and fluvial incision and sediment erosion have dominated since about 4600 14C yr BP. With additional field sampling and paleohydrologic reconstruction, we hope to document the timing and nature of the transition from the previous monsoonal climate to the present hyper-arid environment. Database: GeoRef. ISSN: 0016-7592.

Office of the Chief of Engineers (Army) Washington D C. 1958. "Department of the Army Middle East Airfield Study (MEAFS). Volume I." Jul. Page(s): 69. Abstract: This special study summarizes information on airfields of the Middle East. Countries covered are Turkey, Syria, Lebanon, Iraq, Iran, Saudi Arabia, Jordan, Israel, Egypt, Pakistan, Yemen, Cyprus and the various sultanates of the Arabian Peninsula. A total of 378 airfields with runway lengths 2,000 feet and over have been included. Abstract Classification: Unclassified. Notes: Distribution Statement: Availability: Document partially illegible. DTIC Accession Number: AD0389669.

Orihashi, Yuji, Al-Jailani, Ashraf and Nagao, Keisuke. 1998. "Dispersion of the Afar Plume: Implications from the Spatiotemporal Distribution of the Late Miocene to Recent Volcanics, Southwestern Arabian Peninsula." *Gondwana Research*. 1. Volume 1, Issue 2, Pages 221-234. Descriptors: Afar mantle plume; K-Ar age; volcanic shift; Yemen; southwestern Arabian Peninsula. Abstract: Forty-three new K-Ar dates from the Yemen inland volcanic fields (Amran-Sana'a, Dhamar-Rada, and Marib-Sirwah field) in the southwestern Arabian Peninsula reveal a progression that can be divided into four stages: Stage 1: 6.4-5.2 Ma, Stage 2: 3.6-2.9 Ma, Stage 3: 2.2-1.7 Ma and Stage 4: <1.3 Ma. It is clear from the data that the volcanic activity shifted northeastward, overlapping partly during Quaternary time. A similar shift has been recognized along the Aden Volcanic Line from Perim Island to the Aden volcanic field (10-5 Ma) [Mallick et al., 1990]. This study shows that the northeastward or eastward shift for the late Miocene to recent volcanic activity on southwestern Arabian Peninsula is about 3-5 cm/year (average: 4.1 cm/year). The rate of shift may reflect the rate of dispersion of an Afar plume head which impinged at 15 Ma on the base of the Arabian plate. We refine and further develop the Afar plume dispersion model proposed by Schilling et al. [1992]; we consider that two Afar plumes impinged on Afar province at 38 Ma and 15 Ma and that they are continuing to disperse under the Arabian lithosphere. The refined dispersion model we propose is consistent with the known geochemical and mantle tomographical features in the Afar-Arabian province and with the spatiotemporal distribution of late Miocene to recent volcanics in the southwestern Arabian Peninsula. ISSN: 1342-937X.

Oriol, Ramon A. Arnone, Robert A. and Naval Ocean Research and Development Activity, Stennis Space Center, MS. 1990. Seasonal Optical Properties Derived from Coastal Zone Color Scanner Satellite Data Along the Somali Coast and the Gulf of Aden. Ft. Belvoir:

Geology of Yemen

Defense Technical Information Center. Page(s): 39. Descriptors: Physical and dynamic oceanography; Scientific satellites; Bathymetry; Colors; Measurement; Optical properties; Optics; Ships; Coastal regions; Air pollution; Water; Airborne; Wind; Accuracy; Variations; Seasonal variations; Surface properties; Surveys; Coefficients; Planning; Signals; Images; Surface waters; Visibility; Attenuation; Somalia; Diffusion; Oceans; Channels; Upwelling; Monsoons; Scanners; Digital systems; Aden gulf; Data bases; Image processing; PE63704N; WUDN258031; CZCS (Coastal Zone Color Scanners); NIMBUS-7 Satellite. Abstract: Optical water properties of the world's oceans can be obtained from data collected with Coastal Zone Color Scanner (CZCS) aboard Nimbus-7. Our understanding of the spatial and temporal variability of surface optical properties is greatly improved from synoptic images from visible channel satellites. Current satellite data processing techniques can eliminate the atmospheric contamination that contributes 90% of the visible channel signal. The remaining signal, which constitutes the ocean color, is directly related to the diffuse attenuation coefficient (K) at 490 nanometers for the upper surface waters. Calculation and geographic registration of K can be performed on each sqm image-pixel of the CZCS data, and results show that the accuracy is within 92% of ship measurements. Regional coastal optical atlases are required for planning bathymetric surveys using the Airborne Bathymetric System, CZCS data provide a method of deriving temporal and spatial variability of coastal optical properties in regions where limited ship measurements are available. This report presents a demonstration of the capability of a regional optics data base generated using CZCS data. A series of CZCS images of the eastern Somali coast and the Gulf of Aden has been processed for the diffuse attenuation coefficient and have been used to define a regional optical database. This data base exists digital image form and clearly defines optical variability in response to continental winds, monsoon wind, and coastal upwelling. Keywords: Ocean color, Ocean optics, Satellites, Multispectral, Image processing. Notes: Note(s): Final rept. Report: NORDA-244; General Info: APPROVED FOR PUBLIC RELEASE. OCLC Accession Number: 227760999.

Othman, S.A. 2007. Adapting to water scarcity for Yemen's vulnerable communities: the case study of Aden City; Sana'a City; Sa'dah Basin. The Netherlands Climate Assistance Programme (NCAP) and the Water and Environment Center- Sana'a University. URL: <http://www.nlcap.net/where/yemen/>.

"Outbreak of Rift Valley Fever--Yemen, August-October 2000." 2000. MMWR: Morbidity & Mortality Weekly Report. Centers for Disease Control & Prevention (CDC): 12. Volume 49, Issue 47, Pages 1065. Descriptors: Epidemics; Rift Valley fever; Yemen (Republic). Abstract: Reports on the outbreak of disease compatible with Rift Valley fever in El Zuhrah district of Hodeidah governorate in Yemen from August to October 2000. Response of the country's Ministry of Agriculture and Irrigation and Ministry of Health to the outbreak; Results of investigations done on the disease in humans and animals. ISSN: 0149-2195.

Overstreet, W. C. Kiilsgaard, T. H. Grolier M. J., et al. 1985. "Contributions to the Geochemistry, Economic Geology, and Geochronology of the Yemen Arab Republic." Reston, VA: USGS. Open-File Report. Volume: 85-755, Notes: vi, 115 p.:ill., maps; 28 cm. USGS Publications Warehouse. URL: <http://pubs.er.usgs.gov/usgspubs/ofr/ofr85755>.

Overstreet, William C. Donato, M. M. Grolier, M. J. Domenico, J. A. Crenshaw, G. L. and Tibbitts, G. C. 1979. "Petrographic and Trace-Element Data on Rocks from the Yemen Arab Republic." USGS Open-File Report 80-132. Volume: 80-132, Notes: iv, 68 p. map; 28 cm. USGS Library: (200) R29o no.80-132.

Geology of Yemen

Overstreet, William C. Detra, David E. Botinelly, Theodore, et al. 1988. "Mineral Resources of the Al-Jubah Quadrangle, Yemen Arab Republic." United States: Am. Found. Study Man, Washington, DC, United States. Volume: 4, Wadi al-Jubah archaeological project, v. 4. Descriptors: agriculture; Al-Jubah Quadrangle; Arabian Peninsula; archaeology; artifacts; Asia; chemically precipitated rocks; construction materials; economic geology; evaporites; glasses; igneous rocks; metal ores; metamorphic rocks; metasomatic rocks; mineral resources; obsidian; quarries; refractory materials; salt; sedimentary rocks; soapstone; steatite; trace elements; volcanic rocks; water resources; Yemen. Notes: Non-USGS publications with USGS authors; illus. incl. 10 tables, sketch map. OCLC: 19254382.

Overstreet, William C. Grolier, Maurice J. Grolier, Maurice J. and Brinkmann, Robert. 1997. "Summary of Environmental Background for the Human Occupation of the Al-Jadidah Basin in Wadi Al-Jubah, Yemen Arab Republic." United States: American Foundation for the Study of Man, Washington, DC, United States. Volume: 5, Descriptors: absolute age; agriculture; Arabian Peninsula; archaeological sites; archaeology; artifacts; Asia; C-14; carbon; Cenozoic; dates; ecology; ecosystems; granulometry; Holocene; human activity; human ecology; irrigation; isotopes; land use; Mollisols; pedogenesis; Quaternary; radioactive isotopes; soils; Wadi al-Jubah; water use; Yemen. Notes: illus. incl. 11 tables, geol. sketch map. ISBN: 0614017521. Database: GeoRef.

Geology of Yemen

P

Pacey, A. and Cullis, A. 1986. "Farming with Run-Off: A Weapon against Drought?" *Waterlines*. Volume: 4, no. 4, page(s): 2-4. Abstract: Methods of collecting rainwater before it evaporated for use in agriculture are described with a discussion of potential in areas in Africa and the Middle East. There had been limited experience of this practice except in the African Sahel, Negev desert in Israel, and India. An average annual rainfall of 300 mm (at best 500-600 mm), the right balance of rainfall and evaporation during the growth season as more water was necessary in the summer, and several storms at regular intervals during the 100 day growing season were prerequisites. In Sudan, high bunds had been built along the contours of the plains to the east of the Nile river to store water to inundate the soil before quick maturing millet was planted. Floodwater from mountain flows was successfully harvested in Yemen then diverted by dams or barrages and canals to large land areas, where crops were planted 10-15 days later. Data and information on rainfall and runoff volumes were vital and contour bunds and spillways should be designed on the basis of conventional engineering experience. ISSN: 0262-8104. Database: Technology Research Database.

Paget, Lt Col J. T. 1966. "*Emergency in Aden.*" *British Army Review*. April 1966. Issue No 22., Pages 14-21. ISSN: 0952-4134.

Papakos, Tatiana H. and Root, Kristi. 2010. Hydraulic Modeling of Flash Floods in Sana'a. ASCE. ASCE Conf. Proc. Volume: 371, 41114, page(s): 161. Conference: May 16, 2010. Descriptors: Hydraulic models; Flash floods; Middle East. Abstract: Flash floods, the most common type of flooding in Yemen, have killed many people in Sana'a (the capital of Yemen) in the past decade. A natural disaster risk evaluation, funded by the World Bank, Global Facility for Disaster Reduction and Reconstruction was conducted in Sana'a to identify the main sources of losses from natural disasters such as floods and landslides and to develop an analysis of flood risk exposure and financial response capacity for the city. Climate change and the rapid urban development of Sana'a has led to an increase in flood hazards for two main reasons, changes in land use, and the increased presence of people and buildings in flood prone areas. The major stormwater channel in Sana'a, which runs through the middle of the city and next to the old historic city, also serves as a major transportation route. When a flash flood occurs, the stormwater channel is suddenly flooded causing vehicles to be trapped and sometimes swept away, putting lives at risk. No mechanism is currently in place to prevent vehicles or people from using the channel during extreme flood events. Comprehensive hydrologic and hydraulic modeling of the Sana'a Basin was conducted to support a flood hazard analysis that quantifies the extent and depth of flooding throughout the flood prone areas for a range of flood frequency events. The hydraulic analysis was performed to create water surface profiles and develop floodplains for extreme events within the city of Sana'a. HEC-RAS was used to model the hydraulic response of the stream network to frequency flows. The HEC-GeoRAS tool was used to expedite parameter input and mapping processes. Significant challenges were addressed during the modeling process due to the lack of accurate digital elevation data, few historical flood data, and major changes in the land use from rapid urbanization. The floodplains were mapped along the major stormwater channel identifying the flood hazard areas in Sana'a during extreme events. This information will be used to calculate infrastructure and economic losses, identify mitigation projects and develop a flood warning system for flash floods in Sana'a. URL: <http://link.aip.org/link/?ASC/371/161/1>.

Paris, F. J. H. and Food and Agriculture Organization of the United Nations. 1963. Report to the Government of Aden on Recommendations Concerning the Organization of a Well

Geology of Yemen

Drilling Program to Develop the Underground Water Resources of the Federation of South Arabia and the Eastern Aden Protectorate. Rome: Food and Agriculture Organization of the United Nations. Page(s): 46. Report Number: LA-EPTA 1768. Descriptors: Groundwater -- Aden (Protectorate); Groundwater -- Federation of South Arabia; Water resources development - - Federation of South; Arabia; Water resources development -- Aden (Protectorate); Government publication; International; government publication. Notes: ill. 28 cm. Other Titles: Recommendations concerning the organization of a well drilling program to develop the underground water resources of the Federation of South Arabia and the Eastern Aden Protectorate; Responsibility: by F.J.H. Paris. OCLC Accession Number: 32799803. FAO Library Accession Number: 051768.

Parlow, Thilo and Langbein, Rolf. 1998. "Mikrofazies und Geochemie Eines Oberkretazisch-Alttertiären Kalksteinprofils Im Wadi Mashib (Jemen). Beitrage Zur Geologie Des Suedlichen Jemen. Geology of Southern Yemen." *Zeitschrift Fuer Geologische Wissenschaften*. Akademie-Verlag, Berlin, Federal Republic of Germany Federal Republic of Germany. Volume 26, Issue 5-6, Pages 637-647. Descriptors: alkaline earth metals; anaerobic environment; Arabian Peninsula; Asia; carbonate rocks; Cenozoic; chemical analysis; Cretaceous; cross sections; dolostone; Eocene; iron; lagoonal environment; limestone; lower Eocene; Maestrichtian; magnesium; manganese; marine sedimentation; Mesozoic; metals; micrite; microfacies; Paleocene; Paleogene; sedimentary rocks; sedimentation; Senonian; shallow-water environment; strontium; Tertiary; Upper Cretaceous; wackestone; Yemen; Ypresian. References: 14; sect. Database: GeoRef in Process. ISSN: 0303-4534.

Paustian, D., and N. Heinen. 1982. "The Production of Drinking Water by Reverse Osmosis Desalination. Applications in the Yemen and Saudi Arabia." *LEau, l'Industrie, les Nuisances*. 70 (1982): 71-3. Abstract: A desalination system, based on reverse osmosis, for drinking water production, is described. The system comprises a multi-media filtration unit, a chlorination/dechlorination unit, a safety filter, a heat exchanger, a UV disinfection unit, a modular reverse osmosis unit and a pH adjustment unit. A by-pass is provided for mixing filtered water with the permeate from the reverse osmosis unit if necessary. The system is marketed as a packaged unit complete with a compressor and has been used successfully in the Middle East. ISSN: 0755-5016.

Peace Corps Water/Sanitation Case Studies and Analyses. 1984. Performer: Peace Corps, Washington, DC. Information Collection and Exchange. Creative Associates, Inc., Washington, DC. 1984. 365 pages. Report: PC/ICE/CS-4. Abstract: The report provides an in-depth overview and analysis of Peace Corps water and sanitation projects from 1970 to 1984. It gives case studies of projects in Thailand, Yemen, Paraguay, Sierra Leone, and Togo. Identifies factors that contributed to success or failure of projects. The report concludes with analysis and programming guidelines for successful projects in a variety of environments and cultures. NTIS Database (National Technical Information Service). OCLC: 425533124. URL: <http://www.eric.ed.gov/PDFS/ED243659.pdf>.

Peli, Audrey. 2006. «Les mines de la péninsule Arabique d'après les auteurs arabes (VII^e - XII^e siècles).» *Chroniques yéménites* [En ligne], 13. 2006, mis en ligne le 08 octobre 2007, Consulté le 11 octobre 2011. Abstract: A la période islamique, les principales ressources minières étaient situées en Iran oriental, en Afghanistan, en Espagne et au Maghreb. Cependant, la lecture des textes géographiques arabes et les recherches archéologiques prouvent que la péninsule Arabique n'en était pas dépourvue. Ainsi, le Hijâz, riche en gisements aurifères, a-t-il vraisemblablement contribué à la frappe de dînârs. En outre, le Yémen apparaît comme le plus

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diversement pourvu alors qu'en Oman était majoritairement exploité du cuivre. Par ailleurs, plusieurs étapes sur les principales routes sillonnant la péninsule ont été établies aux abords de sites miniers. (In the Islamic period, the main mineral resources were located in eastern Iran, Afghanistan, Spain and North Africa. However, the reading of Arabic geographical texts and archaeological evidence that the Arabian Peninsula was not free. Thus, the Hijaz, rich in gold deposits, he has likely contributed to the striking of dinars. In addition, Yemen appears to be the most diversely equipped while in Oman was mainly used for copper. In addition, several steps on the main roads crisscrossing the peninsula have been established in the vicinity of mining sites.) URL: <http://cy.revues.org/1176>.

“People’s Democratic Republic of Yemen.” 1985. Popul. Policy Compend. Pages 1-8. Abstract: The population of the People’s Democratic Republic of Yemen grew from 992,000 in 1950 to 1.7 million in 1975, and the total fertility rate has remained relatively constant at 7 since 1950. The Government has not adopted a population policy per se, but has included sectoral policies that have implications for the size, growth, composition, and distribution of the population. The Government maintains that population issues should be viewed comprehensively within the framework of economic and social development. Measures to achieve economic growth, combined with the expansion of health, education, cultural, and social services, as well as the eradication of illiteracy and the emancipation of women, are expected to have a major impact on the society’s demographic structure. The Government’s main concern with regard to population growth is a reduction in morbidity and mortality. The rate of growth is projected to increase from 2.7% in 1980-85 to 2.9 in the year 2000, at which point it should begin to decline. The crude death rate is presently 18.8/1000 and is expected to drop to 13.1/1000 by 2000. Infant mortality stood at 138/1000 in 1980-85. Morbidity and mortality are unacceptably high among infants, children, nomads, and rural residents. Priorities for the health sector include the development and expansion of health services, intensive preventive health care for mothers and children, development of a safe drinking water system, nutrition and health education campaigns, and training of health personnel. Measures that are expected to decrease fertility include family planning education, an expansion of facilities to rural areas, and improvements in the status of women. Family planning services are freely available from maternal and child health centers, mainly in urban areas. A mass literacy campaign seeks to increase the female literacy rate to 90%, and women’s participation in wage labor is being encouraged. A further goal of population policy is to modify spatial distribution through rural development and agriculture collectivization. Database: SCOPUS. ISSN: 0259-6369.

People’s Democratic Republic of Yemen; UNDP and FAO. 1990. Flood Control of Wadi Bana and Wadi Hassan: Democratic Yemen: Project Findings and Recommendations. Rome: UNDP: FAO. Page(s): 45. Descriptors: Project Activities; Flood Control; Water Resources; Groundwater; Hydrological Research; Water Management; Floodplain Management; Hydraulic Engineering; Irrigation; Technical Training; Democratic Yemen; Data Collection; Costs; Statistical Data; Project Management; UNDP -- Programme management; Government publication; International government publication. Notes: vii; chart, graphs, maps, tables. Note(s): Prepared for the Government of Democratic Yemen by FAO, acting as executing agency for UNDP. AG:DP/PDY/84/001. Terminal report. Material type: Development projects. Material type: Govt. documents/publications. Material type: Specialized agencies (incl. GATT and IAEA) material. OCLC Accession Number: 80780239.

Persike, Michael and Albert, Andreas. 1988. “Use of Loam for the Construction of Dwelling Houses in the Peoples Democratic Republic of Yemen; Anwendung Der

Lehmbauweise Im Wohnungsbau Der VDR Jemen.” Bauzeitung Berlin. Volume 42, Issue 12, Pages 559-561. Descriptors: Building Materials; Clay--Applications; Construction Industry--Developing Countries; Houses--Construction; Housing--Construction; Masonry Materials--Developing Countries. Abstract: The principal characteristics of the traditional loam construction methods used in Yemen are described and some aspects are considered for further development. Small amounts of chaff and chopped straw, as well as water, are added to the loam, this mass is mixed, molded into bricks and dried in the sun. Foundations are built from natural stones and bound with cement mortar, the remaining masonry is built from air-dried loam bricks. ISSN: 0005-6871.

Peters, Hartmut and Johns, William E. 2006. “Bottom Layer Turbulence in the Red Sea Outflow Plume.” *J. Phys. Oceanogr. American Meteorological Society*: 09/01; 2011/04. Volume 36, Issue 9, Pages 1763-1785. Abstract: Turbulence in the Red Sea outflow plume in the western Gulf of Aden was observed with an upward-looking, five-beam, 600-kHz acoustic Doppler current profiler (ADCP). The “Bottom Lander” ADCP was deployed on the seafloor in two narrow, topographically confined outflow channels south of Bab el Mandeb for periods of 18–40 h at three locations at 376-, 496-, and 772-m depths. Two deployments were taken during the winter season of maximum outflow from the Red Sea and two in the summer season of minimum outflow. These short-term observations exhibit red velocity spectra with high-frequency fluctuations of typically a few centimeters per second RMS velocity during strong plume flow as well as strong subtidal variations. In one winter season event, the plume flow was reduced by a factor of 4 over an 18-h time span. In variance-preserving form, velocity spectra show a separation at frequencies of 0.3–3 cycles per hour between low-frequency and high-frequency signals. The latter show significant coherence between horizontal and vertical velocity components; hence they carried turbulent stress. Based on a comparison with velocity spectra from atmospheric mixed-layer observations, the authors argue that large variance at frequencies of the order of 1 cph was possibly associated with bottom-generated, upward-propagating internal waves. One coherent feature that matched such waves was observed directly. Higher frequencies correspond to turbulent motions of energy-carrying scales. The turbulent Reynolds stress at heights above the bottom between 4 and 30–40 m was computed for most of the ADCP observations. Near the bottom, the streamwise turbulent stress and the streamwise velocity followed a quadratic drag law with drag coefficients ranging from 0.002 to 0.008. There was also significant spanwise stress, hinting at the three-dimensional nature of the boundary layer flow. The time–height variations of the stress and its spectrum proved to be complex, one of its most striking features being angles of up to $\sim 40^\circ$ between the direction of the stress and that of the low-frequency flow. The turbulent shear production and eddy viscosity were also examined. On the technical side, the paper discusses the role of the fifth, center-beam velocity measurements in correcting for instrument tilt along with the effect of beam spreading in the 30° Janus configuration of the “regular” four ADCP beams. Instrumental noise and detection limits for the stress are also established. ISSN: 0022-3670. URL: <http://dx.doi.org/10.1175/JPO2939.1>.

Peyre, MT and Caulet, JP. 2000. “Paleoproductivity Changes in the Upwelling System of Socotra (Somali Basin, NW Indian Ocean) during the Last 72,000years: Evidence from Biological Signatures.” *Mar. Micropaleontol. Elsevier*: 10 Oct. Volume 40, Issue 3, Pages 321-344. Descriptors: Biogeochemical cycle; Energy flow; Gyres; Palaeo studies; Primary production; Upwelling; Article Taxonomic Terms: *Globigerina bulloides*; *Globigerina falconensis*; *Globigerinita glutinata*; Article Geographic Terms: Yemen, Socotra; Marine. Notes: TR: CS0105642. Abstract: High resolution analyses of foraminiferal and radiolarian assemblages

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were performed on core MD 85682 (10 degree 53'5N-52 degree 23'E, 3092 m depth, 7.23 m length), located close to the Socotra Island, beneath the 10 degree N gyre of the upwelling area of the Somali Basin (NW Indian Ocean), in order to reconstruct the paleoproductivity changes during the last 72 kyr. Correspondence and cluster analyses of combined planktonic foraminiferal and radiolarian quantitative data show that the distribution pattern of the microfauna is partly controlled by temperature and hydrographic structures and their interrelations on water mass fertility. The continuous occurrence of high abundances of foraminiferal species well known in fertile areas such as *Globigerinita glutinata*, *Globigerina bulloides* and *Globigerina falconensis*, as well as radiolarian species characteristic of upwelling systems, testifies to a sustained activity of the upwelling during the last 72 kyr. Downcore evolution of these biological proxies suggests an increase in paleoproductivity during isotope stages 1 and 3, which reflects a stronger upwelling activity during these periods. These observations are in agreement with the results previously obtained by geochemical markers such as biogenic barium, phosphorus, organic matter, and also trace elements related to the organic matter and indicators of redox conditions (vanadium). Samples from isotope stage 2 record a more complex biological and geochemical signature, resulting from increased terrigenous input. Comparison between the biological signatures obtained both under the Socotra (10 degree N) and Somali (5 degree N) upwelling areas indicates higher productivity throughout the last 72 kyr record of the Socotra upwelling system. In both areas, a similar evolution of biological proxies indicative of high fertility is observed during isotope stages 1 and 3. However, minor differences in the biological and geochemical signatures are related to local conditions prevailing beneath the two gyres. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0377-8398.

Pietsch, D., and B. Lucke. 2008. "Soil Substrate Classification and the FAO and World Reference Base Systems: Examples from Yemen and Jordan". *European Journal of Soil Science*. 59, no. 4: pages 824-834. ISSN: 1351-0754. OCLC: 438286241.

Pietsch, D. Structure- and Process-Related Indicators for Dry Tropical Soil Development, Socotra Island (Yemen). Descriptors: Calcification; Climatic changes; Degradation; Global warming; Greenhouse effect; Islands; Land use; Mapping; Resource management; Soil; Soil erosion; Soils; Stratigraphy; Tropical environment; Tropical environments; Water motion; Water wells; overgrazing; soil degradation; thinning; vegetation cover; Article Taxonomic Terms: Socotra; Article Geographic Terms: Arabian Sea; Yemen, Socotra. Abstract: Dry Tropical regions are pre-eminently suitable for the study of the polygenesis and degradation of layered soils, even more so if the land surface is concurrently influenced by a monsoonal climate. High rates of substrate relocation and an increasing aridity, as well as unsustainable land use practices like felling and overgrazing, cause the thinning of the vegetation cover and produce an ascendant water movement. Results are e.g. soil erosion and secondary calcification, leaving behind diverse patterns of regolith and soils. Both soil development and soil heterogeneity can be recorded using indicators of processes and structures. One example of a high soil variety concerning the polygenesis and degradation of layered soils occurs on the Island of Socotra, situated in the Arabian Sea. Investigation of soils in different relief positions, existing under different land use practices, showed not only various features of soil formation, but also distinct patterns of soil heterogeneity. In small areas of a few square kilometers non-calcareous regolith is distributed beside Haplic Cambisols, Calcic Cambisols and Hypercalcic Calcisols, and calcretes. Even at single locations different soil stratigraphies occur. The present structural indicators of soil heterogeneity (as rubefication patterns) are so far exclusively valid for Socotra. Process-related indicators for soil development (as secondary calcification) are, however, valid for the whole dry

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Tropics, which emphasises the supra-regional significance of the approach to identify the layered, polyge-netic and degraded soils in the context of global warming. The presentation introduces the first soil data for Socotra, and is to be regarded as a first step in examining the recent soil development on this dry tropical island. The present approach considers that the soil degradation processes are not isolated phenomena, but are to be regarded as inevitable and important soil forming processes. The characterisation of the soils and their distribution is based on macro- and micro-morphological results as well as on lab and mapping data, from which structural and process-related indicators can be deduced. ISSN: 1029-7006. Database: ASFA: Aquatic Sciences and Fisheries Abstracts.

Pietsch, Dana, Kühn, Peter, Scholten, Thomas, Brunner, Ueli, Hitgen, Holger and Gerlach, Iris. 2010. "Holocene Soils and Sediments Around Ma'rib Oasis, Yemen: Further Sabaeen Treasures?" *Holocene*. Sage Publications, Ltd: 08. Volume 20, Issue 5, Pages 785-799. Descriptors: Soils -- Analysis; Volcanic ash, tuff, etc; Phosphates; Phytoliths; Data analysis; Pleistocene-Holocene boundary; Yemen (Republic); archaeopedology; Holocene palaeosols; Sabaeen culture; Yemen. Abstract: The ancient cultures of Southern Arabia are increasingly recognised as playing a major role in the heritage of mankind as the early cultures of Egypt, Mesopotamia or the Indus Valley. The beginning of the widely known Sabaeen culture dates back to the end of the second millennium BC. Whereas, undoubtedly, its wealth came mainly from the trade along the Incense Road, the backbone of its economy was irrigated agriculture. Since agriculture is based on soil and water resources and, hence, land availability, the buried soils and sediments of the area surrounding the Ma'rib Oasis have been investigated, both as an archive of Holocene soil development in Pre-Sabaeen times and as 'natural treasures', as, for example, ores or alabaster are defined. The natural buried Holocene soils around Ma'rib are rich in phosphate, organic material and volcanic ashes. In a few places they demonstrate cultivation before the Great Dam of Ma'rib was built in the first millennium BC. Most important are those soils that formed during the Neolithic between 8000 and 3000 BC, a time before the permanent settlement of humans in the Bronze Age, and before the arrival of those of the early Sabaeen period at the Ar-Rub' Al-Khali desert margin. Since the area surrounding the oasis shows a huge variety of landscapes, such as dune belts, volcanic fields with archaeological structures and different soils, it is worth accentuating the significance of Holocene soils as an important record or archive of land use. As well as classical soil analysis, AMS-14C-datings, the results of phytolith analysis and geochemistry, including XRF data, have been taken into consideration. ISSN: 0959-6836.

Pietsch D., and Kuhn P. 2009. "Soil Developmental Stages of Layered Cambisols and Calcisols on Socotra Island, Yemen". *Soil Science*. 174, no. 5: 292-302. ISSN: 0038-075X. OCLC: 428497714.

Pillsbury, B. Yacoob, M. and Bourne, P. 1988. What Makes Hygiene Education Successful: Experience from Togo, Sri Lanka, and Yemen and its Relevance for Project Design. Performer: Water and Sanitation for Health Project, Arlington, VA. Sponsor: Agency for International Development, Washington, DC. Office of Health. Sep 1988. 65p. Report: WASH/TR-55, WASH /ACTIVITY-369; AIDPN-ABB-002. Abstract: Supplying clean drinking water, increased amounts of water, and better methods of excreta disposal does not automatically reduce disease or improve health. Hygiene education is, therefore, now recognized as an essential part of water supply and sanitation projects. Hygiene education is an indispensable part of such projects and ensures improved health and sustainability of the system after donor assistance is withdrawn. Hygiene education informs community members about how to use

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water in a more health-promoting, disease-preventing way. It includes instruction in all aspects of water collection, storage, use, and disposal; the use of clean water for feeding infants and general food preparation; desired bathing practices for all ages; and domestic cleanliness. The report provides guidance for project designers and implementers as well as for policy- and decision-makers in water supply and sanitation projects which should lead to both improved health and sustainable projects. Several such projects have had effective hygiene education components. These projects have been analyzed and the lessons learned presented in the report. Database: NTIS Database (National Technical Information Service). OCLC: 31792932.

Pirenne, Jacqueline. 1977. *La Maitrise De l'Eau En Arabie Du Sud Antique Six Types De Monuments Techniques*. Paris: Imprimerie nationale: C. Klincksieck. Mémoires de l'Académie des Inscriptions et Belles-Lettres. nouvelle série, 2. Descriptors: Water-supply -- Arabia, Southern -- History; Génie hydraulique -- Arabie (sud) -- Histoire; Génie hydraulique -- Yémen -- Histoire; Yémen -- Antiquités; Arabia, Southern -- Antiquities; Hydraulique; Arabie du sud ancienne. Notes: 1 vol. (237 p.-27 p. de planches): fig. 28 cm. Note(s): En tête du titre: Institut de France. Notes bibliogr. Index. Responsibility: par Jacqueline Pirenne. LCCN: 78-392836. OCLC Accession Number: 489990105.

Planck, Ulrich. 1987. "Issues of Water in Agrarian Reform Legislation of the Near East." Land Reform, Land Settlement and Cooperatives. Issue 1/2, Pages 58-82. Descriptors: Law -- Middle East; Agrarian Reform; Water Rights; Afghanistan; Egypt; Algeria; Iraq; Iran (Islamic Republic of); Yemen; Morocco; Syrian Arab Republic; Tunisia; Turkey. Abstract: Examines the importance of water for agriculture in the Near East and the concept of agrarian reform. Reviews water rights in Afghanistan, Algeria, Iraq, Iran, Yemen, Morocco, Syria, Tunisia and Turkey. Comments on reasons for neglecting water rights and linkages between water rights and land ownership. Notes: 30 cm. Note(s): Includes bibliographical references. General Info: IN: Land reform, land settlement and cooperatives. No. 1/2 (1987), p. 58-82. Responsibility: by Ulrich Planck. OCLC: 1785568.

Pollastro, R.M.; Karshbaum, A.S.; Viger, R/J. 1998. Maps showing geology, oil, and gas fields and geologic provinces of the Arabian Peninsula. U.S. Dept. of the Interior- Geological Survey- Open File Report 97-470B. URL: <http://pubs.usgs.gov/of/1997/ofr-97-470/OF97-470B/arabGmap.html>.

Popov, G and W. Zeller. 1963. Ecological survey - Mission to the Arabian Peninsula, Jan-Oct 1962. Prospection ecologique - Mission dans la Peninsule arabique, Jan-Oct 1962. FAO 1963 - UNDP/SF Desert Locust Project - Progress Report no Unsf/DI/Es/6 - 94 p., 4 tab., 8 maps, 46 phot., 12 ref. Languages:English, French. Keywords: Insect Control; Acrididae; Ecology; Physiography; Climate; Vegetation; Animal Breeding; Soil Types; Democratic Yemen; Yemen; Saudi Arabia; Middle East. UNDP SF PROJECT. Report Number: PL-UNSF/DL/ES/6. FAO Library Accession Number: 057699.

Popov, Y. M. and Zhumanov, S. B. 1992. "Alluvial-Desert Soils of the South Yemen as an Object of Irrigation." Problemy Osvoeniya Pustyn' - Akademiya Nauk Turkmenskoi SSR. Volume 4, Pages 13-19. Abstract: Conditions of desert-tropical pedogenesis, agrochemical and water-physical properties of alluvial soils have been described. Meliorative aspects of their reclamation, irrigation and exploitation have been shown from the example of Ahwar Wadi delta. -English summary. Database: SCOPUS. ISSN: 0006-3207.

Potts, Daniel T. 2008. "Asia, West Arabian Peninsula." New York: Academic Press. Page(s): 827-834. Descriptors: Arabia archaeology; Bahrain; Kuwait; Oman; Prehistory; South Arabia; UAE; Yemen. Abstract: This chapter discusses human settlement in the Arabian

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penninsula from the Pleistocene to the 7th century AD. Emphasis is placed on environmental conditions, the development of material culture traditions, external ties to neighboring regions, socio-political development and the evolution of cultural complexity. All areas of the Arabian peninsula are included. ISBN: 978-0-12-373962-9.

Pratlong, F., Bastien, P., Perello, R., Lami, P. and Dedet, J. P. 1995. "Human Cutaneous Leishmaniasis Caused by *Leishmania Donovanii* Sensu Stricto in Yemen." *Trans. R. Soc. Trop. Med. Hyg.* 8. Volume 89, Issue 4, Pages 398-399. Descriptors: leishmaniasis; cutaneous leishmaniasis; *Leishmania donovani*; Yemen. ISSN: 0035-9203.

Pratt, D. J. 1977. Yemen Arab Republic Montane Plains and Wadi Rima' Project: a Land and Water Resources Survey; Great Britain and Ministry of Overseas Development (ab 1974). 1977. An Investment and Development Plan for Wadi Rima': Yemen Arab Republic Montane Plains and Wadi Rima' Project: A Land and Water Resource Survey. Surbiton, Surrey: Land Resources Division. Descriptors: Wasserwirtschaftliche Planung (Hydrologie); Jemen (Suedwestasien). Republik Jemen; Grundwasser + Grundwassereigenschaften (Hydrologie); Hydrologie; Beobachtungen; Daten; Angaben; Aufzeichnungen; Planification Des Ressources En Eau (Hydrologie); Water Management Planning (Hydrology); Dry Valleys (Geomorphology); Yemen (South West Asia). Republic of Yemen; Yemen (Asie Du Sud-Ouest). Republique Du Yemen; Groundwater + Groundwater Properties (Hydrology); Hydrology; Observations; Data; Records. Notes: VII, 167 S; 30 cm: Ill + 4 Faltkarten; Am Kopf der Titelseite: Ministry of Overseas Development. Responsibility: D. J. Pratt. OCLC Accession Number: 637506066.

Pringle, Heather. 1998. "Archaeology: Yemen's Stonehenge Suggests Bronze Age Red Sea Culture." *Science*. March 6. Volume 279, Issue 5356, Pages 1452-1453. Abstract: In research currently in press in the Proceedings of the Seminar for Arabian Studies, a research team presents preliminary evidence for a previously unstudied Bronze Age culture in coastal Yemen. The evidence includes the ruins of a circular prehistoric religious site, or henge, a cache of copper-alloy tools dated to between 2400 and 1900 B.C., and fragments of children's skeletons from what appear to be ceremonial burials. All this suggests a well-organized people living in an arid coastal plain once thought to have been almost empty at this time. DOI: 10.1126/science.279.5356.1452.

Purser, B. H. and Bosence, Dan W. J. 1998. Sedimentation and Tectonics in Rift Basins: Red Sea-Gulf of Aden. London; New York: Chapman & Hall. Page(s): 663. Descriptors: Rifts (Geology) -- Red Sea Region; Rifts (Geology) -- Aden, Gulf of,; Region; Sedimentation and deposition -- Red Sea; Sedimentation and deposition -- Aden, Golfe, d'; Tectonique -- Mer Rouge; Tectonique -- Aden, Golfe d'; Riftsystem; Sedimentation; Tektonik; Aufsatzsammlung; Rotes Meer (Region); Golf von Aden; Internet resource. Abstract: Sedimentation and Tectonics in Rift Basins: Red Sea - Gulf of Aden presents new case studies and synthesises the results of recent research on the sedimentological evolution of the Red Sea - Gulf of Aden rift system. This rift basin is generally regarded as the best natural geological laboratory in the world in which to study the processes of rift formation. Uplift of the rift margins in an arid climate results in extensive three-dimensional exposures of pre- and syn-rift strata and associated structures. These serve as analogues for the understanding and hydrocarbon exploration of deeper buried rift-systems on continental margins such as the North Sea and the Atlantic margins. The Red Sea - Gulf of Aden rift is also exceptional in that its stratigraphy spans all stages from pre-rift environments, syn-rift continental to marine environments through the rift to drift transition to post-rift sea-floor spreading. The work is arranged in eight sections: following a review of the

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sedimentology and stratigraphy of rift basins, the magmatism and structural evolution of the Red Sea - Gulf of Aden rift is reviewed. Subsequently, new case studies are presented of the early rifting environment, syn-rift sedimentation, tectonics and diagenesis, evaporites and salt tectonics. Post-rift sediments of the axial trough are then discussed along with studies of reefs, coastal zone and shelf sediments, and the tectonic geomorphology of the rift margin escarpment. This work results from extensive new research in the rift basin largely carried out under collaborative research projects by European and Middle Eastern geologists. It will be an invaluable reference work for geoscientists in the hydrocarbon, groundwater and mineral extraction industries, as well as for researchers in university departments of earth sciences, mining and physical geography. Notes: xiv; ill. (some color), maps; 29 cm. Note(s): Includes bibliographical references (p. [613]-652) and index. Responsibility: edited by Bruce H. Purser and Dan W.J. Bosence. ISBN: 0412734907; 9780412734908. LCCN: 97-69705. OCLC Accession Number: 39261639.

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Qadhi, S. M. Mohamed, A. K. and Bashir, S. Y. 2002. Assessment of Potential Contamination of Seiyun-Wadi Hadhramaut-Water Wellfield; Proceedings; Geotechnical and Geoenvironmental Engineering in Arid Lands. Netherlands: A.A. Balema Publishers, Lisse, Netherlands. Second International Conference on Geotechnical and Geoenvironmental Engineering in Arid Lands, Riyadh. Saudi Arabia Conference: Oct. 6-9, 2002. Descriptors: aquifers; Arabian Peninsula; Asia; boreholes; drinking water; ground water; models; MODFLOW; MODPATH; movement; pollution; preventive measures; risk assessment; Seiyun Yemen; simulation; Wadi Hadhramaut; water resources; water supply; water wells; Yemen. References: 6; sect., sketch map. ISBN: 9058095142. GeoRef Accession Number: 2004-018119.

Quadflieg, A. and Langguth, H. R. 1988. "Erste Ergebnisse Hydrogeologischer Untersuchungen in Der Umgebung Von Ibb (Arabische Republik Jemen). Early Hydrogeologic Studies in the Region of Ibb, Yemen." Geologisches Jahrbuch Hessen. Hessisches Landesamt fuer Bodenforschung, Wiesbaden, Federal Republic of Germany Federal Republic of Germany. Volume 116, Pages 273-292. Descriptors: aquifers; Arabian Peninsula; Asia; atmospheric precipitation; basalts; chemical composition; evapotranspiration; geochemistry; ground water; hydrochemistry; hydrogeology; hydrology; igneous rocks; ignimbrite; petrography; pump tests; pyroclastics; surveys; temperature; volcanic rocks; water balance; water supply; Yemen. References: 16; illus. incl. 36 anal., 4 tables, sketch map, charts. Database: GeoRef. ISSN: 0341-4027.

"Quick Takes: Action is Heating Up in Yemen..." 2002. Oil & Gas Journal. Volume 100, Issue 42, Pages 8. Abstract: A group led by DNO ASA found new pay in Tasour field on Block 32 in the Masila basin in a well extending the main field pay south into an area previously assumed to be below the oil-water contact. The structurally high Tasour 7 cut full oil columns in Cretaceous Qishn S1A sandstone and the unspecified new pay just below Qishn. The Tasour field, which went on production 11/3/2000, peaked at 12,500 bpd in February 2001 and averaged 8187 bpd in 2001. TransGlobe anticipates 7200 bpd in 2002, consistent with predicted natural declines. Qishn recovery factor utilized in 2001 was 45% compared with 20% assumed in 2000. Tasour 7 is forecast to increase the field's reserves. Database: SCOPUS. ISSN: 0030-1388.

Quigley, James M. 1956. "Tanks of Tawela." Travel. March. Volume 105, Pages 54-55. Descriptors: Water supply- Aden (Protectorate); Water tanks; Water supply/Aden. Notes: Illustrations. ISSN: 0041-1965.

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Rahman, Atiur. 1992. *Calcareous Nannofossils in the Jurassic and Neogene: Applications in Biostratigraphy and Paleoceanography*. United States -- Utah: The University of Utah. 235 pages. Abstract: Calcareous nannofossils were studied by light and scanning electron microscopy in Neogene and Jurassic samples from three Deep Sea Drilling Project Sites in the Gulf of Aden (231, 232) and in the western North Atlantic (534), four Ocean Drilling Program Sites (794, 795, 796, 797) in the Japan Sea, and from the European Platform. Nannofossils in the Gulf of Aden reflect paleoceanographic changes. The surface water was relatively cold during 10.7 to 6.32 Ma, which is attributed to increased upwelling in the northwestern Indian Ocean, and relatively warm from 6.32 to 2.59 Ma. The most intense cooling took place during 2.59 to 1.69 Ma. Intense upwelling during this interval is coincident with global climatic deterioration. The surface water was cold from 1.59 to 1.00 Ma and from 0.61 to 0.24 Ma, and warm from 1.00 to 0.61 Ma and after 0.24 Ma. Seven zones and two subzones ranging from Holocene to Miocene were recognized in the Japan Sea. A diverse assemblage with warm-water taxa in the upper part of lower Miocene to the lower part of the middle Miocene suggests a relatively warm and stable surface water condition, attributed to an increased supply of warm water from the subtropical western Pacific. The oldest zone at Site 797 ranges between 18.4 and 15.7 Ma, which predates the rotation of southwest Japan, and suggests that at least the Yamato Basin was formed before this rotation and that the latter cannot be attributed the initial opening of the Japan Sea as some workers did previously. The study of nannofossils in Callovian to Tithonian strata allowed calibration of nannofossil events with ammonite stratigraphy, and testing and revision of the Jurassic nannofossil biostratigraphy. Twenty-one nannofossil events including three new events, seven zones, and eight subzones are recognized. Four new zones and three new subzones are proposed and described; two zones in the Callovian, two zones and four subzones in the uppermost Callovian to basal Tithonian. The new events and zones increased the biostratigraphic resolution and allowed revision of the previous age assignments of the major lithostratigraphic units at Site 534. Notes: The University of Utah; Ph.D. Database: ProQuest Dissertations & Theses. OCLC: 26100543.

Raja'a, Y. A., Al-Ashwal, M. Y. and Al-Ghaili, A. A. 2001. "The Quality of Partially Treated Drinking-Water Produced in Sana'a City." *East. Mediterr. Health J.* Volume 7, Issue 1-2, Pages 247-254. Abstract: We assessed the quality of partially treated drinking water in 30 private establishments in Sana'a City, Republic of Yemen. We also compared the assessed water with the quality of 43 private wells and 18 estate wells. Microbiological examinations showed that 83% of the samples were contaminated; 50% with fecal coliforms and 33% with total coliforms. Concentration of mineral exceeded nominal values in 7% of the samples for nitrates, 10% for iron salts and in 20% of the samples for fluorides. In 33% of the samples, fluoride concentrations were lower than normal. Only 16.7% of the samples were found microbiologically and chemically potable. Database: SCOPUS. ISSN: 1020-3397.

Raja'a, Y. A., Sulaiman, S. M., Mubarak, J. S., et al. 2001. "Some Aspects in the Control of Schistosomosis and Soil-Transmitted Helminthosis in Yemeni Children." *Saudi Med. J.* Volume 22, Issue 5, Pages 428-432. Descriptors: Albendazole; Control; Praziquantel; Schistosomosis; School children; Soil-transmitted helminthosis. Notes: Cited By (since 1996): 4. Abstract: Objective: Prevalence, intensity and incidence of schistosomosis and soil-transmitted helminthosis among school children in an ignored area in Yemen were determined. The study aimed to investigate the impact of single doses of Praziquantel or Albendazole or both, relating to sanitary, socioeconomic and behavioral practices on the prevalence and intensity of infections.

Methods: Out of a total number of 897 pupils, 453 were randomly selected from AlMahweet town and 444 from rural surrounding areas. Millipore filtration, modified Kato and precipitation techniques were applied for urine and stool analysis. Results: Prevalence rates were 27% for schistosomosis, 61% for ascariasis, 21% for trichuriasis, 2% for fasciolosis, 0.3% for entrobiosis, 0.7% for hook worm infection and 0.2% for strongyloidosis. Factors found confounding the relationship between schistosomosis and residence, under logistic regression analysis, were sex and frequency of water contact. Probability of infection by Bilharzia for boys who reside in rural AlMahweet and visit the water source is 0.52, compared to 0.30 for their mates who reside in AlMahweet town. Odds ratio estimates accounted for via residence was 2.5, via water contact 1.7 and via boys 3.2. With regards to other helminthic infections, availability of latrines remained the only significant factor under ANOVA. Conclusion: In conclusion, annual campaigns for treatment as a single control measure can reduce the infection rate of *S. mansoni* by 62.5%, *T. trichura* by 48% and *A. lumbricoides* by 24%. Whereas for *S. hematobium* the appropriate time interval for intervention should be shortened according to the findings of a properly designed intervention study before used as a single control measure. Since 77% of the children were infected by other helminthes, therefore mass treatment should be extended to cover all children. For those boys in rural AlMahweet who visited the water source during the week before the interview, mass treatment for schistosomosis is recommended since the prediction of infection rate reached 52%. Database: SCOPUS. ISSN: 0379-5284.

Rampen, SW, Schouten, S., Koning, E., Brummer, GJA and Sinninghe Damste, JS. 2008. "A 90 Kyr Upwelling Record from the Northwestern Indian Ocean using a Novel Long-Chain Diol Index." *Earth Planet. Sci. Lett.* 30 Nov. Volume 276, Issue 1-2, Pages 207-213. Descriptors: Article Subject Terms: Fossil Foraminifera; Holocene; Late Glacial Maximum; Marine sediment cores; Monsoons; Ocean circulation; Ocean floor; Organic carbon in seawater; Palaeoceanography; Palaeotemperature; Paleoceanography; Primary production; Southwest monsoon; Temperature trends; Upwelling; Article Taxonomic Terms: Bacillariophyceae; Socotra; Article Geographic Terms: Arabian Sea; Arabian Sea, Somali Basin; Indian Ocean; Somalia; Yemen, Socotra; Marine. Notes: TR: CS0913398. Abstract: Presently, upwelling is of major importance for driving primary productivity in the Arabian Sea but its intensity in the past is not well constrained. Here we used long-chain 1,14-alkane diols, specific lipids of diatoms of the genus *Proboscia*, as new proxies to reconstruct upwelling conditions in the Arabian Sea. Variations in the seasonal lipid fluxes were determined using sediment traps in the Somalia upwelling system deployed 80 km off the coast on the Somali continental slope (NIOP 905, 10 super(o)45.444'N / 51 super(o)56.655'E) at 1265 m water depth, 268 m above the sea floor and 270 km off the coast in the deep Somali Basin south of Socotra (NIOP 915, 10 super(o)43.068'N / 53 super(o)34.422'E), at 3047 m depth, 1000 m above the sea floor. Highest fluxes of C sub(2) sub(8) and C sub(3) sub(0) 1,14-diols (up to almost 600 approximately equal to g m super(-) super(2) day super(-) super(1)) were only observed during nutricline shoaling at the onset of the Southwest monsoon (SWM), prior to massive upwelling. By contrast, fluxes of C sub(3) sub(0) 1,15-diols, derived from as yet undefined biological sources, only increased marginally during the SWM and also during the Northeast monsoon (NEM), when, instead of upwelling, enhanced vertical mixing led to a second productivity pulse. Sediment core NIOP 905 taken at the continental slope site showed strong fluctuations in relative concentrations of long-chain 1,14- and 1,15-diols with time, which we quantified as the summed concentrations of C sub(2) sub(8) and C sub(3) sub(0) 1,14-diols divided by the summed concentrations of C sub(2) sub(8) and C sub(3) sub(0) 1,14-diols and C sub(3) sub(0) 1,15-diols. This diol index follows the same trend

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as other upwelling intensity records from the Arabian Sea that are based on sea surface temperature reconstructions, organic carbon content, barium/aluminium ratios, and abundance and stable isotope composition of specific foraminiferal species. The diol index was relatively high during the Holocene (ca. 0.7) but much lower during the Late Glacial Maximum (ca. 0.2). It was generally low during the last Glacial but elevated values were found during the first half of marine isotope stage 3 (between 60 and similar to 45 ka) and at the end of marine isotope stage 5.1 (approximately 80 ka), suggesting intensified glacial upwelling. Our data shows that long chain diols are suitable proxies to reconstruct past upwelling intensities in the Arabian Sea. Database: Meteorological & Geostrophysical Abstracts. ISSN: 0012-821X.

Rand Corporation, Santa Monica, CA and Chalk, Peter. 2009. "Maritime Piracy: Reasons, Dangers and Solutions." Feb. Page(s): 10. Report Number: RAND-CT-317 XD-XD Monitor Series: XD. Abstract: This testimony aims to inform and put into context the current debate on piracy by providing an overview of the scope and contributing factors driving armed maritime violence in the contemporary era and the principal dangers associated with this particular manifestation of transnational crime. Given the publicity and unprecedented character of the international response to Somali-based piracy, the testimony also briefly addresses the appropriateness of the measures that have been instituted to deal with armed maritime violence off the Horn of Africa and Gulf of Aden. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf). Congressional testimony; Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA493656. Handle / proxy Url: <http://handle.dtic.mil/100.2/ADA493656>

Rand Corporation, Santa Monica, CA and Fukuyama, F. 1984. "The New Marxist-Leninist States in the Third World," Sep. Page(s): 45 Report Number: RAND/P-7020. Abstract: If one were to survey the full range of Soviet clients in the Third World in the mid-1980s and contrast them with those of a generation earlier, say in the mid-1960s, perhaps the single most salient difference that emerges is the proliferation of regimes claiming Marxism-Leninism as their governing ideology. In the earlier period there were only three: North Vietnam, North Korea, and Cuba. Moscow's other major Third World clients at that time were a heterogeneous collection of left-leaning states like Egypt under Nasser, Syria, India, Indonesia, Mali, Ghana, and the like. Each one professed a vaguely socialist ideology tailored to the country's specific national and cultural traditions, maintained an equally vague non-aligned and anti-imperialist foreign policy, and disavowed any adherence to orthodox Marxist-Leninist principles. Twenty years later, by contrast, the three Communist regimes had not only survived (and in case of Vietnam substantially expanded), but were joined by at least six others: Afghanistan, the People's Democratic Republic of Yemen (PDRY), Angola, Mozambique, Ethiopia, and Nicaragua. In this report we analyze the similarities of the six new Marxist-Leninist regimes more closely in terms of four categories--internal structure, foreign policy, military policy, and internal opposition, and conclude with some observations about their place in the Third World more broadly. Abstract Classification: Unclassified Technical Reports Collection. DTIC Accession Number: ADA152546.

Rand Corp Santa Monica, Ca and Mylroie, L. 1983. "Politics and the Soviet Presence in the People's Democratic Republic of Yemen: Internal Vulnerabilities and Regional Challenges." Dec. Page(s): 85 Report Number: RAND/R-N-2052-AF Contract Number: F49620-82-C-0018. Abstract: Since its independence in 1967, the People's Democratic Republic of Yeman (PDRY) has posed various challenges to the conservative pro-Western states of the Arabian penninsula, and thus indirectly to the United States. This Note describes the evolution of the PDRY's internal

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political and economic situation and discusses its relations with other states in the region and with the Soviet Union. It also discusses potential changes in the PDRY's relationships with the Soviet Union and with the conservative Arab states and analyzes various U.S. options in relation to the PDRY. The United States can play a background role: U.S. policies that enhance the conservative Arab states' sense of security will contribute to greater rigor in their dealings with the PDRY. In addition to strengthening the PDRY's neighbors, the United States might, in the proper circumstances, consider playing a subsidiary role in the South Arabian detente itself. Abstract Classification: Unclassified Technical Reports Collection. Notes: Interim rept., DTIC Accession Number: ADA142311.

Rand Corp Santa Monica Calif and Jason, Heda. 1968. "The Narrative Structure of Swindler Tales," Feb. Page(s): 36 Report Number: P-3788. Abstract: The object of the paper is to design a model for the narrative structure of swindler tales. By 'swindler-tale' is meant an oral narrative (prose or verse) about a clever personage who cheats a less clever one in order to win (usually) a small material gain or gratification. The material on which the discussion is based stems from disparate cultures and thus demonstrates the generality of the proposed narrative structure: Africa (Basuto), Amerindian (Kutenai), India (Ceylon), Yemen (Jewish), and Yugoslavia (narrative songs). Abstract Classification: Unclassified Technical Reports Collection. DTIC Accession Number: AD0666018.

Rand Corp Santa Monica Calif and Wolfe, Thomas W. 1969. "The USSR and the Arab East," Sep. Page(s): 16. Report Number: P-4194. Abstract: The document is concerned with Soviet policy toward the Arab states in what the Soviet Union customarily defines as the Near East -- which includes the UAR, Syria, the two Yemens and the Sudan. Abstract Classification: Unclassified Technical Reports Collection Citation Format: FOIA. DTIC Accession Number: AD0694576.

Rapp, A. 1988. "Climatic History in the Middle East during 10,000 Years and Climate-Adapted Runoff Farming." *Svensk Geografisk Arsbok*. Volume 64, Pages 9-24. Abstract: Climatic fluctuations during the Holocene time of 10,000 years are discussed based on interpretations of sediments in the Dead Sea basin. These interpretations show a Holocene optimum period of more humid climate until about 4500 BP. During the last 4000 years the climate has been arid with fluctuations of more humid episodes. A similar history is reconstructed for southern Sahara based on old lake sediments in northern Sudan and also by archeological studies of artefacts in present desert. A combination of drier climate after 4500 BP and growing overexploitation by early cultivators and pastoralists indicates a long history of desertification. Ancient techniques of water harvesting and runoff farming in Marib oasis, Yemen, Avdat in Israel and Matmata, Tunisia show very old examples of ecologically well adapted irrigation technology in desert areas. -English summary. Database: SCOPUS. ISSN: 0081-9808.

Rappenhoener, D. 1989. "Resource Conservation and Desertification Control in the Near East." Federal Republic of Germany Dtsch. Stiftung internation. Entwickl., Zentralstelle Ernaehr. Landwirtsch., Feldafing. Descriptors: Africa; agriculture; Arabian Peninsula; arid environment; Asia; case studies; desertification; East Africa; ecosystems; environmental geology; erosion; geomorphology; Jordan; land use; Mali; methods; Middle East; Morocco; North Africa; Sahel; Saudi Arabia; semi-arid environment; Senegal; soil erosion; soils; South Yemen; Sudan; symposia; Syria; terrestrial environment; Tunisia; vegetation; water erosion; West Africa; Yemen. Notes: References: 7; illus. incl. sects., charts, block diags., 25 tables, geol. sketch maps. Database: GeoRef in Process. GeoRef Accession Number: 25036-1.

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Rappold, G. D., Ergenzinger, P. and Scholz, F. 2000. "Hydrological Analysis of Terraced Catchments; a Case Study of the Tiazz Region, Yemen; European Geophysical Society, 25th General Assembly; Abstracts." Geophysical Research Abstracts. European Geophysical Society, Katlenburg-Lindau, Federal Republic of Germany. Volume 2, Descriptors: Arabian Peninsula; Asia; catchment hydrodynamics; hydrodynamics; hydrology; semi-arid environment; terraces; terrestrial environment; Tiazz Yemen; water balance; water regimes; water resources; Yemen. Notes: Compact disc. Database: GeoRef. ISSN: 1029-7006.

Rappold, Gerhard D. 2005. "Precipitation Analysis and Agricultural Water Availability in the Southern Highlands of Yemen; Mountain Hydrology." Hydrol. Process. John Wiley & Sons, New York, NY. 15 Aug. Volume 19, Issue 12, Pages 2437-2449. Descriptors: agriculture; Arabian Peninsula; Asia; atmospheric precipitation; climate; evapotranspiration; frequency; hydrology; irrigation; probability; rainfall; statistical analysis; statistical distribution; temperature; water management; water resources; Yemen. References: 18; illus. incl. 6 tables. Abstract: Rain-fed agriculture with supplementary irrigation, usually referred to as "water harvesting on terraced fields" is the traditional irrigation technique in the Ta'izz area, located in the southern uplands of the Yemen Mountain Massif. The non-traditional method of groundwater irrigation has recently led to overuse and depletion of aquifers. A new orientation towards the traditional agricultural irrigation techniques is necessary for the purpose of sustainability. This requires a better scientific understanding of these irrigation systems. In order to understand the design and management of water harvesting schemes, rainfall analysis and the identification of prevailing rainfall patterns is required. A statistical rainfall analysis was conducted to detect the probability of rainfall exceedance during the vegetation period from May until October. Rainfall supply was then measured against water requirements of the prevailing crop Sorghum bicolor. To explore the beneficial effect of the local runoff irrigation schemes, also referred to as water harvesting schemes, water-harvesting factors were introduced. The rainfall is supplemented by a water-harvesting factor to show the amplifying effect of those water-harvesting measures. Analysis results show that a lack of rainfall during the end of the first rainy season and an intermediate dry period under pure rain-fed conditions can be mitigated by the local runoff irrigation schemes. A fairly reliable and sufficient rainfall characterizes the second rainy season. Database: GeoRef. ISSN: 0885-6087. URL: <http://dx.doi.org/10.1002/hyp.5894>.

Rathod, KS and Rushton, KR. 1991. "Interpretation of Pumping from Two-Zone Layered Aquifers using a Numerical Model." Ground Water GRWAAP. Vol. 29, No. 4. July/August. Volume p 499-509, Pages 26 ref. Descriptors: Aquifer characteristics; Aquifers; Groundwater movement; Mathematical models; Model studies; Pumping tests; Boreholes; Case studies; Computer models; Computer programs; Computers; Finite difference methods; Groundwater hydraulics; Sandstones; Yemen. Abstract: A numerical model was developed that represents both the radial and vertical flow components that usually result from pumping from boreholes in layered aquifers. The model, which is based on finite-difference approximations, runs on a microprocessor system and can be used for the analysis of pumping test results. A version of the program in BASIC is available together with a full description of the input data. The model was applied to an analysis of a pumping test in a weathered-fractured aquifer, and three case studies were conducted in which the numerical model was used to gain a greater understanding of the aquifer flow processes. These case studies include a layered aquifer in Yemen, an unconfined sandstone aquifer, and artificial recharge by injection in an alluvial aquifer. The model assumes that the flow towards the pumped borehole is radial. In certain situations, the heterogeneous nature of the aquifer or the occurrence of lateral flows within the aquifer means that the radial

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flow approximation is not applicable. Another limitation of the model is that, when the upper zone is unconfined, it is not possible to distinguish between the unconfined response at the water table and the confined response below the water table. Despite these limitations, the model presents a more realistic representation of the actual field conditions than many of the techniques currently used for pumping test analysis. Database: Water Resources Abstracts. ISSN: 0017-467X.

Ravishankar, Krish; Thurber, Mark William; Brower, Rick Allan and McClurg, Jon. 2008. Waste Management in a Desert Environment, Yemen. Doha, Qatar: Society of Petroleum Engineers. Page(s): 1-6. SPE Middle East Health, Safety, Security and Environment Conference and Exhibition 2008 - Strengthening Sustainable Practices and Regulations, October 20, 2008 - October 22. Conference: 2008. Descriptors: Waste incineration; Arid regions; Contractors; Environmental impact; Geophysical prospecting; Groundwater; Health; Health risks; Hydrogeology; Landforms; Management; Mineral resources; Minerals; Offshore oil wells; Petroleum engineering; Petroleum prospecting; Petroleum transportation; Recycling; Regulatory compliance; Solar radiation; Strengthening (metal); Sustainable development; Waste disposal. Abstract: An integrated waste management plan was developed and implemented in a remote desert petroleum-producing region of Yemen. Challenges included: an absence of in-country contractors that recycle, handle hazardous, non-hazardous, and mixed waste; sensitive receptors including nearby communities, groundwater and desert ecosystems; limited options for safe disposal within the petroleum block; logistical challenges of transporting waste long distances in sand sea environments, and historical ad hoc disposal practices by previous operators that created waste liabilities. Occidental of Yemen (Oxy) and Walsh Environmental Scientists and Engineers (Walsh) consulted in-house stakeholders (geophysical exploration, exploration drilling, production managers, operations, and HES) and external stakeholders (Ministry of Oil and Mineral Resources, local tribal leaders and government officials, contractors, and NGOs) and developed an integrated waste management plan that is functional, cost effective, and addresses concerns of local and national stakeholders in the logistically challenging sand sea environment. The Waste Management Plan was developed consistent with Oxy's Worldwide Standard of Care that involves the principle elements consisting of: regulatory compliance; segment/business unit HES performance objectives; correction or cessation of any activities that pose an unacceptable risk to health, safety, or to the environment; and a risk evaluation and mitigation program that achieves consistent results worldwide. The waste management plan presents clear principals for managing waste streams, which include reuse, recycling, incineration, proper storage, and final disposal to prevent exposure to sensitive receptors. The important improvements in waste management are: construction of a centralized waste management facility that collects and processes waste streams from nearby production areas and remote drilling pads; lining of pits, and location outside active channels of wadis away from houses and agricultural fields; re-injection of some liquid wastes, and an active program of remediating pre-existing environmental impacts from previous operations. ISBN: 9781605607016; 1605607010. OCLC: 449842353; 553779129.

Reale, Antoinette, Burns, Stephen J., Fleitmann, Dominik, Matter, Albert, Kramers, Jan and Al-Subbary, Abdulkarim A. 2003. "A High-Resolution, Speleothem Record of the Indian Monsoon during the glacial/interglacial Transition from Socotra Island, Yemen; Geological Society of America, 2003 Annual Meeting." Abstracts with Programs - Geological Society of America. Geological Society of America (GSA). Nov. Volume 35, Issue 6, Pages 415. Descriptors: absolute age; Arabian Peninsula; Arabian Sea; Asia; C-13/C-12; carbon; Cenozoic;

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dates; geochemistry; glacial environment; high-resolution methods; Indian Ocean; interglacial environment; isotope ratios; isotopes; monsoons; Moomi Cave; O-18/O-16; oxygen; paleoclimatology; paleoecology; Quaternary; rainfall; Socotra Island; solution features; speleothems; stable isotopes; stalagmites; Th/U; upper Quaternary; vegetation; Yemen. Abstract: A high-resolution speleothem record from the Indian Ocean yields oxygen and carbon isotope ratios that can be used to reconstruct variations in the East African-Indian Monsoon system. A stalagmite (M1-4) was taken from Moomi Cave on Socotra Island off the coast of Yemen. Annual rainfall on the island is convective activity associated with the migratory patterns of the inter-tropical convergence zone (ITCZ). Ages were determined using (super 234) U/ (super 230) Th dating techniques, and a preliminary age model indicates speleothem growth from approximately 10.5 to 35 ky BP. More than 1000 C and O stable isotope measurements allow a detailed reconstruction of climate for this period. Oxygen isotope values range from approximately -4 to +2 per mil and carbon isotope values range from about -10 to 0 per mil (both vs VPDB). The oxygen isotopes in this system express primarily the isotopic composition of rainfall and to a lesser extent cave temperature, with delta (super 18) O values being inversely related to the amount of precipitation. The most negative values are found during the Holocene, with generally lower values indicating a drier climate during the last glacial. The oxygen isotopes show a millennial-scale pattern of variation that is similar, but not identical to the Greenland ice cores. D/O events are of lesser magnitude in the stalagmite. The carbon isotopes display several sharp rapid increases to values of near 0 per mil against a more steady background of much negative values of -8 to -10. Carbon isotope fluctuations are often thought to express vegetation changes from C (sub 3) (forest) to C (sub 4) (grassland) plants however, we interpret the least negative carbon isotope values to represent periods of extreme drought and near lack of vegetation when dissolved carbon input to the groundwater was primarily from the atmosphere. Database: GeoRef. ISSN: 0016-7592.

Republic of Yemen. 2001. Taiz water supply and sanitation project: Rehabilitation of Water and Sewerage Networks. Environmental Impact Assessment (Al-Qaida): Republic of Yemen Ministry of Electricity and Urban Water and Sanitation Project with Dorsch Consult and Gitec Consult.

Republic of Yemen, 2008, Sector wide environmental and social assessment (SWESA) for the water sector support program. Consulting Engineering Services (India) Republic of Yemen Ministry of Water and Environment and Ministry of Agriculture and Irrigation.

Riaz, Khalid. 2002. "Tackling the Issue of Rural-Urban Water Transfers in the Ta'iz Region, Yemen." Natural Resources Forum. Volume 26, Issue 2, Pages 89-100. Descriptors: Water resources; Conservation; Groundwater; Managers; Rural areas. Abstract: The Ta'iz region of Yemen is facing serious water problems. Total water use has become unsustainable. While agriculture places a heavy demand on the region's water resources, supplies for the fast growing city and the industrial sector are severely rationed despite their much higher willingness-to-pay for water relative to the returns on most agricultural uses. The article considers several decentralized management options for enhancing sustainability and improving intersectoral water allocation. These include, taxing groundwater extractions, taxing inputs used in pumping groundwater, and implementing a tradable water rights regime. The first two options could lead to resource conservation but are politically difficult to implement and may not necessarily result in better intersectoral water allocation. The tradable water rights regime has potential for achieving the twin objectives of resource conservation and improved intersectoral resource allocation. If farmers' de facto water rights were legitimized, this option would be more

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acceptable to them. However, the following additional conditions need to be met for making the option viable: (a) a set-aside allocation is made for lifeline supplies for the poor; (b) the water law provides for separation of water rights from land rights; and (c) community organizations are involved as co-managers of the region's water resources. ISSN: 0165-0203. URL: <http://dx.doi.org/10.1111/1477-8947.00010>.

Richards, Tony. 2002. "Assesment of Yemen Water Law. Final Report." Prepared for: Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ) GmbH. 35 pages. Summary: The aim of the Law is stated (in Article 3) to be: "*to regulate, develop and ration the exploitation of water resources, as well as the protection thereof from depletion and pollution, the improvement of the efficiency of conveying and distributing their uses and the proper maintenance and operation of the installations thereof, and the participation of the beneficiaries thereof in their management in the various stages of their development, investment and conservation thereof.*" The Law is laid out in nine Chapters, some with sub-sections : I Nomenclature and Definitions; II Objectives and General Concepts/Principles; III Water Resource Management and Planning; i Management of Water Resources; ii Water Resources Planning; IV Water Use; i Priorities of Water Use; ii Controls for Dealing with the Use of Water; V Water Rights and Permits; i Water Rights; ii Licenses; VI Water Conservation and Protection From Pollution; i General Technical Standards and Specifications; ii Conservation of Water Resources from Depletion and the Rational use of Water; VII Protection From Floods and Rainwater Runoff; VIII Enforcement and Penalties; i Enforcement Procedures; ii Criminal Punishments; IX General Final Provisions; In general terms the Law reflects the issues that would be expected to be dealt with in water resources management legislation, with prime responsibility being given to the National Water Resources Authority (NWRA). However, there are two major issues arising from the formulation of the Law. URL: <http://www.tc-wateryemen.org/documents/downloads/AssessmentofYemenWaterLawFinalReport.pdf>

Riggs, HC. 1977. "A Brief Investigation of the Surface-Water Hydrology of Yemen Arab Republic." Open-File Report 77-150. 1977. 37 pages, 16 Fig, 3 Tab. 16 ref. Descriptors: Hydrology; Surface waters; Foreign research; Arid lands; Ephemeral streams; Arabian Peninsula; Yemen Arab Republic; Hydrologic data; Floods; Streamflow; Precipitation (Atmospheric); Alluvial channels; Investigations; Surveys; Evaluation; Wadis. Abstract: Yemen, near the southwest tip of the Arabian Peninsula, is a mountainous country bordered by a desert on the east and a coastal plain on the west. Rainfall is low and seasonal; consequently, most streams (wadis) are ephemeral. The natural flow regimens of many of the smaller wadis are modified by terracing for agriculture. The only streamflow data available in Yemen are short records on four large wadis. A brief field investigation and application of reconnaissance techniques are the bases for the largely qualitative description of the hydrology, and for the proposal to collect streamflow data needed for orderly development of the expanding economy. Responsibility: by H.C. Riggs; prepared in cooperation with the Yemen Arab Republic under the auspices of the United States Agency for International Development. Database: Water Resources Abstracts. ISSN: Series 0196-1497. OCLC Accession Number: 3392898.

Riisager, Peter, Knight, Kim B., Baker, Joel A., et al. 2005. "Paleomagnetism and $^{40}\text{Ar} / ^{39}\text{Ar}$ Geochronology of Yemeni Oligocene Volcanics: Implications for Timing and Duration of Afro-Arabian Traps and Geometry of the Oligocene Paleomagnetic Field." *Earth Planet. Sci. Lett.* 9/15. Volume 237, Issue 3-4, Pages 647-672. Descriptors: Yemen; Afro-Arabian traps; Oligocene; $^{40}\text{Ar}/^{39}\text{Ar}$ geochronology; magnetostratigraphy; paleomagnetic pole; large igneous province. Abstract: A combined paleomagnetic and $^{40}\text{Ar} / ^{39}\text{Ar}$ study was carried out along eight stratigraphically overlapping sections in the Oligocene Afro-Arabian flood volcanic province in Yemen (73 sites). The composite section covers the entire volcanic

stratigraphy in the sampling region and represents five polarity zones that are correlated to the geomagnetic polarity time scale based on $^{40}\text{Ar} / ^{39}\text{Ar}$ ages from this and previous studies. The resulting magnetostratigraphy is similar to that of the conjugate margin in Ethiopia. The earliest basaltic volcanism took place in a reverse polarity chron that appears to correspond to C11r, while the massive rhyolitic ignimbrite eruptions correlated to ash layers in Oligocene Indian Ocean sediment 2700 km away from the Afro-Arabian traps, appear to have taken place during magnetochron C11n. The youngest ignimbrite was emplaced during magnetochron C9n. Both $^{40}\text{Ar} / ^{39}\text{Ar}$ and paleomagnetic data suggest rapid < 1 Ma eruption of the basal basalt units and punctuated eruption of the upper silicic units over a duration potentially as long as 3 Ma with interspersed eruptive hiatuses. Eruption of the basal basalts may have preceded the Oi2 cooling event. The paleomagnetic pole $\lambda = 74.2^\circ\text{N}$, $\phi = 249.1^\circ\text{E}$ ($A95 = 3.6^\circ$; $N = 48$) is supported by a positive reversal test. Paleosecular variation, estimated as the angular standard deviation of the VGP distribution $14.2^\circ + 2.3^\circ / - 1.7^\circ$, is close to expected, suggesting that the paleomagnetic pole represents a time-averaged field. The pole is in excellent accord with the paleomagnetic poles obtained from the Ethiopian part of the Afro-Arabian province, after closure of the Red Sea. By analyzing Afro-Arabian paleomagnetic data in conjunction with contemporaneous paleomagnetic poles available from different latitudes we argue that the Oligocene paleomagnetic field was dominated by the axial dipole with insignificant non-dipole field contributions. ISSN: 0012-821X.

Ritchie, Dr Sebastian. 2008. “*RAF Counter-Insurgency Operations in Oman and Aden, 1950-1970.*” Royal Air Force Air Power Review. Spring 2008. Volume 11, Issue No. 1, Pages 50-69.

Robertson, Alastair H. F. and Bamakhalif, Khalid A. S. 2001. “Late Oligocene-Early Miocene Rifting of the Northeastern Gulf of Aden; Basin Evolution in Dhofar (Southern Oman); Peri-Tethys Memoir 6; Peri-Tethyan rift/wrench Basins and Passive Margins.” *Memoires Du Museum National d’Histoire Naturelle*. Ed. du Museum National d’Histoire Naturelle, Paris, France. Volume 186, Pages 641-670. Descriptors: Africa; African Plate; Arabian Peninsula; Arabian Plate; Arabian Sea; Asia; basins; Cenozoic; deformation; Dhofar Oman; East Africa; extension tectonics; faults; Gulf of Aden; IGCP; Indian Ocean; lithofacies; lithostratigraphy; lower Miocene; Miocene; Mughsayl Formation; Na’r Formation; Nakhlait Formation; Neogene; Oligocene; Oman; Paleogene; Peritethys; plate tectonics; rifting; Somali Republic; southern Oman; tectonics; Tertiary; uplifts; upper Oligocene; Yemen. Notes: IGCP, International Geological Correlation Programme; IGCP Project No. 369; References: 64; illus. incl. sect., strat. cols., geol. sketch maps. Abstract: The Neogene-Recent, rifted, northeastern continental margin of the Gulf of Aden is excellently exposed onshore in Dhofar where a narrow coastal plain is backed by a major fault escarpment, rising to 1800 m. In the west, Quaternary alluvium conceals a major E-W trending rift basin, the Ashawq Graben (90 km long by 20 km wide). This structure is infilled with Oligo-Miocene, mainly carbonate sediments that record rifting prior to initiation of sea-floor spreading in the eastern Gulf of Aden. An initial rift pulse in the early Oligocene (Rupelian; ca. 33 Ma) resulted in accelerated subsidence, with marginal facies in the northwest, patch reefs on a high in the south and shallow open-marine deposition in the east (Nakhlait Member). A latest early Oligocene (late Rupelian) rifting pulse (ca. 29 Ma) then created a steep-sided asymmetrical rift basin, the Ashawq Graben, in which pelagic carbonates and calciturbidites, ca. 1000 m thick accumulated, in water depths of ca. 400 m (Mughsayl Formation). Limestone talus was shed from master faults in the north, near the present the Jebel Qara Escarpment, and debris flows, slumps and detached blocks of shallow-water limestone

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were also fed northwards into the rift basin from a marginal rift high to the south, the Aquabat Horst. In addition, carbonate was redeposited eastwards within channels into deeper water. In the southwest, the extension of the Aquabat Horst is marked by a zone of E-W trending coastal fault blocks stepping down into deep water. Following partial infill, the Ashawq Graben was cut by NE-SW trending normal faults, correlated with the landward projection of a major oceanic fracture zone (Alula-Fartak Fracture Zone). This faulting coincided with the onset of sea-floor spreading in the eastern Gulf of Aden around middle Burdigalian time (ca. 18-19 Ma). Associated flexural deformation of the continental margin gave rise to a prominent break-up unconformity and development of a major fault escarpment bordering the coastal plain. The rift basin itself was uplifted by ca. 400 m, whereas its northern flank was upfaulted by around 1500 m. Tertiary and older units were eroded during the early Miocene, giving rise to shallow marine clastics, consisting mainly of limestone conglomerates. Erosion continued after marine regression and red alluvial conglomerates accumulated on the coastal plain during the Pliocene (N'ar formation). Fluvial downcutting continued during the Quaternary in a tectonically quiescent post-rift setting. Despite the oblique spreading of the Gulf of Aden, the rift morphology in Dhofar is more akin to orthogonally rifted (Atlantic-type) margins than to strike-slip dominated rifts, as most structures show evidence of dominantly normal faulting. Database: GeoRef. ISBN: 2856535283.

Rodriguez, Fritz; World Bank and Europe, Middle East, and North Africa Regional Office. 1986. Staff Appraisal Report: People's Democratic Republic of Yemen Greater Aden Second Water Supply Project. Washington: World Bank. Page(s): 67. Descriptors: Water-supply -- Yemen (Republic); Loans, Foreign -- Yemen (Republic); Government publication; International government publication. Notes: ii; [1] folded leaf of plates: ill., col. maps; 28 cm. Note(s): Cover title. "For official use only." "October 3, 1986." "Report No. 5858a-YDR." "Water Supply and Sewerage Division, Europe, Middle East and North Africa Regional Office." Includes bibliographical references (p. 67). Other Titles: Yemen Greater Aden second water supply project. OCLC Accession Number: 52958571.

Root, Kristi and Papakos, Tatiana H. 2010. Hydrologic Analysis of Flash Floods in Sana'a, Yemen. ASCE. ASCE Conf. Proc. Volume: 394, 41143, page(s): 112. Conference: August 23, 2010. Descriptors: Hydrologic aspects; Flash floods; Middle East. Abstract: Floods, especially flash floods, have killed many people in Sana'a in the past years. The urban development of Sana'a, the capital of Yemen, has led to an increase in flood hazards due to rapid changes in existing landuse to impervious surfaces and the presence of increased population and buildings in flood prone areas. A comprehensive hydrologic analysis of the Sana'a Basin was conducted using GIS for pre- and post-processing of large datasets, HEC-SSP for rainfall frequency analysis and HEC-HMS for hydrologic modeling. This analysis identified the basin characteristics, estimated rainfall distributions, depth, and frequencies, and developed flows for different storm frequency events to be used in hydraulic modeling and floodplain mapping of Sana'a floods. Significant challenges were addressed during the modeling process including: limited historical flood data, short historical rainfall records, non-standard hydrologic input data, poorly understood local hydrology, and major changes in the landuse from rapid urbanization. Based on the results of the hydrologic analysis and further hydraulic modeling, the floodplains were effectively mapped along Sana'a major stormwater channel and the Sana'a flood hazard areas were identified for extreme storm events. This information is being used to support a natural disaster risk evaluation for Sana'a. ISBN: 978-0-7844-1143-8. URL: <http://link.aip.org/link/?ASC/394/112/1>.

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Root, Kristi and Papakos, Tatiana H. 2010. Flooding Impacts and Modeling Challenges of Tropical Storms in Eastern Yemen. ASCE. ASCE Conf. Proc. Volume: 371, 41114, page(s): 206. Conference: May 16, 2010. Descriptors: Storms; Middle East; Flash floods. Abstract: Most of Yemen is located in an arid climate with convective storms that produce flash floods and cause significant damage. A Tropical Storm landed in the eastern part of Yemen between October 23 and 25 of 2008 causing severe destruction and leaving thousands without their homes or livelihoods. A probabilistic risk assessment project, funded by the World Bank, Global Facility for Disaster Reduction and Reconstruction (GFDDR), was conducted for Hadramout and Al-Mahra governorates to (1) determine the extent and depth of flood risks in these governorates and (2) develop recommendations for the recovery and reconstruction of these areas to reduce devastation from future flood events. As a result of this Tropical Storm, the Government declared Hadramout and Al-Mahra governorates as disaster areas. Nearly 6,600 homes and huts in these two governorates sustained total or significant damage, leaving 25,000 people in need of shelter. Flooding was reported to have claimed 73 lives, left 17 people missing, and injured many others. The flooding not only damaged homes but also had a devastating effect on agricultural land. It is believed that nearly 50 percent of the population of the affected areas had their livelihoods destroyed or substantially damaged. A flood hazard analysis was performed to recreate the Tropical Storm of 2008 and to determine the extent and depth of flooding for the 100-year flood frequency event. Hydrologic modeling analysis performed with HEC-HMS software was used to process precipitation data, identify basin characteristics, and simulate the design flows produced by the Hadramout and Al-Mahra river basins. Hydraulic modeling performed with HEC-RAS software used the design flows and geometry data to model the stream conveyance. HEC-GeoHMS and HEC-GeoRAS were used in the pre- and post-processing efforts to expedite the parameter inputs and mapping process. Many challenges were addressed during the modeling processes. Specifically, there was limited historical data that could be used in the flood model developments. In addition, a high resolution digital elevation model (DEM) was not available for use in the hydrologic and hydraulic model. Finally, only a limited number of high water levels and flood extents were obtained after Tropical Storm 03B to be used in the calibration process. These challenges were overcome and floodplain maps were developed along the major waterways of the Hadramout and Al-Mahra governorates. These maps are being used to determine the areas prone to flooding and will be used to make recommendations in the rebuilding of roads, buildings in populated areas, agricultural lands, and flood control structures. ISBN: 978-0-7844-1114-8.

Roselló, E., Morales, A. and Popov, S. V. 2005. "A Preliminary Survey of the Late Stone Age Faunas from Gihayu (Khor Umayra Lagoon, Republic of Yemen)." *Archaeofauna*. Volume 14, Pages 253-265. Descriptors: 5th-4th millennium B.C; Fauna; Fish; Fishing; Late stone age; Molluscs; Shellfish gathering; Sub-sistence; Yemen. Abstract: An overview of the fauna] assemblage retrieved during preliminary excavations of the Neolithic site of Gihayu is presented. The analysis, the first of its kind carried out on a site from Yemen, reveals a series of similarities and differences with contemporaneous sites in Ornan on the eastern corner of the Arabian Sea. Within the former, a heavy reliance on marine resources is noted that testifies both to the collecting of shellfish along an open shore as well as the fishing of large pelagics in the open sea. The differences relate to the exploitation of molluscs along the shore rather than in lagoons or mangroves as appears to be the case in Ornan. They may also reflect phenomena not so straightforwardly related to the availability of certain biotopes. Among these an apparent dominance of carangids (jacks) over scombrids (tunas) could be taken to indicate a less seasonal

focused fishery a hypothesis that will require verification once systematically sieved samples become available. Database: SCOPUS. ISSN: 1132-6891.

Rösler, H., Köhler, J. and Böhme, W. 2008. "A New Species of the Diurnal Gekkonid Genus *Pristurus* Rüppell, 1835 from the Red Sea Island Hanish Al-Kabir, Yemen." *Amphib. Reptilia*. Volume 29, Issue 2, Pages 217-227. Notes: Cited By (since 1996): 1. Abstract: We describe a new species of gecko of the genus *Pristurus* from the Yemenite Red Sea Island Hanish al-Kabir. It is a small species (snout-vent length less than 30 mm) of the genus, distinguished from its congeners by a unique combination of morphological characters. Superficially, it is most similar to *P. rupestris*, but differs mainly by a longer and narrower snout, by its strongly compressed tail, presence of a lateral caudal groove, by a tail crest present in both sexes, by a higher number of scales bordering infralabials and a higher midbody scale count. The new species is tentatively considered to represent an island endemic. Its possible origin is briefly discussed. Database: SCOPUS. ISSN: 0173-5373.

Ruiz, A. 1966. "Efforts of US Agency for International Development to Supply Water to People of Yemen." *American Water Works Association Journal*. October. Volume 58, Pages 1247-1259. Descriptors: International cooperation; Water supply/Yemen; Water supply; Water Supply and Irrigation Systems. Notes: Map; Diagram. ISSN: 0003-150X.

Rushton, K. R. 2006. "Significance of a Seepage Face on Flows to Wells in Unconfined Aquifers." *Quarterly Journal of Engineering Geology and Hydrogeology*. Geological Society of London, London, UK. 01 Nov. Volume 39, Issue 4, Pages 323-331. Descriptors: Aden Yemen; aquifers; Arabian Peninsula; Asia; case studies; discharge; drawdown; elevation; England; equations; Europe; finite difference analysis; Great Britain; ground water; hydraulic conductivity; numerical models; pressuremeters; pump tests; pumping; River Wye; seepage; simulation; unconfined aquifers; United Kingdom; Wadi Bana; water table; water wells; Western Europe; Yazor Gravels; Yemen. References: 23; illus. Abstract: When pumping occurs from a well in an unconfined aquifer, a seepage face develops between the elevation where water table intercepts the well face and the water level in the well. The existence of a seepage face often leads to well yields which are less than values determined by conventional analysis. Using numerical models to represent the two-dimensional flow through an aquifer to a well bore, the distribution of inflows at the well face are determined; flows per unit depth (incremental flows) from the seepage face are normally less than those into the water column. Two case studies are examined; numerical model simulations show that as the pumping rate is increased and the water level in the well falls, incremental flows from the seepage face into the well bore are unchanged, although incremental flows into the water column do increase. When pumping ceases from a well with a significant seepage face, rapid recovery of the well water level occurs, this allows estimates to be made of water table elevations at a pumping station; the methodology is illustrated by a field example. Database: GeoRef. ISSN: 1470-9236. URL: <http://www.ingentaconnect.com/content/geol/qjeg;jsessionid=689tvr88rgi4.victoria?>

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Saad, MA. 1992. "Observations of Benthic Fauna of the South Yemeni Coastal Waters." *J. Mar. Biol. Assoc. India*. Volume 34, Issue 1-2, Pages 171-178. Descriptors: correlation; mud; samples; sediments; zoobenthos; Article Taxonomic Terms: Crustacea; Echinodermata; Mollusca; Nematoda; Nemertea; Polychaeta; Article Geographic Terms: Yemen; Marine. Notes: TR: DP9400040. Abstract: Analyses of the benthic samples collected from the coastal water between Ras A1 Ara and Ras Fartak and around Socotra showed that numerically Polychaeta was the most abundant group (54.6%) in the benthic fauna with 3553 n/m super(3), followed by Crustacea (36.2%) with predominance of amphipods isopods, decapods, cumaceans and tanaidaceans. Echinoderms contributed to 7.2%, though absent at several stations. Other benthic communities recorded were molluscs (0.5%), nematodes and nemertines (1%). About 50% of the benthic fauna collected were from Ras A1 Ara and Aden, the minimum being from A1 Kalb (4.4%). While Polychaeta exhibited a direct correlation with the mud content of the sediment, the relationship of Crustacea was negative. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0025-3146.

Sabahi, E., Abdul, RS, Wan, ZWY, Al Nozaily, F. and Alshaebi, F. 2009. "A Study of Surface Water and Groundwater Pollution in Ibb City, Yemen." *Electron. J. Geotech. Eng. Electronic Journal of Geotechnical Engineering*. Volume 14, Issue F, Descriptors: Article Subject Terms: Boreholes; Cadmium; Chemical oxygen demand; Chlorides; Contamination; Dissolved oxygen; Groundwater; Groundwater Pollution; Land use; Landfills; Leachates; Physicochemical Properties; Ponds; Surface Water; Surface-groundwater Relations; Temperature; Urban areas; Waste disposal sites; Wastewater discharges; Water Pollution; boreholes; heavy metals; valleys; Article Geographic Terms: Yemen. Abstract: A study was carried out to determine the land use impact on water pollution at three different sites, Al-Sahool, Mitm and Al-Sayyadah valleys around Ibb city, Yemen. Besides determining the status of water pollution, this study also aims to recognize the sources of pollution and the results will be used to identify the relationship between the impact of land use activities and water pollution. Groundwater samples were collected in all valleys. While leachate samples were collected only from Al-Sahool area and surface water samples from Mitm area. Groundwater was sampled from the existing wells that were drilled in these areas. Surface water and leachate were sampled from small stream and leachate ponds. The physico-chemical characteristic of leachate, groundwater and surface water samples such as pH, temperature, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO) were measured in-situ, while fluoride (F), chloride (Cl), sulphate (SO₄), nitrites (NO₂), nitrates (NO₃), ammonia-N (NH₃-N), heavy metals (Pb, Zn, Ni, Cr, Cd, Cu), major cations (Na, Mg, Ca, K, Fe) and biological parameters (COD, BOD₅) were analysed in the laboratory. The results show that, the leachate from the landfill is in methanogenic phase. The BOD₅/COD value of 0.1 mg/l obtained for leachate suggested the partially stabilization. For the groundwater at Al-Sahool area borehole two is the most contaminated borehole, in which physico-chemical parameters are higher, followed by borehole three, borehole four and borehole five. At Mitm area the surface water in general seems to be affected by the discharge of untreated wastewater based on the comparison with unpolluted surface water outside the area. The groundwater quality at Mitm area shows that, only three boreholes are contaminated due to the percolation of untreated wastewater. For Al-Sayyadah area, the low values of physico-chemical parameters indicate a clean area and this is due to the absence of sources of contaminations. In general, Al-Sahool area is the most contaminated area compared to Mitm and Al-Sayyadah areas. The contamination level at Mitm area is higher than

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Al-Sayyadah area due to the discharge of wastewater directly to the Mitm valley. Therefore, a leachate collection pond should be build to collect and treat the leachate to prevent further contamination as well as build more sanitary landfill facilities in Al-Sahool area to prevent further contamination. An additional wastewater treatment plant at Mitm area is highly recommended to prevent further contamination to surface and groundwater. Database: Water Resources Abstracts. ISSN: 1089-3032.

Sadek, Ali. 1992. "Infracambrian Sediments of the Middle East; 29th International Geological Congress; Abstracts." International Geological Congress, Abstracts--Congres Geologique Internationale, Resumes. Abstracts--Congres Geologique Internationale, Resumes. Volume 29, Pages 260. Descriptors: Africa; Arabian Peninsula; arkose; Asia; biogenic structures; chemically precipitated rocks; clastic rocks; conglomerate; Egypt; erosion features; evaporites; graywacke; Infracambrian; intrusions; Iran; Jordan; lava flows; lithostratigraphy; marine environment; Middle East; Neoproterozoic; North Africa; Oman; peneplains; Precambrian; Proterozoic; reefs; sandstone; Saudi Arabia; sedimentary rocks; sedimentary structures; shallow-water environment; sills; stromatolites; submarine environment; thickness; Turkey; unconformities; upper Precambrian; Yemen. Notes: IGC, International Geological Congress; Database: GeoRef.

Safadi, MM. 1995. "A Pilot Study of Lake Ma'rib, Yemen." *Hydrobiologia*. Volume 315, Issue 3, Pages 203-209. Descriptors: Article Subject Terms: artificial lakes; community composition; freshwater organisms; land use; watersheds; Article Taxonomic Terms: Crustacea; Insecta; Mollusca; Article Geographic Terms: Yemen, Ma'rib L. Crustacea; artificial lakes; Freshwater. Notes: TR: CS9607256. Abstract: We provide information on the location, capacity, climate, land tenure and use, vegetation, conservation, economic, and social value of a large artificial lake in Yemen. We also list the extant freshwater macrofauna of Ma'rib lake, which comprises leeches, crustaceans, insects, molluscs, fishes, amphibians and birds. Database: Water Resources Abstracts. ISSN: 0018-8158.

Safadi, MM. 1991. "Freshwater Macrofauna of Stagnant Waters in Yemen Arab Republic." *Hydrobiologia*. Volume 210, Issue 3, Pages 203-208. Descriptors: Article Subject Terms: community composition; freshwater environments; geographical distribution; macrofauna; new records; population structure; stagnant water; Article Geographic Terms: Yemen; Yemen, Arab Rep. biological surveys; wadis; Freshwater. Abstract: The author inventories the freshwater macrofauna of 4 different wadis, representing the low and highlands, in the Yemen Arab Republic. The fauna comprised 6 molluscan, 21 coleopteran, 8 hemipteran, 2 amphibian and one fish species. Of the Coleoptera, 8 spp. are new records to Yemen Arab Republic. The genus *Exitianus* is recorded for the first time in Yemen Arab Republic. Diversity in the uplands and lowlands was similar, but biomass was much higher in the lowlands. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0018-8158.

Sahooly, Anwer. 2003. "Public-Private Partnership in the Water Supply and Sanitation Sector: The Experience of the Republic of Yemen." *Int. J. Water Resour. Dev.* Carfax Publishing Company: Volume 19, Issue 2, Pages 139-152. Descriptors: Water supply; Privatization; Public works; Regulatory compliance; Sanitation. Abstract: The objective of this paper is to provide information on the institutional development of the water supply and sanitation (WSS) sector in Yemen, its achievements, challenges and constraints. In 1997 the government of Yemen approved its water supply and sanitation reform agenda in the form of a Council of Ministers decree and since then the implementation of the reform agenda has started with technical and financial assistance from Germany, the Netherlands, the World Bank and other donors in

addition to the contribution from the government of Yemen. The main principles of the reform agenda are these: the separation of the executive from the regulatory functions; decentralization of service provision and corporatization through the establishment of autonomous WSS corporations; the establishment of a regulatory agency; capacity building and human resources development; and public-private partnership (PPP). This paper gives a summary of what has been achieved in the implementation of the reform agenda in general and concentrates on the pilot case of the first PPP initiative in Sana'a, the capital of Yemen. The paper takes us through the stages of PPP option study right through to the preparation of the request for proposals, which was completed in August 2002. ISSN: 0790-0627. URL: <http://dx.doi.org/10.1080/0790062032000089275>.

Salem, A. K. A., Kabesh, M. L., Attawiya, M. Y. and Ali, M. M. 1989. "Petrology of the Hajja Granitic Pluton, Yemen Arab Republic." *Zeitschrift Fur Geologische Wissenschaften*. Volume 17, Issue 1, Pages 51-57. Abstract: The granitic rocks of Hajja from the Precambrian basement of Yemen are chemically characterized. Petrochemically, the Hajja granitoids belong to the alkaline suite representing sialic material of magmatic origin. In general they also possess sodic-potassic characters. The investigated granitic rocks crystallized from acidic magma under high water-vapour pressure 10Kb, (Tuttle & Bowen 1958). These rocks were emplaced at relatively great depth in the crust. From the trace element contents of the examined granitoids it is concluded that the investigated rocks may have derived from normal magmatic processes of differentiation. Hajja granitoids underwent metasomatism producing anomalous granites. Database: SCOPUS. ISSN: 0303-4534.

Salim, M.M. 1970. "Note on the agricultural development in the Hadramout Valley." Report on a fact-finding mission to the People's Republic of Southern Yemen on rural development in the Hadramout and the Northern Desert. 8 p. Keywords: Democratic Yemen; Deserts; Agricultural Development; Climate; Hydrology; Tenure; Crops; Animal Production. Report No: ESR. FAO Library Accession Number: 111003.

Sallam, J. A. and Wright, S. G. 1992. "Schistosomiasis *Mansoni* in Yemen: A Review." *Ann. Saudi Med.* Volume 12, Issue 3, Pages 294-296. Notes: Cited By (since 1996): 2. Abstract: Schistosomiasis is a major public health problem in Yemen. In 1922 *Schistosoma mansoni* was first reported to be found in Yemeni patients. In 1951 the first population survey was carried out in Taiz and revealed the presence of *Biomphalaria bioxysi arabica* where 35% of the snails were heavily infected with *S. mansoni* and in Sana'a no snails were infected. Although *S. mansoni* and *S. hematobium* infections have been found in most parts of the Yemen Arab Republic (YAR) it seems that the disease is not a public health problem in some parts of the country such as Hodeidah, Al-Beidah, Mareb, and Al-Gouff. The source of *S. mansoni* and *S. hematobium* in Yemen was attributed to the continual migration of infected persons from Eritrea and other countries of East Africa to Yemen. The prevalence of infection is higher in rural than in urban areas. The complications of *S. mansoni*, notably portal hypertension, esophageal varices, and hematemesis have become a major clinical problem. The availability of Praziquantel as a safe and effective treatment makes case finding and treatment an important part of schistosomiasis control. Control of the disease also requires field studies followed by mollusciciding, improvement of water supply and sanitation and, perhaps most importantly, health education. Database: SCOPUS. ISSN: 0256-4947.

Sallam, T. A., Al-Jaufy, A. Y., Al-Shaibany, K. S., Ghauth, A. Bin and Best, J. M. 2006. "Prevalence of Antibodies to Measles and Rubella in Sana'a, Yemen." *Vaccine*. 9/11. Volume 24, Issue 37-39, Pages 6304-6308. Descriptors: Rubella; Measles; Yemen. Abstract: Prevalence

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of antibodies to measles and rubella was tested in sera collected from 1368 subjects in urban and rural Sana'a. Overall, 11.7% had no antibodies to measles and 14.6% had no antibodies to rubella, despite the fact that measles but not rubella vaccine is included in the vaccination program in Yemen. Of 89 children <5 years of age 49 (55.1%) had no detectable antibodies to measles, demonstrating that supplementary measles immunization campaigns are required to prevent virus circulation. Assessment of measles immune status among infants in the first year of life is required to determine the optimum age for measles vaccination. Rubella vaccination should be considered with care in Yemen. ISSN: 0264-410X.

Sallam, T. A., Raja'a, Y. A., Al-Zubiery, T. K., et al. 2003. "Chlamydia Trachomatis Infections among Yemeni School Pupils in Relation to Environmental Conditions." *Saudi Med. J.* Volume 24, Issue 1, Pages 84-87. Notes: Cited By (since 1996): 1. Abstract: Objectives: This study is aimed at establishing the prevalence of Chlamydia trachomatis infections among school pupils in Sana'a, Republic of Yemen, and to explore the association of infection with environmental and social factors. Methods: A total of 787 school children, 529 boys and 258 girls, were randomly selected for enrollment in this study. Four hundred and twenty-nine were from 4 schools in Sana'a city, and 358 from 3 rural schools around Sana'a, Republic of Yemen. Questionnaire forms were filled in for each child to investigate environmental and social factors. Sera were tested for anti Chlamydia trachomatis IgG antibodies using enzyme-linked immunosorbent assay CTM-IgG®. Results: An overall rate of infection of 45.9% was determined. The rate of infection among rural pupils (73.2%) was higher ($P < 0.0001$) than that among urbanones (23.1%). The rate of infection was found significantly ($P < 0.001$) inversely correlated with age of the pupils. Environmental factors which were found to influence the infection rate were; rural residence, unplastered walls, mud floor, lack of stand pipe water, lack of latrine and presence of animals within dwelling with odds ratio of 9.1, 6.3, 6.1, 5.2, 3.7, 3.5 and 1.7. Also, the male sex and illiteracy of the parents has been found to be risk factors for infection. Conclusion: Prevalence of Chlamydia trachomatis infection was found to be high. The prevalence correlates inversely with age. Rural residence, environmental conditions and social factors were risk factors for infections. Yemen could be identified as a trachoma endemic area, which should be targeted by the control programs. Database: SCOPUS. ISSN/ISBN: 03795284.

Sallam, Talal A., Cuevas, Luis E. and William Tong, C. Y. 2003. "Increase in Susceptibility of Young Adults to Hepatitis B Infection in the Republic of Yemen." *Trans. R. Soc. Trop. Med. Hyg.* 6. Volume 97, Issue 3, Pages 302-304. Descriptors: hepatitis B virus; seroprevalence; Yemen. Abstract: Susceptibility to hepatitis B virus (HBV) infection among 987 young adult male blood donors in 2 major Yemeni cities was investigated. Hepatitis B surface antigen (HBsAg) was detected in 10.8% () of donors and 284 (28.8%) had evidence of ongoing or past HBV infection. Hepatitis B surface antibody (anti-HBs) only was detected in 34 (3.4%) donors. Thus, 67.8% () of donors had no detectable HBV-markers indicating susceptibility to infection. The proportion of HBV-susceptible donors decreased from 70.9% () in donors aged 34 years ($P = 0.002$). The high proportion of susceptible young adults in a community with a high HBsAg carrier rate could be the result of changing epidemiology of hepatitis B in Yemen. Consideration should therefore be given to immunizing young adults as an adjunct to the current expanded infant immunization programme. ISSN: 0035-9203.

Salwen, Sarah. 2007. "Faith in Moderation: Islamist Parties in Jordan and Yemen. by Jillian Schwedler. Cambridge University Press, 2006. 252pp. \$80.00." *J. of Church and State.* March 1. Volume 49, Issue 2, Pages 353-354. ISSN: 0021-969X.

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Sandau, C. Waddell, J. and Berthelet, T. 2008. Novel Approach to High Water Cut Measurement in a Mature Oil Field. Soc. Pet. Eng. - Abu Dhabi Int. Pet. Exhib. Conf. ADIPEC Volume: 1, page(s): 364-370. 13th Abu Dhabi International Petroleum Exhibition and Conference, ADIPEC 2008. Abu Dhabi Conference: 3 November 2008 through 6 November 2008. Abstract: Canadian Nexen Petroleum Yemen (CNPY) produces two million barrels of fluid per day at 95 percent watercut from the Masila Block (Block 14) in Yemen. Asset development decisions are based on numerous factors, one of the most important being the amount of oil produced from a well. With increasing oil price, it is becoming economically feasible to produce wells at significantly higher watercuts. The analytical variability of volumetric methods used in Block 14 to measure watercut restricts the accuracy and precision of these measurements. The authors developed a robust and reproducible water cut determination method for this mature petroleum asset based on gravimetric measurement of oil and water phases. The gravimetric measurement approach follows the volumetric method procedures but uses a balance to weigh the oil or water fractions. To keep consistent with historical reporting of oil production, the density of each phase is then used to correct the values to a volume basis. The methodology outperforms the volumetric determination of water cut by being more reproducible (better precision) and allowing for the accurate measurement of water cuts up to 99.5 percent. In side by side comparison of the gravimetric and volumetric methods at 99.5 percent water cut, the gravimetric methodology showed a five fold increase in accuracy. In addition, the gravimetric method provides six to ten times better precision in the measurement of watercut on representative field samples compared to the volumetric methodology. The program at Block 14 investigated the use of a reference calibration matrix standard as a data quality system to establish the detection limits of the methodology and to institute a testing procedure to monitor laboratory performance. The increased accuracy and precision in watercut measurement gives reservoir engineers the confidence to make economic decisions on well viability to maximize overall project NPV. ISBN: 9781605606996. Database: SCOPUS.

Sander, Kirk M., Oches, Eric A., Anderson, Scott, McCorriston, Joy and Harrower, Michael. 2005. "Tufa Records of Holocene Climate Change in Highland Southern Yemen; Geological Society of America, 2005 Annual Meeting." Abstracts with Programs - Geological Society of America. Geological Society of America (GSA), Boulder, CO. Oct. Volume 37, Issue 7, Pages 426. Descriptors: absolute age; agriculture; aquatic environment; Arabian Peninsula; arid environment; Asia; C-14; carbon; Cenozoic; chemically precipitated rocks; climate change; dates; discharge; Gastropoda; ground water; highlands; Holocene; humid environment; Invertebrata; isotopes; lacustrine environment; lower Holocene; meteoric water; middle Holocene; Mollusca; paleoclimatology; paleohydrology; Plantae; point sources; Quaternary; radioactive isotopes; recharge; reconstruction; riparian environment; sedimentary rocks; springs; terrestrial environment; tufa; Wadi Hadramawt; Wadi Idim; Wadi Sana; Yemen. Abstract: As a paleoclimatic recorder tufa can be instrumental in reconstructing the mid-Holocene paleoclimate and paleohydrology in Wadi Idim and Wadi Sana, which are north flowing tributaries to Wadi Hadramawt, in the highlands of southern Yemen. Based on preliminary age estimates, tufa formation began around 10,000 14C yr B.P., when a stronger summer monsoon brought increased precipitation across the southern Arabian peninsula. Approximately 5,000 14C yr B.P. formation of major tufa mounds ceased, as the monsoon weakened and shifted southward, leading to an increasingly arid climate in the region. Radiocarbon age estimates recovered from sand lenses in the tufa deposits indicate a possible north to south headward migration of the tufa source through Wadi Idim and Wadi Sana. Ages on tufa deposits from both wadis correspond

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with evidence from other paleoclimate proxies in eastern Africa, the Arabian Sea, western India, and elsewhere in southern Arabia, that indicate increased moisture availability from about 10,000 to 5,000 years ago. In our study area, increased precipitation contributed to enhanced meteoric recharge of shallow aquifers discharging as springs, which served as point-sources for tufa formation. More active spring discharge led to the formation of expansive marsh and wetland environments, which are indicated by organic-rich lacustrine sediments grading from the tufa mounds to the wadi center. Fossil aquatic gastropods and plant impressions are abundant in the tufa sediments, providing additional evidence for the extensive riparian environment adjacent to the spring sources. Radiocarbon age estimates determined on charcoal recovered from sand lenses within the tufa deposits are correlated with periods of more extensive human occupation in the region, as documented by the RASA (Roots of Agriculture in Southern Arabia) team. Evidence suggests that early farmers may have been exploiting water resources discharging from these fossil springs during the mid-Holocene humid phase. Subsequent aridification has led to abandonment of agricultural subsistence and return to pastoralism in much of the region. Database: GeoRef. ISSN: 0016-7592.

Sayyaghi, al-Husayn ibn Ahmad. 1966. *Qanun San`a: Fi Al-Qarn Al-Thani Ashar Al-Hijri; Wa Yaliha Qanun Al-Rayy Fi Al-Yaman Wa Hikam `Ali Ibn Zayd. San`a: tubi`a tahta ishraf `Abd Allah Isma`il Ghamdan*. Descriptors: Islamic law -- Yemen -- History; Water -- Law and legislation -- Yemen. Notes: 57, 16p. Other Titles: *Qanun al-rayy fi al-Yaman wa hikam `Ali ibn Zayd*. Responsibility: bi-qalam Husayn ibn Ahmad al-Siyaghi. OCLC Accession Number: 607645325.

Schaap, H. B., Den Dulk, M. O. and Polderman, A. M. 1992. "Schistosomiasis in the Yemen Arab Republic. Prevalence of *Schistosoma Mansoni* and *S. Haematobium* Infection among Schoolchildren in the Central Highlands and their Relation to Altitude." *Trop. Geogr. Med.* Volume 44, Issue 1-2, Pages 19-22. Notes: Cited By (since 1996): 10. Database: SCOPUS. ISSN: 0041-3232.

Scheepers, Lidwien M. 1991. "Jidda: The Traditional Midwife of Yemen?" *Soc. Sci. Med.* Volume 33, Issue 8, Pages 959-962. Descriptors: Yemen; traditional birth attendant; midwife; birth-practices; childbirth. Abstract: Contrary to what is assumed, traditional birth attendants (TBAs) do not appear to be clearly defined category of women with specialized knowledge and experience of assistance at deliveries in the local cultural situation at village level in the Anis region of the central highlands in Yemen. In the actual design of training for TBAs in Yemen, this results in problematic provision of basic mother and child health care, in particular safe and clean deliveries to all women at village level. ISSN: 0277-9536.

Scheifele, C., Nassar, A. and Reichart, P. A. 2007. "Prevalence of Oral Cancer and Potentially Malignant Lesions among Shammah Users in Yemen." *Oral Oncol.* 1. Volume 43, Issue 1, Pages 42-50. Descriptors: Mouth mucosa; Chemical burn; Oral leukoplakia; Squamous cell carcinoma; Mouth neoplasms; Potentially malignant lesions; Smokeless tobacco; Shammah; Qat; Yemen. Abstract: Summary The purpose of this study was to assess the prevalence of oral precancerous lesions and squamous cell carcinoma (OSCC) in Yemeni users of shammah, a traditional smokeless tobacco habit known in the Arabian Peninsula. The study group comprised 199 male and one female shammah users who were interviewed via a standardised questionnaire and clinically examined in 48 Yemeni villages and cities. Cases with oral leukoplakia (OL) or mucosal burns (MB) were compared with users without any lesion. MB were detected in 31%, of which 46.8% were located on the tongue or floor of the mouth, and OL in 27%, of which 59.2% were located in the same region. In addition, two cases (1%) of apparent OSCC were identified.

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Statistically significant increased OR (95% CI) of OL were (a) 6.91 (2.66–17.95) for an average duration of the respective shammah application >5 min. (b) 4.90 (1.99–12.08) for a daily frequency of those applications >10; and (c) 4.22 (1.43–12.43) for a daily duration >6 h of chewing qat, also a traditional habit in Yemen. Likewise, decreased OR were (a) 0.39 (0.18–0.85) for rinsing the mouth after the shammah application; (b) 0.36 (0.17–0.78) for successful attempts to stop the use in the past; and (c) 0.26 (0.09–0.72) for existing knowledge about the carcinogenicity of shammah that was present in only 19% overall. In conclusion, evidence was shown for a significant association between the prevalence of OL and the daily duration of shammah application in a dose-dependent manner. An appropriate public health program might help to reduce this potential OSCC burden in shammah users. ISSN: 1368-8375.

Schils, T., De Clerck, O. and Coppejans, E. 2003. "The Red Algal Genus *Reticulocaulis* from the Arabian Sea, Including *R. Obpyriformis* Sp. Nov., with Comments on the Family Naccariaceae." *Phycologia*. Jan. Volume 42, Issue 1, Pages 44-55. Descriptors: Article Subject Terms: Anatomy; Biogeography; Distribution records; Gametophytes; Geographical distribution; New records; New species; Phenotypes; Plant morphology; Plant reproductive structures; Sea water; Seaweeds; Thalli; Article Taxonomic Terms: Naccariaceae; *Reticulocaulis mucosissimus*; *Reticulocaulis obpyriformis*; Hawaii; Arabian Sea; Oman, Masirah I. Yemen, Socotra; Oman; Taxonomy; Yemen; Marine. Abstract: *Reticulocaulis obpyriformis* Schils, sp. nov. is described from the south coast of Socotra Island (Yemen), and a second species, *R. mucosissimus*, is recorded from a similar upwelling area in the Arabian Sea (Masirah Island, Oman). These are the first published records of Naccariaceae for the Indian Ocean and end the monospecific, Hawaiian-endemic status of *Reticulocaulis*. Features distinguishing *R. obpyriformis* from *R. mucosissimus* include its more sparsely branched thallus, obpyriform rather than cylindrical inner cortical cells, the presence of short moniliform laterals of small spherical cells on the cortical filaments, monoecious rather than dioecious gametophytes, and the direct development of spermatangia from catenate mother cells. The morphology and anatomy of the gametophytes of this heteromorphic genus are discussed in relation to those of other naccariacean genera. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 0031-8884.

Schmidt, Michael; Al-Nozaily, Fadhl and Al-Ghorbany, Amer. 2008. "Standards for and Evaluation of Small-Scale Dam Projects in Yemen." Federal Republic of Germany Springer, Berlin, Federal Republic of Germany. Volume: 3, Descriptors: Arabian Peninsula; arid environment; Asia; construction; dams; degradation; drinking water; ground water; habitat; human activity; irrigation; policy; pollution; public health; recharge; reclamation; risk assessment; standardization; surface water; terrestrial environment; water quality; water use; Yemen. References: 15; illus. incl. 3 tables. ISBN: 9783540311409; 9783540311416.

Scholten, Alma. 1992. *Agricultural Transformation in Yaffi and Markha: A Comparative Study in Central Yemen*. Utrecht: Geografisch Instituut, Rijksuniversiteit Utrecht. Descriptors: Agriculture -- Yemen (Republic) -- Bayda Region; Agricultural surveys -- Yemen (Republic) -- Bayda Region; Agriculture -- Economic aspects -- Yemen (Republic) -- Bayda Region; Agricultural development -- Yemen; Farming systems -- Yemen; Agrarische ontwikkeling; Water. Notes: 1 v. (various pagings): maps; 30 cm. Note(s): Cover title. "Februari 1992." Includes bibliographical references (p. B1-B3). LCCN: 94-202369. OCLC Accession Number: 33360894.

Schiettecatte, Jérémie. 2006. "L'évolution de l'armature urbaine en Arabie du Sud: la vallée du Jawf du VIIIe siècle av. au VIe siècle apr." [M@ppemonde](#). Issue: 84. Pagination not given. Keywords: Archéogéographie; Jawf; Paléoenvironnement; Peuplement; Yémen. Abstract:

Geology of Yemen

L'approche archéogéographique du peuplement de la vallée du Jawf (Yémen) met ici en évidence les dynamiques qui affectent le réseau urbain de cette région au cours du Ier mill. av. J.-C. et au début de l'ère chrétienne. Cette approche permet de relativiser les causes jusqu'ici avancées du déclin et de la disparition des villes tout en mettant en avant l'impact de probables modifications environnementales et les conséquences d'une action anthropique sur le paysage plus en amont. ISSN: 1769-7298.

Schliephake, Konrad, and Ahmed Almas. *Südlicher Jemen: wirtschaftliche Entwicklung und Wasser als physisch-geographische Grundlage: Protokolle zur Exkursion Aden und Hadhramaut, März 2000, und wissenschaftliche Beiträge = Southern Yemen. Southern Yemen Economic Development and Water as a Physical Basis: Protocols from an excursion to Aden and Hadhramaut, March 2000, and scientific contributions.* Würzburg: Geographisches Inst, 2001.

IV, 265 S. Ill., graph. Darst., Kt. Würzburger Geographische Manuskripte, 54. OCLC: 216398084.

Schweitzer, Sylvia. 1998. *Finanzierung Lokaler Infrastrukturmassnahmen Durch Kostendeckende Tarife: Theoretische Analyse Und Empirische Untersuchung Am Beispiel Der Wasserversorgungem Jemen.* Translated title: "Local infrastructure financing through cost-covering tariffs measures: Theoretical Analysis And Empirical Investigation Using the example of water supplies Yemen." Bochum: Institut für Entwicklungsforschung und Entwicklungspolitik der Ruhr-Universität Bochum. Page(s): 7. Descriptors: Economic development projects -- Yemen; Local finance -- Yemen; Water supply -- Yemen; Sanitation -- Yemen; Infrastructure (Economics) -- Yemen. Notes: 140; ill., maps; 30 cm. Includes bibliographical references (p. 134-140). ISBN: 3927276510; 9783927276512; LCCN: 98-208269. OCLC Accession Number: 226267889.

Scott, Hugh. 1942. *In the High Yemen.* London: John Murray. Page(s): 260. Descriptors: Scott, Hugh, 1885-; British Museum Expedition to South-west; Arabia, 1937-1938; Yemen (Republic) -- Description and; travel; Yemen, South -- Description and travel. Notes: xix; , [33] leaves of plates: ill. 23 cm. Note(s): Account of the author's experiences with the British Museum (Natural History) Expedition to South-west Arabia, 1937-1938. Includes bibliographical references (p. 239-242) and index. Responsibility: by Hugh Scott; with over a hundred photographs by the author and Everard B. Britton. Includes information on tribes and divisions in the country. OCLC Accession Number: 4122429.

Segele, Zewdu T., Lamb, Peter J. and Leslie, Lance M. 2009. "Seasonal-to-Interannual Variability of Ethiopia/Horn of Africa Monsoon. Part I: Associations of Wavelet-Filtered Large-Scale Atmospheric Circulation and Global Sea Surface Temperature." *J. Climate. American Meteorological Society*: 06/01; 2011/04. Volume 22, Issue 12, Pages 3396-3421. ISSN: 0894-8755. URL: <http://dx.doi.org/10.1175/2008JCLI2859.1>.

Segelhorst, Ken. "An Introduction to Arab Culture: A Brief Synopsis for U.S. Soldiers." *Infantry* 98 (January-February 2009): 39-44.

Serjeant, R. B. 1965. "Notices on The "Frankish Chancre" (Syphilis) in Yemen, Egypt, And Persia." *J Semitic Studies*. January 1. Volume 10, Issue 2, Pages 241-252.

Seryi, V. V. and Naval Oceanographic Office Washington D C. 1973. *On the Water Exchange between the Red Sea and the Gulf of Aden (O Vodoobmene Mezhdou Krasnym Morem i Adenskim Zalivom).* Ft. Belvoir Defense Technical Information Center: Descriptors: Physical and Dynamic Oceanography; (Ocean currents; Red sea); Transport properties; Salinity; Heat transfer; Interactions; Oceanographic data; Deep water; Shallow water; Surface temperature; Halogen compounds; Sea water; Ocean bottom topography; Ussr; Aden Gulf; Thermohaline

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Circulation; Translations. Abstract: The paper is based on data collected during a 3-year period by Vladimir Vorob'yev (1961-1964) along a cross section at the northeastern limit of Bab el Mandeb (Strait). Indirect methods permitted definition of sharp seasonal intensity variations of deep water flowing from the Red Sea into the Gulf of Aden, as well as the causes of these variations. Thermohaline and hydrochemical properties of Red Sea water change during the year in proportion to the degree of transformation of the water in Bab el Mandeb (Strait). (Modified author abstract). Notes: 11 p. Note(s): Translation of Okeanologicheskije Issledovaniya (USSR) n19 p195-200 1968, by V. Astvazaturov. Report: NOO-Trans-546; General Info: APPROVED FOR PUBLIC RELEASE. OCLC Accession Number: 227533130.

Shaaban, M.A.; AlEryant, M.L. 1982. Hydro-geo-electrical study of the Tihama ground water, Yemen Arab Republic. *Journal of Gulf Arabian Peninsula Studies* 2 (1982), pp. 7 - 25.

Shaaban, M. A. 1980. "A Geoelectrical Study of the Sana'a Groundwater Basin, Yemen Arab Republic." *Geologie En Mijnbouw.Netherlands Journal of Geosciences. De Bussy Ellerman Harms, Amsterdam, Netherlands. Volume 59, Issue 1, Pages 79-86. Descriptors: Arabian Peninsula; Asia; electrical conductivity; electrical methods; geophysical methods; geophysical surveys; ground water; hydrogeology; Sana'a Basin; surveys; water resources; Yemen. References: 7; illus. incl. geol. sketch map. Database: GeoRef. ISSN: 0016-7746.*

Shaaban, Mohamed A. 1982. "A Geoelectrical Study of the Groundwater Potentialities of Wadi Zabid, Yemen Arab Republic." *Faculty of Science Bulletin - Sana'a University. UBS Publishers' Distributors LTD for the Faculty of University, Yemen Arab Republic, New Delhi, Yemen: Yemen. Volume 2, Pages 11-21. Descriptors: aquifers; Arabian Peninsula; Asia; electrical methods; geophysical methods; geophysical surveys; ground water; resistivity; surveys; Wadi Zabid; Yemen. References: 5; illus. incl. sects., sketch map. Database: GeoRef.*

Shaaban, Mohamed A. 1982. "Importance of Geophysical Techniques for Groundwater Investigation in Y.A.R." *Faculty of Science Bulletin - Sana'a University. UBS Publishers' Distributors LTD for the Faculty of University, Yemen Arab Republic, New Delhi, Yemen. Volume 2, Pages 23-38. Descriptors: Arabian Peninsula; Asia; conductivity; economic geology; electrical methods; geophysical methods; geophysical surveys; ground water; resistivity; surveys; water resources; Yemen. References: 9; illus. incl. sketch map. Database: GeoRef.*

Shaaban, Mohamed Ahmed. 1980. "Geoelectrical Study of the Sana'a Groundwater Basin, Yemen Arab Republic." *Geol. Mijnbouw. Volume 59, Issue 1, Pages 79-86. Descriptors: Aquifers; Geophysics - Electrical; Water Resources - Groundwater. Abstract: The ground water conditions and possibilities in Sana'a Basin were analyzed for the purpose of locating a suitable source of water supply, and to delineate the structural set-up of the area. Resistivity vertical soundings, previously performed in the area, were interpreted to construct geoelectrical sections of the subsurface along some selected profiles. Also, some parametric resistivity and conductivity measurements were undertaken at some locations for the different rock types and waters of wells encountered in the area. Correlation between the geoelectrical results and the available geological and hydrological data was made. ISSN: 0016-7746.*

Shahin, Mamdouh. 2007. "Water Resources and Hydrometeorology of the Arab Region." *Water Science and Technology Library. Springer, Dordrecht, Netherlands. Volume 59, Pages 586. Descriptors: Africa; Algeria; Arabian Peninsula; arid environment; Asia; atmospheric precipitation; Bahrain; climate; Djibouti; drainage basins; East Africa; Egypt; erosion; evaporation; evapotranspiration; fluvial features; global change; ground water; history; hydrology; Iraq; Jordan; Kuwait; Lebanon; Libya; Mauritania; meteorology; Middle East; Morocco; North Africa; Oman; Palestine; pollution; Qatar; rainfall; recycling; rivers and*

streams; runoff; Saudi Arabia; Somali Republic; storage coefficient; streamflow; Sudan; surface water; Syria; terrestrial environment; Tunisia; United Arab Emirates; wadis; waste water; water erosion; water quality; water resources; water use; West Africa; Yemen. Includes CD-ROM; References: 398; illus. Database: GeoRef. ISBN: 1402045778. URL:

<http://www.springer.com/sgw/cda/frontpage/0,11855,4-40515-69-33112474-0,00.html>.

Shaji, C. and Gangopadhyay, A. 2007. "Synoptic Modeling in the Eastern Arabian Sea during the Southwest Monsoon using Upwelling Feature Models." *J. Atmos. Oceanic Technol.* American Meteorological Society: 05/01; 2011/04. Volume 24, Issue 5, Pages 877-893. Notes: doi: 10.1175/JTECH1984.1; M3: doi: 10.1175/JTECH1984.1; 15. ISSN: 0739-0572. URL: <http://journals.ametsoc.org/doi/abs/10.1175/JTECH1984.1>.

Shakun, J. D., Burns, S. J., Fleitmann, D., Kramers, J., Matter, A. and Al-Subary, A. 2007. "A High-Resolution, Absolute-Dated Deglacial Speleothem Record of Indian Ocean Climate from Socotra Island, Yemen." *Earth Plan. Sci. Lett.* Volume 259, Issue 3-4, Pages 442-456. Descriptors: deglaciation; Indian monsoon; intertropical convergence zone (ITCZ); Socotra; speleothem; uranium-series. Notes: Cited By (since 1996): 6. Abstract: Stalagmite M1-5 from Socotra Island, Yemen in the northwest Indian Ocean provides a robust, high-resolution paleoclimate record from ~ 27.4-11.1 ka based on 717 stable isotope and 28 ²³⁰Th measurements. Variations in M1-5 oxygen isotope ratios ($\delta^{18}O$) are interpreted to be primarily driven by an amount effect related to changes in the mean position and/or intensity of convection of the intertropical convergence zone, the island's only source of precipitation. The M1-5 $\delta^{18}O$ time series is strongly correlated to the Greenland ice cores, similar to an older Socotra speleothem deposited from 53-40 ka [S.J. Burns, D. Fleitmann, A. Matter, J. Kramers, A. Al-Subary, Indian Ocean climate and an absolute chronology over Dansgaard/Oeschger events 9 to 13, *Science* 301 (2003) 1365-1367], indicating that a North Atlantic-Indian Ocean cold-dry/warm-wet teleconnection persisted through the end of the last glacial period. Peak aridification occurred at ~ 23 ka and a gradual increase in moisture thereafter was interrupted by an abrupt drying event at ~ 16.4 ka, perhaps related to Heinrich event 1. Indian Ocean rainfall increased dramatically during the Bølling period and then decreased continuously and gradually through the Allerød and Younger Dryas. The Holocene began abruptly with increased precipitation at 11.4 ka and was followed by a major but short-lived drying during the Preboreal Oscillation at ~ 11.2 ka. M1-5 is highly correlated to the Dongge Cave record from 15.5-11 ka, suggesting much of the Indian Ocean monsoon region responded similarly to the major climate changes of the last deglaciation. The transitions into the Younger Dryas and to a lesser extent the Bølling are remarkably gradual in M1-5, as they are in all other Asian speleothem records, occurring over several centuries. These gradual transitions are in striking contrast to high-resolution records from around the North Atlantic basin where the transitions are extremely abrupt and generally occur in under a century. This spatially variable pattern of climate change is consistent with an Atlantic origin for these deglacial climate events. Database: SCOPUS. ISSN: 0012821X.

Shaw, Julia E., Baker, Joel A., Menzies, Martin A., Thirlwall, Matthew F. and Ibrahim, Khalil M. 2003. "Petrogenesis of the Largest Intraplate Volcanic Field on the Arabian Plate (Jordan): A Mixed Lithosphere-Asthenosphere Source Activated by Lithospheric Extension." *J. Petrology*. September 1. Volume 44, Issue 9, Pages 1657-1679. Abstract: Miocene to Recent volcanism in northwestern Arabia produced the largest intraplate volcanic field on the Arabian plate (Harrat Ash Shaam, Jordan). The chemically and isotopically diverse volcanic field comprises mafic alkali basalts and basanites. The magmas underwent limited fractional

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crystallization of ol {+/-} cpx {+/-} plag and rare samples have assimilated up to 20% of Late Proterozoic crust en route to the surface. However, there are subtle Sr-Nd-Pb isotopic variations ($^{87}\text{Sr}/^{86}\text{Sr} = 0.70305\text{--}0.70377$, $^{143}\text{Nd}/^{144}\text{Nd} = 0.51297\text{--}0.51285$, $^{206}\text{Pb}/^{204}\text{Pb} = 18.8\text{--}19.2$), which exhibit marked correlations with major elements, incompatible trace element ratios and abundances in relatively primitive basalts ($\text{MgO} > 8.5$ wt %), and cannot be explained by fractional crystallization and crustal contamination alone. Instead, the data require polybaric melting of heterogeneous sources. Semi-quantitative melt modelling suggests that this heterogeneity is the result of small degree melts (2-5%) from spinel- and garnet-facies mantle, inferred to be shallow Arabian lithosphere, that mixed with smaller degree melts (<1%) from a predominantly deep garnet-bearing asthenospheric(?) source with ocean island basalt characteristics. The latter may be a ubiquitous part of the asthenosphere but is preferentially tapped at small degrees of partial melting. Volcanism in Jordan appears to be the result of melting lithospheric mantle in response to lithospheric extension. With time, thinning of the lithosphere allowed progressively deeper mantle (asthenosphere?) to be activated and melts from this to mix with the shallower lithospheric mantle melts. Although Jordanian intraplate volcanism is isotopically similar to examples of Late Cenozoic volcanism throughout the Arabian peninsula (Israel, Saudi Arabia), subtle chemical and isotopic differences between Yemen and Jordan intraplate volcanism suggest that the Afar plume has not been channelled northwestwards beneath the Arabian plate and played no role in producing the northern Saudi Arabian and Jordan intraplate volcanic fields.

Sheikh, M. I. 1984. "The Water Decade. some Challenges and Prospects for the Eastern Mediterranean Region." *Water Quality Bulletin* 9.3 (1984): 127-34. Abstract: Access to safe water in the eastern Mediterranean region from Tunisia to Pakistan is examined. Three-quarters of the population in nine of the 23 Member States in the region have relatively easy access to safe water supplies. Six countries lie in the range 50 to 75 per cent, while in eight countries only 50 per cent of the population is provided. These include Afghanistan, Democratic Yemen, Oman, Pakistan, Saudi Arabia, Somalia, Sudan and Yemen Arab Republic. Over the whole region, the proportion of rural population having adequate supplies has remained the same since 1970, while that of the urban population has increased from 77 to 80 per cent. Future trends are outlined.

Shindou, S. and Tagutschi, Y. 1981. "Water Resources of the Yemen Arab Republic; Hydrogeology." *Science Reports of the Institute of Geoscience, University of Tsukuba, Section B: Geological Sciences. University of Tsukuba, Institute of Geoscience, Ibaraki, Japan: Japan; University of Tsukuba, Section B: Geological Sciences. Volume 2, Pages 77-100. Descriptors: aquifers; Arabian Peninsula; arid environment; Asia; electrical conductivity; geochemistry; ground water; hydrogen; hydrogeology; isotopes; natural recharge; radioactive isotopes; surveys; terrestrial environment; tritium; watersheds; Yemen. References: 9; illus. incl. 4 tables, sketch map, geol. sketch map. Database: GeoRef. ISSN: 0388-6182.*

Shindou, S. and Tagutschi, Y. 1981. "Environmental Geology of the Yemen Arab Republic, Tihamah Plain." *Chigaku Zasshi = Journal of Geography. Tokyo Chigaku Kyokai, Tokyo, Japan. Volume 90, Issue 3, Pages 1-21. Descriptors: Arabian Peninsula; Asia; conservation; economic geology; environmental geology; hydrogeology; hydrology; impact statements; regional planning; Tihamah Plain; water resources; Yemen. References: 21; illus. incl. 2 tables, sketch map, geol. sketch map. Database: GeoRef. ISSN: 0022-135X.*

Shindou, Shizuo and Tagutschi, Yuhsaku. 1979. "Environmental Geology of Yemen Arab Republic; 1, Natural Environment and Water use." *Chigaku Zasshi = Journal of Geography. Tokyo Chigaku Kyokai, Tokyo, Japan: Japan. Volume 88, Issue 4, Pages 195-215.*

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Descriptors: aquifers; Arabian Peninsula; Asia; drainage basins; economic geology; environmental geology; fluvial features; geomorphology; ground water; hydrology; land use; rainfall; regional planning; surveys; water resources; water supply; watersheds; Yemen.

References: 28; illus. incl. sketch maps. Database: GeoRef. ISSN: 0022-135X.

Shiwafi, N., Rushdi, AI* and Ba-Issa, A. 2005. "Trace Metals in Surface Seawaters and Sediments from various Habitats of the Red Sea Coast of Yemen." *Environ. Geol.* Aug. Volume 48, Issue 4-5, Pages 590-598. Descriptors: Article Subject Terms: Absorption; Biogeochemistry; Cadmium; Chemical Analysis; Chromium; Coasts; Cobalt; Copper; Geology; Habitat; Habitats; Heavy metals; Iron; Laboratory Equipment; Lead; Manganese; Metals; Nickel; Sea water; Seawater; Sediments; Trace Metals; Vanadium; Water Analysis; Zinc; Geographic Terms: Red Sea; Yemen; Red Sea; Yemen; Marine. Notes: TR: CS0701631. Abstract: The purpose of this study was to determine and assess the concentrations of trace metals in surface seawaters and sediments from different coastal habitats of the Red Sea coast of Yemen. Surface seawater and sediment samples were collected, treated and analyzed for cadmium, cobalt, manganese, chromium, lead, iron, nickel, copper, zinc and vanadium by the atomic absorption spectrometric analysis. The concentrations were high for cadmium, cobalt and lead and low or consistent with the natural background concentrations for the rest of the metals. However, the coastal habitats of the Red Sea coast of Yemen are still considered unpolluted, it is concluded that the cadmium cobalt and lead levels in surface seawaters are high and could have negative effects on marine life of the sites. Further studies are needed to characterize the sources fate, biogeochemical processes and impacts of these trace metals on coastal habitats and marine life of the region. Database: Water Resources Abstracts. ISSN: 1432-0495.

Shorley, Christopher. 2007. "In Search of Sheba: An Arabian Adventure Andre Malraux and Edouard Corniglion-Molinier, Yemen, 1934." *French Studies.* October 1. Volume 61, Issue 4, Pages 545-546.

Shukri, N. M. Basta, E. Z. Jami`at al-Qahirah and Kulliyat al-`Ulum. 1959. Petrography of the Volcanic Rocks of 'Aden. Descriptors: Aden -- Geology. Notes: Column 87-107.: ill. 22 x 36 cm. folded to 22 x 19 cm. Note(s): Title from caption. "Cario. Fouad I Universite. Faculty of Science, Bulletin, no. 35, 1959, p. 87-107.1." Photocopy (positive); each column represents 1 page of the original. Bibliography: p. 107. Other Titles: Bulletin (Jami`at al-Qahirah. Kulliyat al-`Ulum); no. 35. OCLC Accession Number: 18782321.

2009. Sieghart, Lia Carol. "Unilateral Clean Development Mechanism – an Approach for a Least Developed Country: The Case of Yemen." *Environ. Sci. & Policy.* 4. Volume 12, Issue 2, Pages 198-203. Descriptors: Clean Development Mechanism; Unilateral; Least developed country; Financing; Yemen. Abstract: Decision parameters prevailing in the market lead to a slim expression of interest of foreign investors for Clean Development Mechanism (CDM) projects in a bi- or multilateral design in Yemen. The Designated National Authority Secretariat in Yemen experiences the preference of Annex I entities of merely buying Certified Emission Reductions rather than investing in projects. Yemen's ability, like many least developed countries, to carry out unilateral CDM projects is moderate. Domestic project developers perceive difficulties in procuring underlying finance as key barrier in materializing CDM project activities in a unilateral design. The country remains trapped in a "catch 22 situation". International assistance through low interest loans and capacity building for domestic financial institutions tailored to CDM project activities may trigger the market. Aggravation can be assisted by amending the policies of Annex I countries, in consequence to allocate a substantial share of their procurement activities to Certified Emission Reductions from least developed

Geology of Yemen

countries. Acquisition programmes may give preference to projects from host countries not traditionally represented in the pool of attractive CDM destinations. ISSN: 1462-9011.

Simões, N., Apel, M. and Jones, D. A. 2001. "Intertidal Habitats and Decapod Faunal Assemblages (Crustacea: Decapoda) of Socotra Island, Republic of Yemen." *Hydrobiologia*. Volume 449, Pages 81-97. Descriptors: Decapod fauna; Indian Ocean; Intertidal habitats; Socotra Island; Zoogeography. Notes: Cited By (since 1996): 3. Abstract: The Socotra Archipelago, situated in the north-western part of the Indian Ocean at the entrance of the Gulf of Aden, has a unique zoogeographical position, as the transition between the Arabian and Red Seas and East African shores. The Socotran marine environment, however, is as yet poorly studied, with only sparse and incomplete reference to the field of crustaceans. The current work presents results from a survey of the intertidal decapod assemblages of Socotra Island conducted in spring 1999. The information from 185 sites sampled around the island is summarized in a map with short descriptions of representative intertidal habitats, their relative area and distribution. Both rocky shores and cobble beaches have the largest diversity of decapods. Sandy beaches are dominated mainly by *Ocypode saratan* and *Coenobita scaevola*, whilst rocky shores are dominated by *Grapsus albolineatus*, *G. tenuicrustatus*, *Plagusia tuberculata*, *Pachygrapsus minutus*, *Metopograpsus messor* and *Eriphia smithii*. In cobble beaches, *Pseudozium caystrus*, *Leptodius exaratus*, *Xanthias sinensis*, *Clibanarius signatus* and *Clibanarius virescens* are the most common species. *Cardisoma carnifex* and *Uca inversa* are common bordering mud flats and coastal lagoons. As fishing pressure is low, mud flats surrounding wadis and coastal lagoons host small undisturbed populations of *Scylla serrata* and *Fenneropenaeus indicus*. There is only a reduced number of mangrove trees and area of mangrove, most of which is already destroyed or under severe human and environmental pressure. The largest and most representative stand has an unusual structure: species diversity is strikingly low, it is disconnected from the sea by a sand bar or dune, and is completely dry. Interesting zoogeographical findings are detailed, and a list of intertidal decapod fauna, relating each species to its common habitat is presented. This list is compared with previous studies, and other intertidal decapod assemblages from the Arabian Gulf, Red Sea and East Africa. Database: SCOPUS. ISSN: 00188158.

Slater, Maj S. M. 1981. "*Radfan*." *British Army Review*. December 1981. Issue No. 69, Pages 16-19.

Smith, G.V.; Al-Mooji, Y.A. 1987. Groundwater Development in the Tihama Coastal Plain. Proceedings of the subregional expert consultation on wadi development for agriculture in the natural Yemen, Technical Background Papers: International 11, Aden, PDR Yemen. Abstract: The Tihama Coastal Plain, with an estimated 5,000 km² of cultivated land, has become a prime target for agricultural development in the Yemen Arab Republic. About 30% (140,000ha) of this fertile land is located within the alluvial fans formed by the seven major wadis in the area. OCLC: 20642235.

Smith, L. J. 1987. "Sewage Stabilisation Ponds in Arabia and Kenya." *Water Science and Technology*. Lisbon, Port. Volume 19, Issue 12, Pages 345-347. Descriptors: Sewage Treatment; Sanitary Engineering - Developing Countries. Notes: Compilation and indexing terms, Copyright 2009 Elsevier Inc. undefined; undefined; undefined; undefined; undefined. Abstract: Experience of pond design and operation in Arabia and Kenya is described. In Saudi Arabia major stabilization pond installations were built for the Three Cities Project at Hofuf, Buraidah and Qatif. Summaries of results, comment on performance achieved and implications for future stabilization pond design are noted. Recently commissioned ponds in Aden for both domestic and industrial sewages are featured and points of interest indicated. The basis of the most recent

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designs now ready for tender for applications in Aden and Seiyun, P. D. R. Yemen are provided. Conclusions are drawn regarding the future potential of pond treatment for disposal of waste water for re-use in irrigation. ISSN: 0273-1223.

SOGREAH, 1979. Wadi Hadramaut feasibility study. Interim report. Water resources - Land use - Land classification. SOGREAH. Grenoble-France.

Sogreah Consulting Engineers, and Hunting Surveys. *Feasibility Study of the Wadi Siham Basin: Report on Electrical Resistivity Sounding Survey*. [S.l.]: [s.n.], 1979. "Yemen Arab Republic, Ministry of Agriculture, Tihama Development Authority. OCLC: 66855026.

Sogreah Consulting Engineers, and Hunting Surveys. "Water scarcity and climate change adaptation for Yemen's vulnerable communities". *Local Environment*. 16, no. 5: 473-488. Issn: 1354-9839. Oclc: 741307135.

Sohlman, Eva. 2004. "Ecology: A Bid to Save the 'Galápagos of the Indian Ocean'." *Science*. March 19. Volume 303, Issue 5665, Pages 1753.

Sokolowski, A. Bawazir, A. and Wolowicz, M. 2004. Trace Metals in the Brown Mussel *Perna perna* from the Coastal Waters off Yemen (Gulf of Aden): How Concentrations are Affected by Weight, Sex, and Seasonal Cycle. *Arch. Environ. Contam. Toxicol.* Volume: 46, no. 1, page(s): 67-67-80. Abstract: The effects of seasonal cycle, sex of individuals, and changes of soft tissues weight on accumulated trace metal concentrations (Cd, Cu, Fe, Mn, Pb, Zn) were examined in the brown mussel *Perna perna* collected monthly from a natural rocky habitat in the coastal waters off Yemen, the Gulf of Aden, for a period of ten months. Basic hydrological parameters were recorded simultaneously. All metals analyzed displayed seasonal fluctuations with different temporal patterns and variable amplitudes. Similar seasonal cycles were observed for Cu, Mn, and Pb with an increase in accumulated concentration during the rainy period (NE monsoon), and a decrease thereafter. The concentrations of Cu, Mn, and partially Pb appeared to be related to environmental changes, the concentration of Pb possibly also being related to changes in body weight. Accumulated concentrations of Cu and Mn thus seem to reflect actual metal bioavailability in the ecosystem quite efficiently. The tissue levels of Fe and Cd changed inversely to fluctuations in body weight with additional variation due to monsoon-related environmental changes. The behaviors of Fe and Cd are therefore driven by seasonally changing body weight with a considerable contribution of external factors including fluctuations in hydrological conditions and metal exposure. The Zn concentrations tended to increase gradually throughout most of the year regardless of its concentration in the environment. Zinc is considered to be mainly regulated by physiological mechanisms in the mussel, making its accumulated metal concentration independent to some degree of environmental levels. Significant differences in trace metal concentrations between sexes (in favour of females) might have resulted from more intense formation of reproductive tissues and metal accumulation in sexual products of females during the prespawning and spawning periods. ISSN: 0090-4341. Database: Technology Research Database. URL:

<http://search.proquest.com/docview/33939684?accountid=12084>.

Speece, Mark. 1982. *Draft environmental report on Yemen (Yemen Arab Republic)*. Washington, D.C. U.S. National Committee for Man and the Biosphere, Dept. of State. Notes: "February 1982." "Funded by A.I.D., Bureau of Science and Technology under SA/TOA 1-77." "National Park Service Contract No. CX-0001-0-0003." Description: i, 208 pages; ill., maps; 29 cm. [prepared by the Arid Lands Information Center Office of Arid Lands Studies, University of Arizona; Mark Speece, compiler]. OCLC: 14872538.

Geology of Yemen

Spoor, G. and Berry, R.H. 1990. "Dryland Farming Tillage and Water-Harvesting Guidelines for the Yemen Arab Republic." *Soil and Tillage Research SOTRD5* Vol.16. No. 1/2, p 233-244. April. Pages 14 ref. Descriptors: Dry farming; Tillage; Water harvesting; Yemen; Crop yield; Economic evaluation; Plowing; Semiarid climates; Soil surfaces; Traffic. Abstract: Moldboard plowing to 400-500 mm constitutes the standard primary cultivation practice on the medium textured soils used for dryland crops in the semiarid intermontane plains of the Yemen Arab Republic. The justification for this practice is examined and guidelines for the future development of tillage and water-harvesting practices are identified based on the physical characteristics of the different soil horizons. Major benefits, in terms of increased and more reliable crop production, could accrue through increased water availability from developing flexible water harvesting systems and through bringing more structurally stable subsurface soil horizons onto the surface. The development of controlled-traffic systems within the water-harvesting systems would greatly assist in reducing tillage costs. The identification of a satisfactory alternative to the moldboard plow for perennial rhizomatous weed control would help maintain the improved soil surface condition. Database: Water Resources Abstracts.

Sporry, R. J. 1991. "Groundwater Exploration on the Mountain Plains of Dhamar and Rada in the Yemen Arabic Republic; Application of Geophysics to Water Prospecting in Arid and Semi-Arid Areas; Proceedings of the 1990 International Symposium." *Geoexploration*. Feb. Volume 27, Issue 1-2, Pages 135-164. Descriptors: Arabian Peninsula; Asia; Dhamar; electrical methods; electrical sounding; electromagnetic methods; exploration; geophysical methods; geophysical surveys; ground water; Rada; resistivity; resources; surveys; Yemen. References: 8; illus. incl. sects., geol. sketch maps. Database: GeoRef. ISSN: 0016-7142.

"Stalagmite shows Climate Changes." 2003. *Global Environmental Change Report*. 11. Volume 15, Issue 12, Pages 8-9. Descriptors: Stalactites & stalagmites; Climatic changes; Universities & colleges; Ice; Yemen (Republic); United States; Greenland; Indian Ocean. Abstract: This article cites a study on stalagmite from Socrata Island, Yemen, in the Indian Ocean to determine climate changes by researchers from various universities of the United States. The study reveals precipitation patterns similar to the patterns observed in a previous study of ice cores from Greenland. The results from the Socrata Island research were able to confirm the findings of rapid climate changes estimated from the Greenland ice cores. The correlation between the Indian Ocean's hydrological cycle and temperatures of high latitudes showed that when there was cooling in the high latitudes, a decrease in precipitation was observed in the Indian Ocean. ISSN: 1049-9083.

Stangalino, G., Aumento, Fabrizio, Al Masri, Abdellatif, Noaman, Towfik and Lacy, Robert G. (chairperson). 1982. "The Circular Vertical Sounding Method Applied to the Exploration of the Dhamar-Rada'a (Y.A.R.) Geothermal Area; Geothermal Energy; Turn on the Power!" *Transactions - Geothermal Resources Council*. Geothermal Resources Council, Davis, CA. Volume 6, Pages 169-172. Descriptors: Arabian Peninsula; Asia; Dhamar-Rada'a; electrical logging; exploration; foliation; fractures; geophysical surveys; geothermal fields; resistivity; schistosity; sounding; surveys; well-logging; Yemen. References: 4; illus. incl. sketch map. Database: GeoRef. ISBN: 0934412561.

Steenbergen, Frank. 2006. "Promoting Local Management in Groundwater." *Hydrogeol. J. Springer-Verlag*. Mar. Volume 14, Issue 3, Pages 380-391. Descriptors: Article Subject Terms: Costs; Geohydrology; Groundwater; Groundwater Management; Local Governments; Monitoring; Planning; Regulations; Training; Article Geographic Terms: India; Pakistan; Yemen. Abstract: There is a strong case for making greater effort to promote local groundwater

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management-in addition to other measures that regulate groundwater use. Though scattered, there are several examples-from India, Pakistan, Yemen and Egypt-where groundwater users effectively self-imposed restrictions on the use of groundwater. There are a number of recurrent themes in such spontaneously-developed examples of local regulation: the importance of not excluding potential users; the importance of simple, low transaction cost rules; the power of correct and accessible hydrogeological information; the possibility of making more use of demand and supply management strategies; and the important supportive role of local governments. The case is made, using examples, for actively promoting local groundwater management as an important element in balancing groundwater uses. Two programmes for promoting local groundwater management in South India are described-one focussing on participatory hydrological monitoring, and one focussing on micro-resource planning and training. In both cases the response was very positive and the conclusion is that promoting local groundwater regulation is not difficult, costly or sensitive and can reach the necessary scale quickly. Database: Water Resources Abstracts. ISSN: 1435-0157.

Stern, R. J., Ali, K. A., Liegeois, J. P., Johnson, P. R., Kozdroj, W. and Kattan, F. H. 2010. “{Degrees}Distribution and Significance of Pre-Neoproterozoic Zircons in Juvenile Neoproterozoic Igneous Rocks of the Arabian-Nubian Shield.” *American Journal of Science*. November 1. Volume 310, Issue 9, Pages 791-811. Abstract: Igneous rocks of the Arabian-Nubian Shield (ANS) have lithologic associations (ophiolites, calc-alkaline igneous rocks, immature sediments) and radiogenic isotopic compositions consistent with formation as juvenile continental crust as a result of accreting intraoceanic arc systems during 880 to 630 Ma, with crustal differentiation continuing until [~]570 Ma. ANS igneous rocks locally contain zircons with ages that are much older than this, leading some researchers to infer the presence of pre-Neoproterozoic crust at depth in spite of Nd isotopic evidence that ANS crust is overwhelmingly juvenile. The ANS is flanked by pre-Neoproterozoic crust but geochronology and isotopic compositions readily identify such tracts. We have compiled U-Pb zircon ages for 302 samples of ANS igneous rocks that have been analyzed for the age of individual zircons (2372 ages) and find that a significant proportion ([~]5%) of these have ages older than 880 Ma (zircon xenocrysts). Zircon xenocrysts are more common in volcanic than plutonic rocks and mafic relative to felsic igneous rocks. Four explanations are considered: 1) contamination during sample processing; 2) involvement of pre-Neoproterozoic crust; 3) incorporation of detrital zircons from sediments; and 4) inheritance from a mantle source. Possibilities 1 and 2 are discounted, and we conclude that the presence of pre-880 Ma zircon xenocrysts in ANS igneous rocks with mantle-like isotopic compositions indicates either incorporation of sediments or inheritance from the mantle source region, or both.

Stevens, Lt Col T. M. P. 1965. “Operations in the Radfan.” *Royal United Services Institute for Defence Studies Journal*. November 1965. Volume 110, Issue No. 640, Pages 335-349. OCLC: 1876550.

Sturgess, M., Wharton, R. J. and Maycock, I. D. 1995. “A Petroleum System in Block 18, Marib-Jawf Basin, Yemen; American Association of Petroleum Geologists 1995 Annual Convention.” *Annual Meeting Expanded Abstracts - American Association of Petroleum Geologists*. American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, Tulsa, OK. Mar. Volume 4, Pages 93. Descriptors: Alif Formation; Arabian Peninsula; Asia; basement; carbon; carbonate rocks; chemically precipitated rocks; clastic rocks; claystone; Cretaceous; deep-water environment; deltaic environment; depositional environment; evaporites; faults; fluvial environment; fractures; genesis; Gondwana;

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Jurassic; kerogen; Lam Formation; Lower Cretaceous; Marib-Jawf Basin; maturity; Meem Formation; Mesozoic; migration; natural gas; normal faults; organic carbon; organic compounds; organic materials; permeability; petroleum; porosity; reservoir rocks; sandstone; sedimentary rocks; source rocks; structural traps; thickness; traps; Upper Jurassic; Yemen. Database: GeoRef. ISSN: 0094-0038.

Sullivan, Patrick J. Agardy, Franklin J. and Clark, James J. J. 2005. *The Environmental Science of Drinking Water*. Butterworth-Heinemann. Page(s): 1-384. Descriptors: Environmental Science (General); Public Health and Health Policy; Food Science; Management, Monitoring, Policy and Law; Water Science and Technology. Abstract: In today's chemically dependent society, environmental studies demonstrate that drinking water in developed countries contains numerous industrial chemicals, pesticides, pharmaceuticals and chemicals from water treatment processes. This poses a real threat. As a result of the ever-expanding list of chemical and biochemical products industry, current drinking water standards that serve to preserve our drinking water quality are grossly out of date. *Environmental Science of Drinking Water* demonstrates why we need to make a fundamental change in our approach toward protecting our drinking water. Factual and circumstantial evidence showing the failure of current drinking water standards to adequately protect human health is presented along with analysis of the extent of pollution in our water resources and drinking water. The authors also present detail of the currently available state-of-the-art technologies which, if fully employed, can move us toward a healthier future.* Addresses the international problems of outdated standards and the overwhelming onslaught of new contaminants. * Includes new monitoring data on non-regulated chemicals in water sources and drinking water.* Includes a summary of different bottled waters as well as consumer water purification technologies. ISBN: 0750678763.

Svetov, B. S. and Ageev, V. V. (Ageyev, V.V.). 1996. "Electromagnetic Sounding of Frequency Dispersive Media; 58th EAGE Conference and Technical Exhibition; Extended Abstracts; Volume 1, Oral and Poster Presentations; Geophysical Division." Conference and Technical Exhibition - European Association of Geoscientists and Engineers. European Association of Geoscientists and Engineers (EAGE), International. Volume 58, Descriptors: Arabian Peninsula; Asia; case studies; electrical conductivity; electromagnetic methods; electromagnetic waves; frequency; frequency sounding; geophysical methods; geophysical surveys; layered materials; mathematical models; petroleum; petroleum exploration; polarization; salt domes; surveys; transient methods; Yemen. Database: GeoRef. ISBN: 907378107X.

Swagman, Charles F. 1989. "FIJAc: Fright and Illness in Highland Yemen." *Soc. Sci. Med.* Volume 28, Issue 4, Pages 381-388. Descriptors: Middle East; Yemen; folk illness; medical anthropology. Abstract: Sudden fright, 'fijac', has played an important role in the traditional explanatory models of illness experiences in highland Yemen. Fijac is quite similar to other examples of the fright illness taxon in that it is a folk-illness category that is attributed to a wide variety of underlying conditions. It is argued that given the extremely labile symptomatology, fijac, like other examples of the fright illness taxon, does not constitute a culture-bound psychiatric syndrome. Based on analysis of case studies and preliminary survey data, fijac appears to be much more common among folk etiologies offered by Yemeni women than men. It is suggested that this social profile might be explained by changes in the distribution of medical knowledge in Yemen. With the rapid rate of social change and the increased exposure to cosmopolitan medicine resulting from internal development of cosmopolitan health care and international labor migration, men have supplemented their traditional explanatory models with

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alternatives drawn from cosmopolitan medicine. Succumbing to illness as a result of fright is contradictory to the male ideal of the courageous tribesman; alternative explanatory models that do not challenge this ideal self predominate. By contrast, the Yemeni value system defines women and children as vulnerable and weak; therefore, being subject to the impact of fright is consistent with youth and the cultural definition of the female self. ISSN: 0277-9536.

Swanjord, Don Edward. *A Bibliography of Agriculture and Rural Life in Yemen*. 1986. Abstract: Intended as a key to current work in agriculture in Yemen, this bibliography cites more than 520 resources produced since 1963 including monographs, journal articles, theses and dissertations, conference papers, case studies, reports, proposals, surveys, bibliographies, and United Nations publications. Foreign language materials in German, French, and Russian are included. Listed alphabetically by authors, the entries provide, when applicable, title, date and place of publication, publisher, volume number, and pagination. A detailed subject index cross references materials to author and page of the entry. The 28 index subject categories and number of entries under each are agriculture--beekeeping (4); agriculture--coffee (9); agriculture--cotton (5); agriculture--fisheries (1); agriculture--forestry (12); agriculture--grapes (3); agriculture--horticulture (6); agriculture--Qat (16); agriculture--appropriate technology (3); animal production (24); bibliographies (1); botany--general (29); botany--historical (13); climatology (8); crops (25); cultural background (47); economic development (52); agricultural education and extension (30); entomology and plant protection (35); agricultural history (12); management and administration studies (8); marketing studies (21); population (6); soils (24); statistics (3); survey and community studies (49); water resources (46); and women and development (21). OCLC: 425421707.

Szefer, P., Ali, A. A., Ba-Haroon, A., Rajeh, A. A., Geldon, J. and Nabrzyski, M. 1999. "Distribution and Relationships of Selected Trace Metals in Molluscs and Associated Sediments from the Gulf of Aden, Yemen." *Environmental Pollution*. Volume 106, Issue 3, Pages 299-314. Abstract: Concentrations of Cd, Pb, Zn, Cu, Ni, Co, Cr, Mn and Fe in the soft tissue of *Turbo coronatus*, *Acanthopleura haddoni*, *Ostrea cucullata* and *Pitar* sp., as well as in associated surface sediments (bulk and bioavailable metal concentrations) from the Gulf of Aden, Yemen, were determined by atomic absorption spectrophotometry method. Large differences between size-classes of molluscs in metal concentrations were recorded. Significant spatial differences in metal concentrations in both the soft tissue of the molluscs and associated sediments studied were mostly identified. Statistically significant correlations ($p < 0.01$) between concentrations of selected metals were observed. A slope of the linear regression is significantly higher than unity for Fe (9.91) and Cd (3.45) in *A. haddoni* and for Ni (4.15) in *T. coronatus*, suggesting that the bioavailability of these metals is disproportionally increased with a degree of enrichment of the sediments in Fe, Cd and Ni, respectively. A slope constant approximating to unity (1.14) for Cu in *A. haddoni* relative to its concentration in sediment extract implies that bioavailability of this metal proportionally increased with growing concentrations of its labile forms in the associated sediment. The degree of contamination of Gulf of Aden waters by the metals studied is discussed and the potential ability of molluscs, especially *A. haddoni* and *T. coronatus*, as biomonitors of metallic pollutants is postulated. ISSN: 02697491. URL: [http://dx.doi.org/10.1016/S0269-7491\(99\)00108-6](http://dx.doi.org/10.1016/S0269-7491(99)00108-6).

Szefer, P., Geldon, J., Ali, A. A., Bawazir, A. and Sad, M. 1997. "Distribution and Association of Trace Metals in Soft Tissue and Byssus of Mollusc *Perna Perna* from the Gulf of Aden, Yemen." *Environ. Int.* Elsevier Science Ltd: Oxford, United Kingdom. Volume 23, Issue 1, Pages 53-61. Descriptors: Seawater; Marine pollution; Metals; Ocean habitats; Oceanography;

Tissue. Abstract: Concentrations of Cd, Pb, Zn, Cu, Mn, and Fe in soft tissue and byssal threads of *Perna perna* from the Gulf of Aden, Yemen, were determined by atomic absorption spectrophotometric (AAS) method. Significant inter-regional differences in the metal concentrations studied in both soft tissue and byssus were identified. The concentration of Cd was an order of magnitude greater in soft tissue than in byssal threads. Statistically significant correlations ($p < 0.01$, $p < 0.05$) between concentrations of selected metals were observed. The spatial distribution of Cu in byssal threads was similar to that in soft tissue. The data indicate that sewage input (at Sira Island) is the most likely anthropogenic source of Cu and Mn. The concentration of tissue Cd at the Fuqum area was the highest among the other stations. Although the Fuqum area is off the harbour, water from a fishery refrigerator and some sewage outflow flux into the sea. It is assumed that the presence of the area near the strait of Bab Al-Mandab, where the water coming from both the Red Sea and the Indian Ocean mixes, especially during the seasonal monsoons, is responsible mainly for elevated tissue Cd concentrations in the molluscs. ISSN: 0160-4120. URL: [http://dx.doi.org/10.1016/S0160-4120\(96\)00077-3](http://dx.doi.org/10.1016/S0160-4120(96)00077-3).

Geology of Yemen

T

Tahir, T. and Al Jailany, J. 2000. Involvement of the Social Fund for Development (SFD) in Low Cost Simple Technology Water Supply and Sanitary Systems in Yemen: A Case Study. Database: COS Conference Papers Index. URL:

<http://search.proquest.com/docview/39215812?accountid=12084>.

Taylor, George E. Chemonics and International Consulting Division. 1981. Reconnaissance Evaluation of Potential Groundwater Sources for Rural Water Supply Development in Hajja Governorate, Yemen Arab Republic. Washington, D.C., U.S.A: Chemonics, Place: United States; District of Columbia; Washington. Descriptors: Groundwater - Yemen (Republic); Water resources development -- Yemen (Republic); Rural development -- Yemen (Republic); Yemen (Republic) -- Rural conditions. Notes: 17 leaves; 28 cm. Cover title. OCLC Accession Number: 47247526.

Taylor, George E. Chemonics and International Consulting Division. 1981. Reconnaissance Evaluation of Groundwater Development Problems for Rural Water Supply in Hodeidah Governorate, Yemen Arab Republic. Washington, D.C., U.S.A: Chemonics, Place: United States; District of Columbia; Washington. Descriptors: Groundwater -- Yemen (Republic); Water resources development -- Yemen (Republic); Rural development -- Yemen (Republic); Yemen (Republic) -- Rural conditions. Notes: 15 leaves; 28 cm. Cover title. Includes bibliographical references. OCLC Accession Number: 47247527.

Taylor, George E. Chemonics and International Consulting Division. 1981. Review and Evaluation of the Current Hydrogeological Activities of the Public Services Department, the Confederation of Yemeni Development Cooperatives. Washington, D.C. Chemonics, Place: United States; District of Columbia; Washington. Descriptors: Groundwater -- Yemen (Republic); Water resources development -- Yemen (Republic); Hydrogeology -- Yemen (Republic). Notes: 9 leaves; 28 cm. Cover title. OCLC Accession Number: 47247529.

“Tenders opened for first explorative well of geothermal energy.” 2010. Yemen Today. August 28, 2010. Abstract: Envelopes of tenders were opened Tuesday for the drilling of the first exploratory well for geothermal energy in Yemen, in Allisi area, Dhamar province. This tender comes within the geothermal energy’s project to assess geothermal energy resources and utilization for power generation. The project is in collaboration with the Energy Research Center in Italy and the Natural Sciences Institute in Germany, with funding from the Global Environment Unit of the United Nations. Chairman of the Geological Survey and Mineral Resources Board (GSMRB) Ismail al-Janad explained to Saba that the board has begun the implementation of the project. He pointed out that the board carried out a survey for places where geothermal energy sources might be found in Yemen. There was a total of about 100 places. The survey collected samples of hot water and gas that were chemically analyzed at the Italian University of Florence during 2001-2006. “The project of thermal energy conducted, during 2007-2010, geological, geothermal, geophysical and geochemical studies and measured Radon gas and prepared a hydrological and hydro geological report in the first promising area in Allisi area in Dhamar”, al-Janad said. The results of the drilling will be an opportunity for Yemen to participate in global projects for the exploration of thermal energy, which is supported by donors and to access to greater support for drilling other exploratory wells. URL: <http://www.yobserver.com/business-and-economy/10019555.html>.

Tesco-Viziterv-Vituki; Food and Agriculture Organization of the United Nations and United Nations Development Programme. 1971. Yemen Arab Republic, Land Tenure and Water Rights: Report. Budapest: Tesco-Viziterv-Vituki. Page(s): 33. Descriptors: Agricultural

Geology of Yemen

engineering -- Yemen -- Wadi Zabid region; Land tenure -- Yemen -- Wadi Zabid region; Water rights -- Yemen -- Wadi Zabid region. Notes: xiv; ill., map. Note(s): Report prepared for the Food and Agriculture Organization of the United Nations acting as executing agency for the United Nations Development Programme. At head of title: Survey of the agricultural potential of the Wadi Zabid. "AGL:SF/YEM 1, Technical Report 9." Includes bibliographical references (p. 33). Other Titles: Survey of the agricultural potential of the Wadi Zabid, Yemen Arab Republic, land tenure and water rights. Responsibility: by Tesco-Viziterv-Vituki. OCLC Accession Number: 5242557.

Tesco-Viziterv-Vituki; Food and Agriculture Organization of the United Nations and United Nations Development Programme. 1971. Yemen Arab Republic, Hydrology and Hydrogeology: Report. Budapest: Tesco-Viziterv-Vituki. Page(s): 149. Descriptors: Agricultural engineering -- Yemen -- Wadi Zabid region; Hydrology -- Yemen -- Wadi Zabid region; Hydrogeological surveys. Notes: xvii; ill., maps (folded in pocket); Note(s): Report prepared for the Food and Agriculture Organization of the United Nations acting as executing agency for the United Nations Development Programme. At head of title: Survey of the agricultural potential of the Wadi Zabid. "AGL:SF/YEM 1, Technical Report 2." Includes bibliographical references (p. 95-96). Other Titles: Survey of the agricultural potential of the Wadi Zabid, Yemen Arab Republic, hydrology and hydrogeology. OCLC Accession Number: 5242506.

Tesco Viziterv-Yituki (firma), and FAO. Supplementary Assistance for the Survey of the Agricultural Potential of the Wadi Zabid, Yemen Arab Republic: Technical Report 2: Appendices: Development of Irrigated Agriculture. Budapest: Tesco Viziterv-Yituki, 1973. Report prepared for the Food and Agriculture Organization of the United Nations; by Tesco Viziterv-Yituki. OCLC: 475804079.

Thabet, A. A. K., Abdulrab, A., Awdhaly, S., Amrani, F. and Al-Jaber, N. 2008. "Knowledge and Performance of the Universal Precautions among Yemeni Nurses." *International Journal of Infectious Diseases*. 12. Volume 12, Issue Supplement 1, Pages e353-e353. Descriptors: Universal precautions; Yemen. ISSN: 1201-9712.

Thoue, Frédéric, Vidal, Gérard and Gratier, Jean-Pierre. 1997. "Finite Deformation and Displacement Fields on the Southern Yemen Margin using Satellite Images, Topographic Data and a Restoration Method." *Tectonophysics*. 11/30. Volume 281, Issue 3-4, Pages 173-193. Descriptors: rifting; Yemen; satellite imagery; digital elevation model; strained structures restoration; displacement fields. Abstract: Geological interpretations of processed satellite images and structural field measurements were used to calculate the amount of extension and the finite displacement field of two stretched areas located on the northern margin of the Gulf of Aden, in Yemen. This calculation was done by a comparison between the deformed and the undeformed states of each studied area. The structural setting established from satellite-image interpretations and fieldwork yields a detailed geometry of the deformed state. The undeformed state was reconstructed from reference layers chosen on satellite images from folded and faulted geological markers. The strike and dip of those layers were computed directly from dip indicator measurements, identified on three-dimensional (3D) realistic views of the sites (derived from SPOT stereoscopic views and topographic data) and controlled by field measurements. From the previous structural data, a numerical model of the deformed state was prepared with respect to the structural setting. The two stretched areas were then restored to their undeformed state successively by (1) an unfolding method (use of the UNFOLD program on each folded piece bounded by faults), and (2) a best-fit method (fitting along the boundary of the unfolded pieces). The comparison between the deformed and undeformed states leads to quantifying the amount of

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strain and to establishing the total finite displacement field. The results point to differences in the amount of extension and in the finite displacement field between the two areas studied. Within the regional context of the Afar triple junction kinematics, this leads to the conclusion that there was an early extensional tectonic phase recorded on the southern Yemen margin, probably linked to the earlier opening of the Gulf of Aden. ISSN: 0040-1951.

Tibbitts, G C, Jr (investigator); Aubel, James (investigator) and Beall, R. M. (investigator). 1983. "Yemen Arab Republic." United States: U. S. Geological Survey, Reston, VA, United States. U.S.Geological Survey Professional Paper. 1983. Volume: P 1375, page(s): 291. Descriptors: Amran Valley; Arabian Peninsula; Asia; geophysical surveys; ground water; hydrogeology; hydrology; imagery; Landsat; remote sensing; surveys; USGS; Yemen. Notes: Publications of the U. S. Geological Survey; ISSN: 1044-9612. Database: GeoRef. URL: http://pubs.er.usgs.gov/djvu/PP/pp_1375.djvu.

Tibbitts, G. C., Jr and Aubel, James. 1980. "Ground-Water Resources Investigation in Amran Valley, Yemen Arab Republic." United States: U. S. Geological Survey, Reston, VA, United States. Open-File Report - U.S.Geological Survey. 1980. Volume: OF 80-0774, page(s): 144. Descriptors: Amran Valley; Arabian Peninsula; Asia; data; economic geology; exploration; geochemistry; ground water; hydrochemistry; hydrogeologic maps; maps; surveys; USGS; water resources; well-logging; Yemen. Notes: USGS, Publications of the U. S. Geological Survey; References: 17; illus. incl. 16 anal., 7 tables, charts, sketch map; MP: Scale: 1:100,000. Type: hydrogeologic map. ISSN: 0196-1497. Database: GeoRef. OCLC Accession Number: 1981-052447.

Tibbitts, G.C., Jr (investigator). 1978. "Ground-Water Survey Activities." United States: U. S. Geological Survey, Reston, VA, United States. U.S.Geological Survey Professional Paper. 1978. Volume: P 1100, page(s): 351. Descriptors: Amran Valley; Arabian Peninsula; Asia; ground water; hydrogeology; international cooperation; Sana Basin; surveys; Yemen. ISSN: 1044-9612. Database: GeoRef. OCLC Accession Number: 1978-047543. URL: http://pubs.er.usgs.gov/djvu/PP/pp_1100.djvu.

Tibbitts, GCJr and Aubel, J. 1980. "Groundwater Resources Investigation in the Amran Valley, Yemen Arab Republic." Geological Survey Open-File Report 80-774, Pages 17 Ref. Descriptors: Groundwater availability; Arid lands; Foreign research; Yemen Arab Republic; Amran Valley; U.S. Agency for International Development; Evaluation; Geologic formations; Aquifer characteristics; Water table; Transmissivity; Storage capacity; Water level fluctuations; Pumping; Drawdown; Water yield; Water use; Water quality; Chemical analysis; Water resources development; Planning. Abstract: A program of hydrologic studies and exploratory drilling was conducted intermittently between 1974 and 1978 to evaluate the water-bearing properties of the unconsolidated alluvial sediments and associated rocks in the semi-arid Amran Valley basin, an 800-square-kilometer area in north-central Yemen Arab Republic. Inventory data from 395 wells were compiled, observation well and rain-gage networks were established and 16 standard complete chemical analyses were made for samples from selected wells. The water resources of the area were overexploited. The chemical quality of the water is generally good. Four aquifer tests were run to determine transmissivity and storage characteristics. The pumping tests show that groundwater occurs under semi-confined leaky-aquifer conditions in the valley fill. Wells drilled in the alluvial fill of the south-central part of the valley have the highest yields. Wells penetrating the limestone and volcanic rocks generally have little or no yield except in fracture zones. Basalt flows occur interbedded with the wadi alluvium at several depths.

Geology of Yemen

Cropping out rocks in the Amran Valley range in age from late Jurassic to Holocene. Database: Water Resources Abstracts. OCLC Accession Number: 8009169.

Timberlake, R. S. 1988. "Traffic Modeling Techniques for the Developing World: Case Studies." *Transp. Res. Rec. Issue 1167*, Pages 28-34. Descriptors: Transportation; Technological Forecasting; Urban Planning--Transportation. Abstract: Traffic models have been used for transportation planning in the Western World for more than 30 years. Recently, attempts have been made to adapt these techniques, which generally originated in developed countries, to suit the needs of the developing world. In adapting the original models, it has usually been necessary to change them, sometimes considerably. The reasons why Western-type traffic models may not be applicable to the developing world are examined. Case studies of rural and urban environments in the Yemen Arab Republic, Sudan, Qatar, and Oman are used as examples, and suggestions are made for changing the Western-type models to better suit developing nations. ISSN: 0361-1981.

Tipton and Kahnbach. Inc. (1974). *Wadi Zabid Groundwater Potential, Tihama Development Project*, TDA, Denver, United States. iv, 44p : fig ; 30cm. oclc: 704165718.

"Towards a Billion Barrels; an Overview of the Yemen Masila Block; Part Two, Current Operations, Reserves and Development Technology; GeoCanada 2000; the Millennium Geoscience Summit." 2000. Abstract Volume (Geological Association of Canada). Geological Association of Canada, Waterloo, ON. Volume 25, Descriptors: Arabian Peninsula; Asia; brackish-water environment; carbonate rocks; clastic rocks; coastal environment; Cretaceous; depositional environment; development; faults; fluvial environment; geophysical methods; intertidal environment; Jurassic; Lower Cretaceous; Masila Block; Mesozoic; normal faults; oil and gas fields; paleorelief; passive margins; petroleum; petroleum exploration; production; Qishn Formation; reactivation; reserves; reservoir rocks; sandstone; sea-level changes; sedimentary rocks; seismic methods; structural controls; topography; transgression; Yemen. Notes: illus. Database: GeoRef. ISSN: 1716-6098.

Turner, JR and Stockholm University, Sweden CORDIO/SAREC Marine Science Program. 1999. *Status Report Socotra Archipelago*. Stockholm (Sweden): CORDIO. Coral Reef Degradation in the Indian Ocean: Status Reports and Project Presentations 1999. Page(s): 63-64. Descriptors: Biological damage; Biotopes; Bleaching; Coral reefs; Degradation; Ecosystem disturbance; Recreation; Reef fisheries; Socioeconomic aspects; Water temperature; Article Geographic Terms: Yemen, Socotra; Marine. Abstract: Socotra Coral reefs are made up of *Acropora formosa*, *Acropora clathrata*, the environment is pristine, except for two small towns and fishing villages. Data indicate that Socotra was affected by rise in temperature during the El-Nino hence affecting the coral reefs ecosystem. Survey carried out indicates that massive corals surrounding Socotra were dead. Many soft corals, especially *Sinularia*, were bleached but alive. Notes: TR: KE0000028. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. OCLC Accession Number: 4661670.

Tutwiler, Richard N. 1980. *Social Aspects of Water Distribution and Consumption in a Subdistrict of Mahweit Province*. Descriptors: Water-supply -- Yemen (Republic) -- Mahwit (Province); Manuscript. Notes: 25 leaves; 28 cm. "February, 1980." OCLC Accession Number: 187316111.

Tutwiler, Richard N. 1978. *Site Reports, Villages of Tina' Am, Qumama, and Dahlil*. Descriptors: Water-supply, Rural -- Yemen; Residential water consumption -- Yemen; Rural development projects -- Yemen; Manuscript. Abstract: Site report: village of Tina'am -- Site

Geology of Yemen

report: village of Qumama. Notes: 7, 5 leaves; 28 cm. Title from subject line of memorandum. Memorandum from Richard Tutwiler to Herb Blank, dated February 18, 1978. Third site report for village of Dahlil is missing. OCLC Accession Number: 187860549.

Tutwiler, Richard N. 1978. Report on Small Water Projects in Yemen: Aspects of Social Impact and Recommendations for Future Actions: Submitted Under Contract Number AID-279-78-414, March 2, 1978. Descriptors: Water-supply, Rural -- Yemen; Residential water consumption -- Yemen; Rural development projects -- Yemen; Manuscript. Abstract: The nature of small water projects -- The implementation of small water projects -- Survey of socio-economic aspects of small water projects -- Conclusions: impact of projects -- Recommendations for future actions -- Site report: village of Qumama -- Site report: village of Magrish -- Site report: village of Tina'am -- Site report: village of Dahlil -- Site report: village of Manakha. Notes: 12, [2], 5, 6, 7, 4, 5 leaves; 28 cm. Note(s): Title from cover. Reproduction: Photocopy. OCLC Accession Number: 187860786.

U

Ukstins Peate, Ingrid, Baker, Joel A., Kent, Adam J. R., et al. 2003. "Correlation of Indian Ocean Tephra to Individual Oligocene Silicic Eruptions from Afro-Arabian Flood Volcanism." *Earth Planet. Sci. Lett.* 6/30. Volume 211, Issue 3-4, Pages 311-327. Descriptors: Yemen; Ethiopia; Indian Ocean; flood volcanism; silicic volcanism; ignimbrite; tephrochronology; in situ Pb isotope laser ablation. Abstract: Widespread silicic pyroclastic eruptions of the Oligocene Afro-Arabian flood volcanic province (ignimbrites and airfall tuffs) produced up to 20% of the total flood volcanic stratigraphy ($>6 \times 10^4$ km³). Volumes of individual ignimbrites and tuffs exposed on land range from ~ 150 to >2000 km³ and eight major units (15–100 m thick) were erupted in 500 km distant; and (b) to two deep sea ash layers sampled by ODP Leg 115 in the Indian Ocean ~ 2700 km to the southeast. This correlation is based on whole rock analyses of silicic units for isotope ratios (Pb, Nd) and rare earth element compositions, in conjunction with novel in situ Pb isotope laser ablation multicollector inductively coupled plasma mass spectroscopy analysis of groundmass and glass shards. Compositional diversity preserved on the scale of individual ash shards in these deep sea tephra layers record chemical heterogeneity present in the silicic magma chambers that is not evident in the welded on-land deposits. Ages of the ash layers can be established by correlation to precisely dated on-land ignimbrites, and current evidence suggests that while these eruptions may have exacerbated already changing climatic conditions, they both marginally post-date the Oi2 global cooling anomaly. ISSN: 0012-821X.

Ukstins, Ingrid A., Renne, Paul R., Wolfenden, Ellen, Baker, Joel, Ayalew, Dereje and Menzies, Martin. 2002. "Matching Conjugate Volcanic Rifted Margins: ⁴⁰Ar/³⁹Ar Chrono-Stratigraphy of Pre- and Syn-Rift Bimodal Flood Volcanism in Ethiopia and Yemen." *Earth Planet. Sci. Lett.* 5/15. Volume 198, Issue 3-4, Pages 289-306. Descriptors: flood basalts; volcanism; rifting; Ar-40/Ar-39; Ethiopia; Yemen. Abstract: ⁴⁰Ar/³⁹Ar dating of mineral separates and whole-rock samples of rhyolitic ignimbrites and basaltic lavas from the pre- and syn-rift flood volcanic units of northern Ethiopia provides a temporal link between the Ethiopian and Yemen conjugate rifted volcanic margins. Sixteen new ⁴⁰Ar/³⁹Ar dates confirm that basaltic flood volcanism in Ethiopia was contemporaneous with flood volcanism on the conjugate margin in Yemen. The new data also establish that flood volcanism initiated prior to 30.9 Ma in Ethiopia and may predate initiation of similar magmatic activity in Yemen by ~ 0.2 –2.0 Myr. Rhyolitic volcanism in Ethiopia commenced at 30.2 Ma, contemporaneous with the first rhyolitic ignimbrite unit in Yemen at ~ 30 Ma. Accurate and precise ⁴⁰Ar/³⁹Ar dates on initial rhyolitic ignimbrite eruptions suggest that silicic flood volcanism in Afro-Arabia post-dates the Oligocene Oi2 global cooling event, ruling out a causative link between these explosive silicic eruptions (with individual volumes ≥ 200 km³) and climatic cooling which produced the first major expansion of the Antarctic ice sheets. Ethiopian volcanism shows a progressive and systematic younging from north to south along the escarpment and parallel to the rifted margin, from pre-rift flood volcanics in the north to syn-rift northern Main Ethiopian Rift volcanism in the south. A dramatic decrease in volcanic activity in Ethiopia between 25 and 20 Ma correlates with a prominent break-up unconformity in Yemen (26–19 Ma), both of which mark the transition from pre- to syn-rift volcanism (~ 25 –26 Ma) triggered by the separation of Africa and Arabia. The architecture of the Ethiopian margin is characterized by accumulation and preservation of syn-rift volcanism, while the Yemen margin was shaped by denudational unloading and magmatic starvation as the Arabian plate rifted away from the Afar plume. A second magmatic hiatus and angular unconformity in the northern Main Ethiopian Rift is evident

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at 10.6–3.2 Ma, and is also observed throughout the Arabian plate in Jordanian, Saudi Arabian and Yemeni intraplate volcanic fields and is possibly linked to tectonic re-organization and initiation of sea floor spreading in the Gulf of Aden and the Red Sea at 10 and 5 Ma, respectively. ISSN: 0012-821X.

UN Volunteers. 1986. Development Microcosm: UNV in Yemen. Geneva: United Nations Volunteers. Page(s): 60. Descriptors: Technical Cooperation; Development Assistance; Economic Conditions; Agricultural Development; Health Services; Public Works; Telecommunications; Water Supply; Industrial Development; Meteorology; Air Transport; Women's Advancement; Technical Training; Yemen; International Voluntary Services; UN Volunteers; Government publication; International government publication. OCLC Accession Number: 123441144.

UN. Department of Humanitarian Affairs. 1994. United Nations Consolidated Inter-Agency Appeal: Emergency Humanitarian Assistance for the most Vulnerable among Conflict-Affected Populations in the Republic of Yemen, August 1994-February 1995. Geneva: Dept. of Humanitarian Affairs. Page(s): 33. Descriptors: Humanitarian Assistance; Emergency Relief; Yemen; Health Services; Water Supply; Sanitation; Food Aid; Agriculture; Education; Landmines; Mine Clearance; Aid Coordination; Coordination Within UN System; Government publication; International government publication. Notes: map, tables. Note(s): Document symbol not printed. UN Job no.: G9402990 E. Material type: Reports/studies. OCLC Accession Number: 80464726.

UN. ECWA. 1983. The International Drinking Water Supply and Sanitation Decade Activities in the ECWA Region. Baghdad: ECWA. Page(s): 231. Descriptors: Water Supply; Drinking Water; Sewerage; Water Policy; Egypt; Yemen; Oman; United Arab Emirates; Qatar; Bahrain; Saudi Arabia; Kuwait; Jordan; Iraq; Syrian Arab Republic; Lebanon; Manpower Development; Human Resources; Resources Mobilization; Education; International Decades; Training Programmes; Government publication; International government publication. Notes: xvi; tables. Title Subject: International Drinking Water Supply and Sanitation Decade (1981-1990); Note(s): Material type: Reports/studies. General Info: Distribution: General. OCLC Accession Number: 123377190.

UN. ESCWA. 2005. ESCWA Water Development Report 1: Vulnerability of the Region to Socio-Economic Drought. New York: UN. Page(s): 70. Descriptors: Drought Control; Water Management; Western Asia; Drought; Early Warning Systems; Case Studies; Jordan; Syrian Arab Republic; Yemen; Government publication; International government publication. Notes: vii; graphs, maps, tables. Note(s): Annexes (p. 61-65): 1. Questionnaire prepared for country studies -- 2. Wilhite drought planning methodology: 10 steps for drought planning -- 3. Socio-economic drought early warning system: sample indicators. Includes bibliographical references (p. 66-70). UN Job no.: I050539 E. ISBN: 9211282942; 9789211282948; 1817-1990. OCLC Accession Number: 170892312. URL: <https://unp.un.org/details.aspx?entry=E05EWD>.

UN. ESCWA. 1997. Water Legislation in Selected ESCWA Member Countries. New York: UN. Page(s): 81. Descriptors: Water Resources; Water Management; Water Law; Jordan; Lebanon; Oman; Saudi Arabia; Syrian Arab Republic; United Arab Emirates; Yemen; Western Asia; Government publication; International government publication; Internet resource. Notes: vi; charts, tables. UN Job no.: I9700203 E. Material type: Reports/studies. General Info: Distribution: General. OCLC Accession Number: 123379592. URL: <http://daccess-ods.un.org/access.nsf/Get?Open&DS=E/ESCWA/ENR/1997/2&Lang=E>.

Geology of Yemen

UN. ESCWA. Economic Development Issues and Policies Division. 2000. Review and Appraisal of Progress made by the Republic of Yemen in the Implementation of the Programme of Action for the Least Developed Countries for the 1990s. New York: UN. Page(s): 49. Descriptors: Economic Development; Structural Adjustment; Social Development; Economic Policy; Yemen; Macroeconomics; Least Developed Countries; Gas Industry; Petroleum Industry; Power Industry; Water Supply; Agriculture; Financial Services; Tourism; Government publication; International government publication. Notes: vii; graphs, tables. Title Subject: Programme of Action for the Least Developed Countries for the 1990s. OCLC Accession Number: 78743584.

UN. ESCWA. Natural Resources, Science and Technology Division. 1986. Development of Guidelines for the Economic use of Water in the ESCWA Region. Baghdad: UN. Page(s): 137. Descriptors: Water Management; Statistical Data; Environmental Statistics; Water Supply; Irrigation; Desalination; Western Asia; Bahrain; Democratic Yemen; Egypt; Iraq; Jordan; Kuwait; Lebanon; Oman; Qatar; Saudi Arabia; Syrian Arab Republic; United Arab Emirates; Yemen; Recommendations; Government publication; International government publication. Notes: xi; tables. Includes bibliographical references. OCLC Accession Number: 80532638.

UN. ESCWA and UNEP. 1996. Proceedings of the Expert Group Meeting on the Implications of Agenda 21 for Integrated Water Management in the ESCWA Region, Amman, 2-5 October 1995. New York: UN. Page(s): 510. Descriptors: Water Resources; Water Management; Water Quality; Groundwater; Desalination; Western Asia; Bahrain; Iraq; Jordan; Lebanon; Qatar; Syrian Arab Republic; United Arab Emirates; Yemen; West Bank; Permanent Sovereignty; Territories Occupied By Israel; Remote Sensing; Hydrology; Regional Cooperation; Freshwater; Participants; Agenda; Information Systems; International Hydrological Programme; Expert Group Meeting on the Implications of Agenda 21 for Integrated Water Management in the ESCWA Region (1995: Amman); Conference publication (cnp); Government publication; International government publication. Notes: ix; ill., charts, graphs, maps, tables. Title Subject: Agenda 21 (1992); Note(s): At head of title: Economic and Social Commission for Western Asia [and] United Nations Environment Programme. UN Job no.: I960300 E. OCLC Accession Number: 83565936.

UN. ESCWA; UNEP and Islamic Development Bank. 1996-06-03. Water Resources Assessment in the ESCWA Region using Remote Sensing and GIS Techniques: Final Report. Amman: ESCWA: UNEP: Islamic Development Bank. Page(s): 264. Descriptors: Water Resources; Groundwater; Shared Water Resources; Surface Waters; Climate; Rivers; Dams; Aquifers; Water Management; Drainage; Reservoirs; Maps; Western Asia; Egypt; Iraq; Jordan; Lebanon; Syrian Arab Republic; Saudi Arabia; Oman; Yemen; Remote Sensing; Natural Resources Surveys; Resources Exploration; Topographic Mapping; Hydrogeology; Hydrology. Notes: vi; ill., charts, graph, maps, tables. OCLC Accession Number: 81231377.

UN. ESCWA; UNEP and Islamic Development Bank. 1996. Water Resources Assessment in the ESCWA Region using Remote Sensing and GIS Techniques: Final Report. Amman: ESCWA: UNEP: Islamic Development Bank. Page(s): 264. Descriptors: Water Resources; Groundwater; Shared Water Resources; Surface Waters; Climate; Rivers; Dams; Aquifers; Water Management; Drainage; Reservoirs; Maps; Western Asia; Egypt; Iraq; Jordan; Lebanon; Syrian Arab Republic; Saudi Arabia; Oman; Yemen; Remote Sensing; Natural Resources Surveys; Resources Exploration; Topographic Mapping; Hydrogeology; Hydrology; Government publication; International government publication; Internet resource. Notes: vi; ill., charts, graph, maps, tables. UN Job no.: I9600217 E. OCLC Accession Number: 123500426.

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UN. United Nations Children's Fund (UNICEF) Statistics: Yemen. Descriptors: Statistics; Demography; Yemen; Country profiles. Abstract: The United Nations Children's Fund (UNICEF) presents demographic statistics on Yemen. The data includes statistics for basic indicators, such as population, annual number of births, and gross national product (GNP). UNICEF also includes data on mortality rates, immunization, water and sanitation, nutrition, reproductive health, and education. Notes: Named Corp: United Nations. Children's Fund. OCLC Accession Number: 48525926.

Underwood, Peter and Margetts, Barrie. 1987. "Cultural Change, Growth and Feeding of Children in an Isolated Rural Region of Yemen." Soc. Sci. Med. Volume 25, Issue 1, Pages 1-7. Descriptors: acculturation; bottle-feeding; malnutrition; marasmus; westernisation; Yemen. Abstract: This paper reports a study on the growth and feeding patterns of children from an isolated region of North Yemen. Marasmus was extremely common and was associated with poor infant feeding practices—particularly the widespread use of bottled milk—and frequent infections. Despite the appearance of a homogeneous traditional society, there were significant differences in the growth of children from adjacent areas. Children from a small township serving as the administrative centre of the region grew more poorly and had a higher mortality than those from the immediate rural hinterland. While poorer living conditions and more frequent infections may explain much of the worse growth and higher mortality of the township children, it is likely less adequate patterns of feeding, particularly greater use of artificial milk, also contribute significantly to the observed difference in growth. Despite the remote rural setting of the study, feeding patterns and growth may be influenced by a number of social factors associated with 'urbanisation'. ISSN/ISBN: 0277-9536.

Underwood, Peter and Margetts, Barrie. 1987. "High Levels of Childhood Rickets in Rural North Yemen." Soc. Sci. Med. Volume 24, Issue 1, Pages 37-41. Descriptors: marasmus; rickets; seclusion; Yemen. Abstract: Despite a warm sunny climate, rickets is extremely common in children living in an isolated mountainous area of North Yemen. In a small township the overall prevalence amongst children under five years attending for vaccination was 27%. The condition was most common at the end of the first year and had disappeared by the fifth year. Marasmus was commonly associated with rickets. Children from the rural villages outside the township had significantly lower rates of rickets. Several factors may contribute to the very high rates of rickets in rural Yemen. However, lack of exposure to sunlight as a consequence of particular cultural practices is likely to be the most important. The major social and behavioural factors which restrict the young child access to sunlight are outlined, and possible remedies discussed. ISSN: 0277-9536.

UNDP. Division of Information. 1988. World Development, v. 1, no. 2, may 1988. New York: UNDP, Division of Information. Page(s): 31. Descriptors: Desertification; Reforestation; Latin America; Wood-Using Industry; Sawmills; Timber; Brazil; Urban Water Supply; Water Quality Management; Indonesia; Medicinal Plants; Traditional Medicine; Madagascar; Textile Industry; Women Workers; Lao People's Democratic Republic; Clothing Industry; China; Cultural Heritage; Development; Yemen; Draught Animals; Philippines; Cultural Property Preservation; Antiquities; Turkey; Looms; Genetic Improvement; Government publication; International government publication. Notes: ill. OCLC Accession Number: 123380817.

UNICEF. Executive Director. 1993-02-25. Country Programme Recommendation: Yemen. New York: UN. Page(s): 20. Descriptors: Socio-Economic Indicators; Country Programmes; Children; Women; Health Services; Water Supply; Sanitation; Education; Social Services; Emergency Relief; Statistical Data; Yemen; Financing; Programme Management;

Geology of Yemen

Recommendations; UNICEF--Programme Management; UNICEF--Financing. Notes: tables. Consists of recommendation by the Executive Director of UNICEF. UN development projects. OCLC Accession Number: 81740208.

UNICEF. Executive Director. 1987-02-26. Country Programme Recommendation: Yemen. New York: UN. Page(s): 27. Descriptors: Statistical Data; Socio-Economic Indicators; Child Health; Basic Services; Country Programmes; Maps; Women; Children; Water Supply; Primary Health Care; Education; Nutrition; Immunization; Sanitation; Yemen; Financing; Recommendations; Programme Management; Unicef--Programme Management. Notes: map, tables. Note(s): Includes UN map no. 3314: Yemen (Feb. 1987). - Consists of recommendation of Executive Director of UNICEF. UN maps included in documents. UN development projects. OCLC Accession Number: 80653073.

UNICEF. Executive Director. 1987. Recommendation for "Notings" for Programmes in the Middle East and North Africa Region without Recommendations for Commitments from General Resources. New York: UN. Page(s): 12. Descriptors: Country Programmes; Middle East; North Africa; Immunization; Water Supply; Sanitation; Democratic Yemen; Women In Development; Egypt; Emergency Relief; Social Welfare; Lebanon; Project Finance; Programme Management; Recommendations; UNICEF -- Programme management; Government publication; International government publication. Notes: tables. Note(s): Consists of recommendation of the Executive Director of UNICEF. OCLC Accession Number: 82327261.

UNICEF. Executive Director. 1987. Country Programme Recommendation: Yemen. New York: UN. Page(s): 27. Descriptors: Statistical Data; Socio-Economic Indicators; Child Health; Basic Services; Country Programmes; Maps; Women; Children; Water Supply; Primary Health Care; Education; Nutrition; Immunization; Sanitation; Yemen; Financing; Recommendations; Programme Management; UNICEF -- Programme management; Government publication; International government publication. Notes: map, tables. Note(s): Includes UN map no. 3314: Yemen (Feb. 1987). Consists of recommendation of Executive Director of UNICEF. Contains: Maps (in UN documents). Material type: Development projects. OCLC Accession Number: 123399153.

UNICEF. Executive Director. 1985-01-22. Country Programme Recommendation: Yemen. New York: UN. Page(s): 4. Descriptors: Statistical Data; Demographic Statistics; Child Health; Country Programmes; Water Supply; Sanitation; Education; Yemen; UNICEF. Notes: tables. Consists of a recommendation of the Executive Director of UNICEF. UN development projects. OCLC Accession Number: 77952575.

UNICEF. Executive Director. 1985. Country Programme Recommendation: Democratic Yemen. New York: UN. Page(s): 5. Descriptors: Statistical Data; Demographic Statistics; Country Programmes; Child Health; Education; Women; Rural Water Supply; Sanitation; Information Exchange; Democratic Yemen; UNICEF; Government publication; International government publication. Notes: tables. Consists of a recommendation of the Executive Director of UNICEF. Material type: Development projects. OCLC Accession Number: 82750928.

United Nations, Department of Technical Co-operation for Development, New York, NY, United States. 1982. "Ground Water in the Eastern Mediterranean and Western Asia." Natural Resources/Water Series. United Nations Department of Economic and Social Affairs, New York-Budapest. Volume 9, Pages 230. Descriptors: Africa; aquifers; Arabian Peninsula; Asia; atmospheric precipitation; Bahrain; climate; Cyprus; eastern Mediterranean region; economic geology; Egypt; ground water; Iran; Iraq; Israel; Jordan; Kuwait; Lebanon; Mediterranean region; Middle East; North Africa; Oman; Qatar; Saudi Arabia; surveys; Syria;

Geology of Yemen

Turkey; United Arab Emirates; water resources; western Asia; Yemen. Notes: illus. incl. tables, geol. sketch maps. Database: GeoRef. ISSN: 1010-397X.

United Nations and Economic Commission for Western Asia. 1984. *The Human Settlements Situation in the Yemen Arab Republic: Country Profile*. New York: United Nations. Page(s): 114. Descriptors: Housing -- Yemen (Republic); Human settlements -- Yemen (Republic); City planning -- Yemen (Republic); Economic Statistics; Demographic Statistics; Statistical Data; Human Settlements; Housing; Households; Housing Statistics; Land; Water Supply; Sanitation; Electric Power; Transport; Communications; Health Services; Education; Building Materials; Construction Industry; Housing Finance; Economic Indicators; Environmental Indicators; Human Settlements Management; Yemen; Yemen (Republic) -- Economic conditions -- 1945-; Government publication; International government publication. Notes: xi; ill. 28 cm. "20 June 1984." "E/ECWA/HS/84/1." OCLC Accession Number: 20350002.

United States Inst of Peace Washington, DC and Yacoubian, Mona. 2007. "Special Report: Engaging Islamists and Promoting Democracy. A Preliminary Assessment." Aug. Page(s): 17 Report Number: 190 XJ-USIP Monitor Series: USIP. Abstract: While U.S. engagement of moderate Islamists remains a hotly debated question, U.S. democracy promoters have been working with legal Islamist parties and their leaders over the past decade. This Special Report examines the experiences of U.S. democracy promoters at the National Democratic Institute (NDI) and the International Republican Institute (IRI) working with Islamist parties in three countries: Morocco, Jordan, and Yemen. The assessment is written from the perspective of democracy promoters; it is based on extensive interviews and discussions with staff members who reside in-country, Washington-based staff, and United States Agency for International Development (USAID) democratization experts. The promoters views are necessarily subjective, providing one viewpoint to understand this complex topic. Abstract Classification: Unclassified Technical Reports Collection. View Full Text (pdf); File: /U2/a472137.pdf; Size: 223 KB; Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA472137.

United States. Agency for International Development. 1981. *Yemen: Taiz Water and Sewerage Construction Project Amendment*. Washington, DC: U.S.A.I.D. Descriptors: Water-supply -- Yemen (Republic) -- Taizz; Sewerage -- Yemen (Republic) -- Taizz; Manuscript. Notes: 1 v. (various pagings); 28 cm. Note(s): "Project assistance paper." "Project number 279-0039." Other Titles: Taiz water and sewerage construction project amendment; Responsibility: Department of State, Agency for International Development. OCLC Accession Number: 187315319.

United States. Army Map Service; Great Britain; Army and Middle East Drawing and Reproduction. . 1957. "Qizan." Washington, D.C: The Service. Ed. 1--GSGS, AMS 3.GSGS 4646; Variation: GSGS (Series); 4646.Descriptors: Saudi Arabia -- Maps, Topographic; Yemen (Republic) -- Maps, Topographic; Government publication; National government publication. Notes: Description: 1 map: col. 45 x 65 cm. Map Info: Scale 1:1,000,000; [polyconic] proj. of the International map [of the World]; Relief shown by form lines, spot heights, and pictorial relief. Shows boundaries, highways and roads, railways, airports, rivers and water features, and other details. "Reprinted from first edition MDR 1/12284, 1945." "British Crown copyright reserved. Reproduced with the permission of Her Britannic Majesty's Stationery Office." Includes index to adjoining sheets, boundary diagram, reliability diagram, and glossary. Standard map series designation: Series 1301. "Sheet NE 38." "12-57."; Other Titles: Title in lower

Geology of Yemen

margin:; Qizan, S.W. Asia; Series 1301; Title in upper margin: World (Asia) 1:1,000,000. OCLC Accession Number: 55858239.

United States. Army Map Service; Great Britain; Army and Middle East Drawing and Reproduction. . 1945. "Bahr as Safi." Washington, D.C: The Service. Ed. 1--GSGS. World (Asia) 1:1,000,000; NE 39; GSGS; 4646; Variation: International map of the World 1:1,000,000. Asia; sheet NE 39. GSGS (Series); 4646. Descriptors: Oman -- Maps, Topographic; Saudi Arabia -- Maps, Topographic; Yemen (Republic) -- Maps, Topographic; Government publication; National government publication. Notes: Description: 1 map: col. 45 x 65 cm. Map Info: Scale 1:1,000,000; "Heights in metres." Relief shown by gradient tints, spot heights, and pictorial relief. Shows boundaries, highways and roads, railways, airports, rivers and water features, and other details. Reprint. Originally published: [London]: Middle East Drawing and Reproduction, 1945. "Reprinted from first edition MDR 1/12253, 1945." "British Crown copyright reserved. Reproduced with the permission of Her Britannic Majesty's Stationery Office."/ Includes index to adjoining sheets, boundary diagram, reliability diagram, and glossary. Standard map series designation: Series 1301. Other Titles: Margin title:; Bahr as Safi, Southwest Asia; Series 1301. OCLC Accession Number: 36049360.

United States. Army Map Service; Great Britain; Army and Middle East Drawing and Reproduction. 1945. "Qizan." Washington, D.C: The Service. Ed. 3--GSGS. Ed. advanced to be concurrent with Ed. 1--GSGS, AMS 3. World (Asia) 1:1,000,000; NE 38; GSGS; 4646; Variation: International map of the World 1:1,000,000. Asia; sheet NE 38. GSGS (Series); 4646. Descriptors: Saudi Arabia -- Maps, Topographic; Yemen (Republic) -- Maps, Topographic; Government publication; National government publication. Notes: Description: 1 map: col. 45 x 65 cm. Map Info: Scale 1:1,000,000; Relief shown by contours, spot heights, and pictorial relief. Shows boundaries, highways and roads, railways, airports, rivers and water features, and other details. "Reprinted from first edition MDR 1/12284, 1945." "British Crown copyright reserved. Reproduced with the permission of His Britannic Majesty's Stationery Office." Includes index to adjoining sheets, boundary diagram, reliability diagram, and glossary. Standard map series designation: Series 1301. Other Titles: Margin title: Qizan, S.W. Asia; Series 1301; Responsibility: printed by Army Map Service, Corps of Engineers. OCLC Accession Number: 36036487.

USAID/Yemen. 1976. Water Supply Systems Management. Washington, D.C: Agency for International Development. Descriptors: Municipal water supply -- Yemen; Sewerage -- Yemen; Economic assistance, American -- Yemen; Yemen Arab Republic National Water and Sewerage Authority; Government publication. Abstract: Project purpose: "to develop the National Water and Sewerage Authority into an effective authority, capable of managing, planning, constructing and operating the urban water and sewerage systems of the YAR." Notes: 15 leaves; 27 cm. Title from project facesheet. "Project no. 279-0028." "279-11-521-028"--Leaf [1]. OCLC Accession Number: 187860182.

USAID/Yemen. 1976. Rural Market Centers Water Supply and Sewerage Studies. Washington, D.C: Agency for International Development. Descriptors: Markets -- Sanitation -- Yemen; Water-supply, Rural -- Yemen; Sewerage -- Yemen; Rural development projects -- Yemen; Economic assistance, American -- Yemen; Government publication; National government publication. Abstract: Project purpose: "provide the YARG the means to construct 15 water and sewerage systems"--Project facesheet. Notes: 7, [4] leaves; 27 cm. Title from leaf [1]. "279-0029."; Other Titles: Rural centers water/sewerage studies. OCLC Accession Number: 187860362.

Geology of Yemen

V

van der Gun, J. A. M., Elderhorst, W. I. M. and Kruseman, G. P. 1992. "Predicting the Long-Term Impacts of Groundwater Abstraction from an Intensively Exploited Coastal Aquifer; Selected Papers on Aquifer Overexploitation from the 23rd International Congress of I.A.H." Hydrogeology. Verlag Heinz Heise, Hanover, Germany. Volume 3, Pages 303-318. Descriptors: aquifers; Arabian Peninsula; Asia; Cenozoic; coastal environment; effects; exploitation; ground water; mathematical models; prediction; Quaternary; salt-water intrusion; Tihama Yemen; Wadi Surdud Yemen; water management; water resources; Yemen. References: 6; illus. incl. 2 tables, sketch map. Database: GeoRef. ISSN: 0938-6378.

van der Gun, Jac A. M. 1998. "Water Resources Scarcity in Yemen; a Time Bomb Under Socio-Economic Development?; Water; a Looming Crisis?" Technical Documents in Hydrology = Documents Techniques En Hydrologie. UNESCO, International Hydrological Programme, Paris, International. Volume 18, Pages 379-384. Descriptors: aquifers; Arabian Peninsula; Asia; climate; depletion; development; ground water; human activity; pumping; sustainable development; water management; water resources; water supply; water use; Yemen. References: 6; 1 table, sketch maps. Abstract: Water scarcity in Yemen has evolved during the last tens of years from a relatively static environmental factor to a fundamental threat to sustainability, as a consequence of rapid population growth and immense groundwater over-exploitation. The water crisis which is present or imminent in most areas of Yemen has severe economic and social implications. There is evidence that the problems can not be solved successfully by uncoordinated individual reactions of water users to changing conditions. Instead, coordinated action and proactive attitudes are required. Attention should go beyond technological improvements and investments in water infrastructure, and include issues of changing water use behaviour and of diversification towards a less water-consuming economy. Database: GeoRef.

van der Gun, Jac A. M. and Ahmed, A. A. 1995. The Water Resources of Yemen - a Summary and Digest of Available Information. Delft, Netherlands: TNO-DGV Institute of Applied Geoscience. Descriptors: Water resources; Arabian Peninsula; Yemen. Report WRAY-35. Notes: var. pagination. At head of title: "Water Resources Assessment Yemen". Includes bibliographical references. OCLC Accession Number: 53046461; 704163340. URLs: <ftp://ftp.hrwallingford.co.uk/pub/dfid/Yemen/Water%20Resources%20of%20Yemen/reportWRAY35.pdf> and: <http://www.tc-wateryemen.org/documents/wsy.htm>.

van der Gun, Jac A. M. and Kruseman, Gideon P. 1992. "Sustainable Groundwater Development; the Challenge for the Hydrogeologist in the 1990's; 13. Tagung Der Fachsektion Hydrogeologie Der Deutschen Geologischen Gesellschaft." Zeitschrift Der Deutschen Geologischen Gesellschaft. Verlag Ferdinand Enke, Stuttgart, Federal Republic of Germany. Volume 143, Issue 2, Pages 190-201. Descriptors: Africa; aquifers; Arabian Peninsula; Asia; conservation; currents; East Africa; Europe; Far East; global; ground water; Indonesia; Java; Netherlands; pollution; prediction; protection; statistics; surface water; Tanzania; water harnessing; water management; water quality; water resources; water supply; Western Europe; Yemen. References: 9; sect., block diag., 2 tables, geol. sketch maps. Database: GeoRef in Process. ISSN: 0012-0189.

van Dijk, A., and T. Wijdeveld. 1996. "Water Management and Remote Sensing." Land & Water International. 84 (1996): 12-5. Abstract: The use of computer models and remote sensing for improving water management and irrigation schemes is described. Benefits of remote sensing are outlined. The integration of water management models with remote sensing image processing software and geographical information systems is discussed. Case studies in the

Geology of Yemen

Yemen and Argentina are described. The role of remote sensing in irrigation management and its limitations are considered.

Van Enk, D.C. and van der Gun, J.A.M. 1984, Hydrology and hydrogeology of the Yemen Arab Republic: a summary of available information. Report WRAY-1, Water Resources Assessment Yemen Arab Republic. TNO Institute of Applied Geoscience, Delft, The Netherlands.

Van Hear, Nicholas. 1994. "The Socio-Economic Impact of the Involuntary Mass Return to Yemen in 1990." *Journal of Refugee Studies*. January 1. Volume 7, Issue 1, Pages 18-38. Abstract: As the Gulf crisis unfolded in the second half of 1990, the Republic of Yemen was obliged to accommodate 800,000 of its nationals forced to leave Saudi Arabia, Kuwait and other states of the region. This paper explores the social and economic impact of this large involuntary movement to Yemen. Since these people returned to their country of nationality, they were not refugees but forced repatriates or returnees', although such terms are problematical when applied to Yemenis long-settled abroad, as the paper shows. After outlining the circumstances of the mass exodus and the character and distribution of the population that arrived en masse in Yemen, the paper reflects on their experience and condition more than two years later, and considers the extent to which the returnees constituted a burden or potential benefit for a poor country already under considerable political and economic pressure. While the evidence on the latter issue is mixed, the Yemen case holds lessons for other countries obliged to deal with sudden, large scale, involuntary repatriations.

van Loon, Louise, Driessen, Peter P. J., Kolhoff, Arend and Runhaar, Hens A. C. "An Analytical Framework for Capacity Development in EIA- the Case of Yemen." *Environ. Impact Assess. Rev.* Volume In Press, Corrected Proof, Descriptors: Capacity development; EA systems; Performance; Analytical framework; Yemen. Abstract: Most countries worldwide nowadays apply Environmental Assessment (EA) as an ex ante tool to evaluate environmental impacts of policies, plans, programmes, and projects. However, the application and performance of EA differ significantly. Scientific analysis of how EA performs mainly focuses on two levels: the micro (or project) level and the macro (or system) level. Macro level analysis usually focuses on institutions for EA and the organisation of stakeholder interaction in EA. This article proposes a more comprehensive framework for analysing EA systems that combines other approaches with a capacity approach and an explicit consideration of the context in which EA systems are developed and performed. In order to illustrate the value of our framework, we apply it to the Republic of Yemen, where over the last decades many EA capacity development programmes have been executed; however, EA performance has not substantially improved. The Yemen case study illustrates that the capacity development approach allows an understanding of the historical process, the stakeholders, the knowledge component, and the material and technical aspects of EA, but perhaps more important is a systemic understanding of the outcomes: problems are not isolated, but influence and even maintain each other. In addition, by taking into account the context characteristics, our framework allows for the assessment of the feasibility of capacity development programmes that aim at improving EA system performance. ISSN: 0195-9255.

van Overmeeren, R. A. 2001. "Hagedoorn's Plus-Minus Method; the Beauty of Simplicity; in Memory of J. G. Hagedoorn." *Geophys. Prospect.* EAGE (European Association of Geoscientists & Engineers), Houten, Netherlands. Nov. Volume 49, Issue 6, Pages 687-696. Descriptors: Arabian Peninsula; Asia; case studies; computer programs; data processing; electrical logging; geophysical methods; geophysical profiles; geophysical surveys; Hagedoorn's method; MATLAB; refraction methods; seismic methods; seismic profiles; surveys;

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Thornburgh's method; vertical seismic profiles; Wadi Surdud; well-logging; Yemen. References: 16; illus. incl. 3 tables. Database: GeoRef. ISSN: 0016-8025. URL:

<http://www.blackwellpublishing.com/journal.asp?ref=0016-8025&site=1>.

Van Overmeeren, R. A. 1989. "Aquifer Boundaries Explored by Geoelectrical Measurements in the Coastal Plain of Yemen: A Case of Equivalence." *Geophysics*. Volume 54, Issue 1, Pages 38-48. Notes: Cited By (since 1996): 18. Abstract: Until 216 vertical electrical Schlumberger soundings were made, little was known about the subsurface geology at the Wadi Surdud area in the coastal plain of the Yemen Arab Republic. These soundings provide information on the distribution of aquifers, aquitards, and impermeable rocks, and the salinity of the groundwater. Database: SCOPUS. ISSN: 0016-8033.

van Overmeeren, R. A. 1987. "The Plus-Minus Method for Rapid Field Processing by Portable Computer of Seismic Refraction Data in Multi-Layer Groundwater Studies." *First Break*. Blackwell, Oxford, UK. Mar. Volume 5, Issue 3, Pages 83-94. Descriptors: Arabian Peninsula; Asia; data acquisition; data processing; geophysical methods; geophysical surveys; ground water; northern Yemen; plus-minus method; refraction; seismic methods; surveys; Yemen. References: 7; illus. Database: GeoRef. ISSN: 0263-5046.

van Steenbergen, Frank. 2006. "Promoting Local Management in Groundwater; Social and Economic Aspects of Groundwater Governance." *Hydrogeol. J.* Springer, Berlin - Heidelberg, Federal Republic of Germany. Volume 14, Issue 3, Pages 380-391. Descriptors: Africa; Arabian Peninsula; Asia; case studies; Egypt; hydrologic cycle; hydrology; North Africa; Southeast Asia; sustainable development; water management; Yemen. Notes: References: 20. Database: GeoRef in Process. ISSN: 1431-2174. URL: <http://www.springerlink.com/content/102028/>.

Vandyk, Anthony. 1994. "Alyemda, Oil-Fueled Expansion." *Air Transport World*. Penton Media: Volume 31, Issue 5, Pages 108. Descriptors: Airlines; Yemen. Database: TRIS. ISSN: 0002-2543. Availability: <http://worldcat.org/issn/00022543>.

Varisco, Daniel Martin. 2009. "Agriculture in Al-Hamdānī's Yemen: A Survey from Early Islamic Geographical Texts." *Journal of the Economic & Social History of the Orient*. Brill Academic Publishers: 06. Volume 52, Issue 3, Pages 382-412. Descriptors: Agriculture; Islam; Yemenis; Water-supply; Water in agriculture; Yemen (Republic); Cultivated Crops; Geography; Irrigation; Yemen; AL-Hamdani, Abu Muhammad al-Hassan ibn Ahmad. Abstract: The area of Yemen has been one of the most productive agricultural regions in the Arab World since the beginning of Islam. This article surveys the available knowledge from Arabic geographical and historical texts on the state of agriculture in Yemen during the early Islamic period up through the 10th century CE. The primary focus is on the work of Abū Muhammad al-Hasan al-Hamdānī, including translation of a section on Yemeni agriculture from his *Sifat jazīrat al-Arab*. In addition to discussion of rain periods, water resources and agricultural methods, information on the known cultivated crops is provided. ISSN: 0022-4995. URL: <http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=41556330&site=ehost-live&scope=site>.

Varisco, Daniel Martin. 2004. "Terminology for Plough Cultivation in Yemeni Arabic." *Journal of Semitic Studies*. March 1. Volume 49, Issue 1, Pages 71-129. Abstract: Yemen, located on the southwestern corner of the Arabian Peninsula, has a rich agricultural tradition with extensive documentation available in manuscripts and published sources. This article draws on the major lexicons, specialized linguistic studies, travel accounts and ethnographic field research in the central highland valley of Ahjur (1978-9) for an annotated glossary of Yemeni Arabic

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terminology for the traditional plough and tillage or cultivation of fields. Terms are arranged by root and to the extent possible the region of the usage is indicated. Yemen is one of the few Arab countries where a historical lexical exercise can be fruitful, since aspects of traditional cultivation continue to the present day and many regional terms appear to have substantial longevity.

Varisco, Daniel Martin. 1982. *The Adaptive Dynamics of Water Allocation in Al-Ahjur, Yemen Arab Republic*. Descriptors: Water resources development -- Al-Ahjur Valley -- Yemen (Republic); Water rights -- Yemen (Republic); Water harvesting; Water-supply; Thesis/dissertation; Manuscript; Microfilm (mfl). Notes: xxxv, 690 leaves. Dissertation: Thesis (Ph. D.)--University of Pennsylvania, 1982. Note(s): Includes bibliographical references (leaves 634-681). Reproduction: Microfilm. Ann Arbor, Mich. University Microfilms, 1986. 1 microfilm reel; 35 mm. OCLC Accession Number: 13191910.

Varisco, Daniel Martin and Institute for Development Anthropology (Binghamton, N.Y.). 1980. *Water Right and Water use in the Yemeni Highlands: The Phenomena of Ghail*. Descriptors: Applied anthropology -- Yemen (Republic). Notes: 10 leaves; 28 cm. Cover title. "Presented at the annual meetings of the Middle East Studies Association, Washington D.C. 1980." Includes bibliographical references. OCLC Accession Number: 66899494.

Vaselli, Orlando, Mattash, Mohamed Ali, Minissale, Angelo, et al. 2004. "Isotopic and Gas Analysis of the Geothermal Systems of Yemen; Italia 2004; 32nd International Geological Congress; Abstracts." *International Geological Congress, Abstracts = Congres Geologique International, Resumes*. [International Geological Congress], [location varies], International; Abstracts = Congres Geologique International, Resumes. Aug. Volume 32, Part 2, Pages 1235-1236. Descriptors: aliphatic hydrocarbons; alkanes; Arabian Peninsula; Asia; bedrock; carbon dioxide; carbonate rocks; chemical composition; chemical ratios; deuterium; Eh; gases; geothermal systems; ground water; hot springs; hydrocarbons; hydrogen; isotope ratios; isotopes; methane; O-18/O-16; organic compounds; oxygen; petroleum; petroleum exploration; reservoir rocks; sea water; sedimentary rocks; springs; stable isotopes; thermal waters; water resources; Yemen. Database: GeoRef.

Vasseli, Orlando, Mattash, Mohamed A., Minnisale, Angelo, Wood, Scott A. and Cetiner, Ziya. 2003. "Geothermal Resources of Yemen and their Geothermometric Characteristics; Geological Society of America, 2003 Annual Meeting." *Abstracts with Programs - Geological Society of America*. Geological Society of America (GSA), Boulder, CO. Nov. Volume 35, Issue 6, Pages 573. Descriptors: Arabian Peninsula; Arabian Sea; Asia; Cenozoic; faults; gases; geochemistry; geologic thermometry; geothermal energy; ground water; Gulf of Aden; hot springs; hydrochemistry; Indian Ocean; Red Sea region; resources; springs; temperature; thermal waters; western Yemen; Yemen. Abstract: Thermal springs and gas vents are widely distributed throughout the country, but the majority is found discharging from igneous centers of Tertiary and Quaternary volcanic fields of the western Yemen Province. Structurally these volcanics are connected to N-NW faults that are parallel to the main Red Sea trend, and partially associated with relatively shallow Tertiary acidic intrusions. In the Gulf of Aden region the heat flow varies from 50-100 mW/m (super 2) . The present geothermal gradient in the Red Sea region ranges from 49 to 77 degrees C/km, and the present heat flow varies from 94 to 154 mW/m (super 2) . Such high and moderate heat flow values have more or less been affected by the thermal equilibrium between the upper mantle and the crust. This had resulted in the formation of the relatively large and widely distributed epithermal alteration haloes throughout the Yemen Cenozoic volcanic areas and also the occurrence of thermal springs. Temperature and

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pH values of the thermal springs range between 37 degrees C and 96DGC, and 6.3 and 8.7, respectively. However, TDS values range between 1000 ppm and 3500 ppm and in some cases may exceed 10000 ppm. The condensates collected from fumaroles and steaming ground have low pH values (<4.5) and TDS (<250 ppm). The Yemeni thermal waters indicate high variability in composition since they are Na (K)-Cl, Na-HCO (sub 3) , and Ca (Mg)-SO (sub 4) types, whereas the surficial waters have the typical worldwide Ca (Mg)-HCO (sub 3) composition. The water samples from the southern Provinces of Yemen have a Na/Cl ratio approximately equal to 1, suggesting variable degrees of mixing with seawater. The remaining samples display a higher, but relatively constant, Na/Cl ratio (4-6). This can be related to the fact that the thermal water in the southern and eastern Provinces is often associated with N (sub 2) -gases, while the others present a CO (sub 2) -rich gas phase. The latter increases the water-rock interaction processes leading to a higher alteration degree and favoring ion-exchange reaction with Na-rich silicates. These waters thus evolve to Na-HCO (sub 3) in composition. Equilibrium temperature evaluation of the thermal reservoirs has been performed by using different liquid phase geothermometers, such as SiO (sub 2) , K (super 2) /Mg and Na/K. Estimated reservoir temperatures range between 70 and 140 degrees C. Database: GeoRef. ISSN: 0016-7592.

Veenstra, S. Al-Nozaily, F. and Alaerts, G. J. 1995. Purple Non-Sulfur Bacteria End their Influence on Waste Stabilisation Pond Performance in the Yemen Republic. Berkeley, CA. Volume: 31, 12, page(s): 141-149. Proceedings of the 2nd International Symposium on Waste Stabilisation Ponds and the Reuse of Pond Effluents, November 30, 1993 - December 3. Conference: 1993. Descriptors: Stabilization ponds; Algae; Ammonia; Bacteria; Biochemical oxygen demand; Biological sewage treatment; Disease control; Effluents; Hydrogen sulfide; Odor control; Wastewater reclamation; Wastewater treatment. Abstract: In the semi-arid Yemen Republic wastewater treatment has high priority to control the spreading of communicable diseases and to make the effluent fit for reuse in agriculture. Experience with existing waste stabilisation ponds has in many cases been unfavourable because of poor BOD removal and odour problems. The raw domestic sewage at the Sana'a waste stabilisation ponds is very strong in terms of BOD, COD, TSS and sulfate, and its ammonia levels are excessively high (150-200 mg N-[NH₃ + NH₄]/L). The combination of high temperature, high organic loading rates and the presence of sulfides, due to conversion of sulfate in the anaerobic ponds, appears to favour development of anoxygenic photo-heterotrophic purple non-sulfur bacteria *Rhodospseudomonas* spp. in facultative ponds. Some species can oxidise sulfides to sulfate using light; they lend the water its typical reddish-pink colour and cause high turbidity which may disfavour algal growth. Also, in large tracts of the ponds the high ammonia levels suppress algal growth, as demonstrated in lab experiments. Consequently, low DO and poor C-metabolisation prevail in the ponds. Low DO in turn again creates conditions stimulating microbial sulfate reduction. Field data from other facultative ponds in Yemen suggests that a minimum retention time in the facultative ponds of 20-25 days is necessary to provide ecological conditions allowing algae to outcompete purple bacteria. Notes: Compilation and indexing terms, copyright 2009 elsevier inc. T3: Water science and technology; undefined; undefined; undefined; undefined; undefined; undefined. ISSN: 0273-1223. URL: [http://dx.doi.org/10.1016/0273-1223\(95\)00501-D](http://dx.doi.org/10.1016/0273-1223(95)00501-D).

Veenstra, S., Al-Nozaily, F. A. and Alaerts, G. J. 1995. "Purple Non-Sulfur Bacteria End their Influence on Waste Stabilisation Pond Performance in the Yemen Republic." *Water Science and Technology*. 30 November 1993 through 3 December 1993. Volume 31, Issue 12, Pages 141-149. Descriptors: Algal toxicity; Ammonia; Hydrogen sulfide; Malodorous compounds; Purple bacteria; Republic of Yemen; Reuse; *Rhodospseudomonas*; Sulfate reduction;

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Waste stabilisation ponds. Notes: Conference code: 44061; Cited By (since 1996): 11. Abstract: In the semi-arid Yemen Republic wastewater treatment has high priority to control the spreading of communicable diseases and to make the effluent fit for reuse in agriculture. Experience with existing waste stabilisation ponds has in many cases been unfavourable because of poor BOD removal and odour problems. The raw domestic sewage at the Sana'a waste stabilisation ponds is very strong in terms of BOD, COD, TSS and sulfate, and its ammonia levels are excessively high (150-200 mg N-[NH₃ + NH₄⁺]/L). The combination of high temperature, high organic loading rates and the presence of sulfides, due to conversion of sulfate in the anaerobic ponds, appears to favour development of anoxygenic photo-heterotrophic purple non-sulfur bacteria *Rhodospseudomonas* spp. in facultative ponds. Some species can oxidise sulfides to sulfate using light; they lend the water its typical reddish-pink colour and cause high turbidity which may disfavour algal growth. Also, in large tracts of the ponds the high ammonia levels suppress algal growth, as demonstrated in lab experiments. Consequently, low DO and poor C-metabolisation prevail in the ponds. Low DO in turn again creates conditions stimulating microbial sulfate reduction. Field data from other facultative ponds in Yemen suggests that a minimum retention time in the facultative ponds of 20-25 days is necessary to provide ecological conditions allowing algae to outcompete purple bacteria. Database: SCOPUS. ISSN: 0273-1223.

Venter, Hendrik J. T. and Verhoeven, Rudolf L. 1999. "A New Species of *Cryptolepis* (Periplocoideae, Apocynaceae) from Arabia." *Bot. J. Linn. Soc.* 12. Volume 131, Issue 4, Pages 417-422. Descriptors: pollen; seed-coat; South Yemen; translators. Abstract: A new species of *Cryptolepis* from Yemen, Arabian Peninsula, *C. yemenensis* is described and figured. It is recognized by the glabrous appearance of the plant, oblong-elliptic to narrowly obovate leaves, small flowers, small follicles and ridged seed. The new species resembles *Cryptolepis gillettii* Hutch. & E.A. Bruce and *C. volubilis* (Balf. f.) Schwartz to some extent. Their flowers are alike, except for size and different corona shapes. However, they differ with regard to the shape and size of the follicles, the texture of the seed coat and the absence or presence of vestiture on the plants. ISSN: 0024-4074.

Verba, M P, Avad Said Al-Kasiri, N A Goncharova, and N P Chizhikova. 1995. "Impact of Irrigation on Micromorphological Features of Desert Soils of Hadramout Valley (Yemen)". *Eurasian Soil Science*. 27, no. 9: 108. ISSN: 1064-2293. OCLC: 87117443.

Vermillion, Douglas Lynn and Al-Shaybani, S. 2004. *Small Dams and Social Capital in Yemen: How Assistance Strategies Affect Local Investment and Institutions*. International Water Management Institute. ISBN: 9290905379. URL: http://books.google.com/books?id=ULRDZberCP8C&printsec=frontcover&source=gbs_v2_summary_r&cad=0#v=onepage&q=&f=false.

Vermillion, D. L. and Al-Shaybani, S. 2004. "Small Dams and Social Capital in Yemen: How Assistance Strategies Affect Local Investment and Institutions." IWMI]. no. 76, [np]. Volume: 76, page(s): Research Report. International Water Management Institute [Res. Re. Descriptors: Article Subject Terms: Capital; Dams; Institutions; International Waters; Investment; Article Geographic Terms: Yemen. ISBN: 9290905379. Database: Water Resources Abstracts. OCLC Accession Number: 7295767.

Vermillion, Douglas L. Shaybani, Sa'id and International Water Management Institute. 2004. *Small Dams and Social Capital in Yemen: How Assistance Strategies Affect Local Investment and Institutions*. Colombo: IWMI. Descriptors: Dams -- Yemen (Republic); Water conservation projects -- Yemen; (Republic); Federal aid to water resources; development; Water resources development -- Finance. Notes: [2] p. 28 cm. OCLC Accession Number: 499984970.

Geology of Yemen

Villwock, G. Ruske, R. and Germany, Institut fuer Geologische Wissenschaften und Geiseltalmuseum, Halle. 1996. Geologische Landesaufnahme Und Naturpotentialbewertung Im Suedlichen Jemen; Afrika Im Spannungsfeld Zwischen Umweltvorsorge Und Rohstoffnutzung; Aufgaben Und Moeglichkeiten in Der Wissenschaftlichen Und Technischen Zusammenarbeit; Afrikagruppe Deutscher Geowissenschaftler, Jahrestagung 1996. Federal Republic of Germany Inst. fuer. Geolog. Wiss. u. Geiseltalmuseum, Halle (Saale), Federal Republic of Germany. Jahrestagung, Afrikagruppe Deutscher Geowissenschaftler; Afrika Im Spannungsfeld Zwischen Umweltvorsorge Und Rohstoffnutzung, Halle. Federal Republic of Germany Conference: June 21-22, 1996. Descriptors: agriculture; Arabian Peninsula; Asia; mapping; parent materials; relief; soil group; soils; water regimes; Yemen. References: 3. Database: GeoRef in Process.

Villwock, G. 1989. "Landschaftliche Raumlagerung Der VDR Jemen Als Grundlage Fuer Die Beurteilung Der Natuerlichen Ressourcen. Spatial Division of Landscapes of the People's Democratic Republic of Yemen as a Basis for the Assessment of Natural Resources." Petermanns Geographische Mitteilungen. VEB Hermann Haack Geographisch-Kartographische Anstalt Gotha/Leipzig, Gotha-Leipzig, Federal Republic of Germany Federal Republic of Germany. Volume 133, Issue 2, Pages 89-97. Descriptors: agriculture; Arabian Peninsula; Asia; classification; climate; genesis; geomorphologic maps; geomorphology; landform description; landscapes; maps; relief; soils; vegetation; water supply; Yemen. Notes: CD: PGGMA3; References: 44; illus. incl. sects., 2 tables, geol. sketch maps; Map Scale: 1:200,000. Type: geomorphologic map. Database: GeoRef. ISSN: 0031-6229.

Vincent, Linden. 2004. Science, Technology and Agency in the Development of Droughtprone Areas: A Cognitive History of Drought and Scarcity. England: Open University (United Kingdom). ProQuest Dissertations and Theses. Abstract: Drought and scarcity are two frameworks in common use to study the relationships between natural phenomena creating lack of water (drought) and the lack of access to water for human security and economic development (scarcity). This thesis studies how these frameworks have shaped public action in droughtprone and scarcity regions over time, in the agencies created for water development, and their cognitive and technical norms used in analysis of drought and scarcity and design of development programmes. These public agencies have relied on science and technology both to generate new understanding of drought mechanisms and social and environmental dynamics shaping scarcity, and also mobilise water sources to reduce vulnerabilities in droughtprone regions. It explores two hypotheses: that scientific, technological and political elites build their power--or struggle to remain prominent actors--through the cognitive and technical norms that they build; and that a cognitive framework linking drought and scarcity can transform options to assess, allocate and use water resources in droughtprone areas. The thesis presents case studies from three droughtprone regions, India, Yemen and Zimbabwe. These regions have different patterns of drought risk and intensity, which manifest themselves in different dependencies and risks on different water sources--soil moisture, groundwater and surface water--to support agricultural production. They are also very different types of state in terms of their commitment to public action for development. The countries show differing dependencies on techno-scientific networks, techno-economic networks and district and community level management in shaping livelihood security in the face of drought, and have had different performances in mitigating drought impacts and creating equitable institutions to mediate scarce water resources. Future public action will be better informed by the emergence of critical science with a stronger commitment to participatory action rather than rational science. Ph.D. C819614. ProQuest

Geology of Yemen

Dissertations & Theses. URL:

<http://search.proquest.com/docview/305054998?accountid=12084>.

Vincent, Linden. "Debating the Water Decade: A View from the Yemen Republic." 1991. *Development Policy Review*. Vol. 9. June. Issue 2, Pages [197]-216. Descriptors: Water and water use -- Yemen; Rural development projects -- Yemen (Republic); Project appraisal -- Yemen. Notes: 22 cm; p. 197-216. Note(s): Includes bibliographical references (p. 215-216). OCLC: 9691139.

Vincent, Linden. 1990. *The Politics of Water Scarcity: Irrigation and Water Supply in the Mountains of the Yemen Republic*. London, England; Colombo, Sri Lanka: Overseas Development Institute; International Irrigation Management Institute. Descriptors: Irrigation -- Yemen (Republic); Irrigation -- Yemen (Republic) -- Management; Water and water use -- Yemen. Notes: 28 p. 21 cm. Cover title. "December 1990." Includes bibliographical references (p. 27-28). Responsibility: Linden Vincent. OCLC Accession Number: 24410969.

Vincent, Linden Faith. 2004. *Science, Technology and Agency in the Development of Droughtprone Areas: A Cognitive History of Drought and Scarcity*. Descriptors: Droughts -- Economic aspects -- India; Droughts -- Economic aspects -- Yemen; (Republic); Droughts -- Economic aspects --; Zimbabwe; Drought relief -- Developing countries; Water use -- Yemen (Republic); Water use -- Zimbabwe; Water use -- India; Integrated water development; Thesis/dissertation. Notes: Dissertation: Thesis (Ph. D.)--Open University. Faculty of Technology. Centre for Complexity and Change - Development Policy and Practice. OCLC Accession Number: 496972522.

Vincent, Linden; Overseas Development Institute (London, England) and International Irrigation Management Institute. 1990. *The Politics of Water Scarcity: Irrigation and Water Supply in the Mountains of the Yemen Republic*. London: Overseas Development Institute. Descriptors: Irrigation water -- Yemen (Republic); Water-supply -- Economic aspects. Notes: 28 p. 21 cm. Caption title. "Odi-IIMI Irrigation Management Network--Cover. "December 1990"--Cover. Includes bibliographical references (p. 27-28). OCLC Accession Number: 23948753.

Vélain, Charles. 1878. *Description géologique de la presqu'île d'Aden, de l'Ile De La Réunion, Des Iles Saint-Paul et Amsterdam*. Paris: Typographie A. Hennuyer. Page(s): 358. Descriptors: Geology -- Indian Ocean Region. Notes: iv; [27] leaves of plates: ill., (some folded, col.), maps; 29 cm. Responsibility: par Charls Vélain. OCLC Accession Number: 6232288.

Vogel, H. 1988. "Impoundment-Type Bench Terracing with Underground Conduits in Jibal Haraz, Yemen Arab Republic." *Transactions - Institute of British Geographers*. Volume 13, Issue 1, Pages 29-38. Notes: Cited By (since 1996): 3. Abstract: Arable farming in mountainous South Arabia is exclusively based on land terracing. The unique characteristic of this agricultural ecosystem is the millions of stone-built bench terraces. Superficially the indigenous hydrotechnology is not eye-catching, although there are subterranean water conduits which strikingly illustrate the high engineering skill and vast hydrological experience of the Yemeni peasant farmers. Database: SCOPUS.

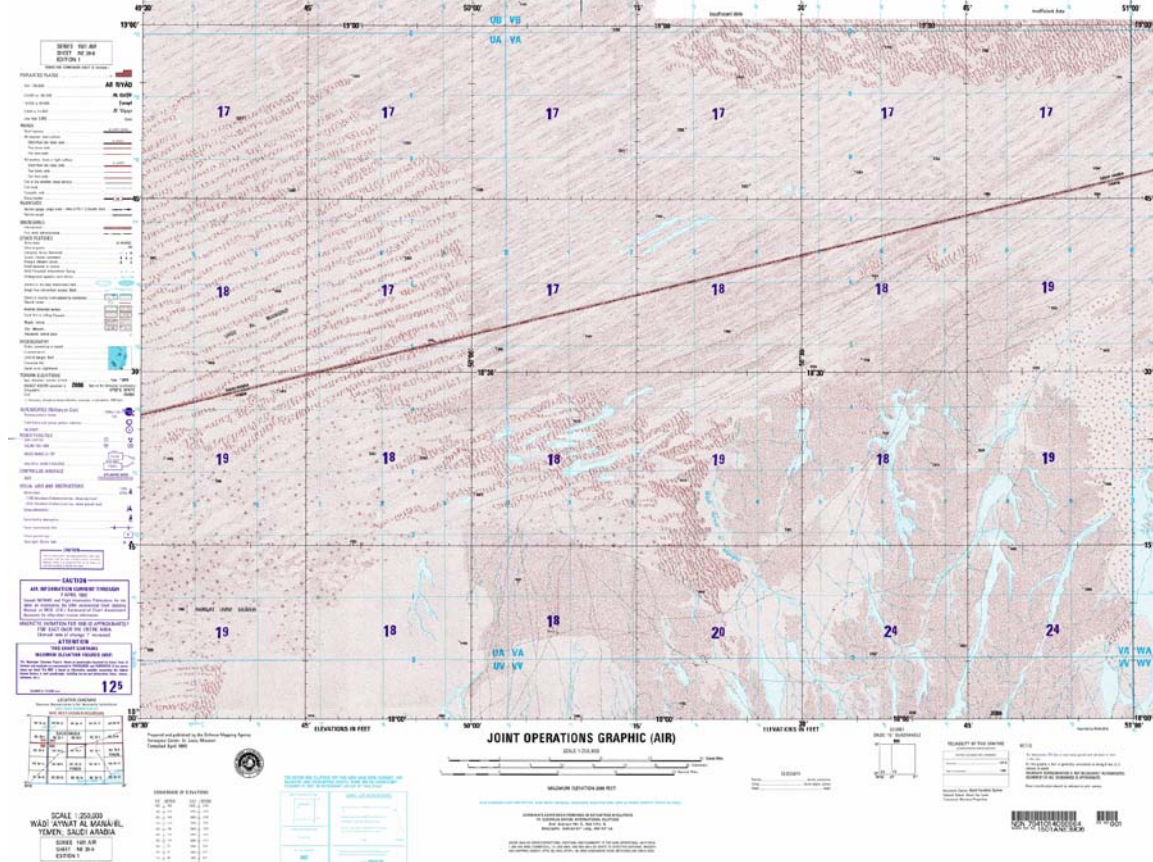
Von Herzen, Richard P. 1963. "Geothermal Heat Flow in the Gulfs of California and Aden." *Science*. June 14. Volume 140, Issue 3572, Pages 1207-1208. Abstract: Eighteen measurements in and near the gulfs of California and Aden indicate the geothermal flux is several times the world-wide mean of 1.2×10^{-6} cal/cm² sec in both regions. Both gulfs closely coincide with the intersection of oceanic rises with continents and have likely been formed under tensional forces, which suggest an association with mantle convection currents.

Geology of Yemen

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Wadi Aywat al Manahil, Yemen, Saudi Arabia. Defense Mapping Agency. Aerospace Center, St. Louis, Mo. 1992. Scale 1:250,000. Series 1501 Air; Sheet NE 39-6; Edition 1. Joint Operations Graphic (Air). Reprinted by NIMA, September 2002. See the website, accessed October 5, 2011:

http://www.lib.utexas.edu/maps/jog/yemen/nd-39-6-wadi_aywat_al_manahil-yemen_saudi_arabia.pdf)



Wagenaar, Arnout and D'Haese, Marijke. 2007. "Development of Small-Scale Fisheries in Yemen: An Exploration." *Mar. Policy*. 5. Volume 31, Issue 3, Pages 266-275. Descriptors: Small-scale fisheries; Development; Yemen. Abstract: Yemen is one of the poorest countries in the world. The development of its fishery sector is increasingly being mentioned as a source of livelihood creation. The aims of this paper are to: (a) provide an overview of the institutional environment in which small-scale fishermen in Yemen operate; (b) investigate the constraints they face; and (c) discuss the potential role that co-operatives could play in such development. Small-scale fisheries in Yemen are increasingly important, yet they struggle with access to infrastructure, markets, and credit. We identify significant differences in the development of the fisheries sector in the two main fishing regions: the Gulf of Aden and the Red Sea. Overall, local capacity within co-operatives needs to be improved and private sector development should be encouraged. ISSN: 0308-597X.

Wagner, Wolfgang and Geyh, Mebus A. 1999. "Application of Environmental Isotope Methods for Groundwater Studies in the ESCWA Region." *Geologisches Jahrbuch. Reihe C: Hydrogeologie, Ingenieurgeologie*. Schweizerbart in Komm., Stuttgart, Germany. Volume 67, Pages 5-129. Descriptors: absolute age; alluvium aquifers; aquifers; Arabian Peninsula; Asia;

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atmospheric precipitation; Bahrain; C-14; carbon; carbonate rocks; clastic rocks; climate; currents; ground water; ground-water provinces; hydrogen; igneous rocks; influence; isotope geochemistry; isotope ratios; isotopes; Jordan; Kuwait; Lebanon; limestone; Middle East; O-16; O-18; O-18/O-16; Oman; oxygen; paleoclimatology; Qatar; radioactive isotopes; recharge; sampling; sandstone; Saudi Arabia; sedimentary rocks; soft rocks; stable isotopes; Syria; tritium; United Arab Emirates; volcanic rocks; water quality; Yemen. Database: GeoRef in Process. ISSN: 0341-6410.

Wakai, Seigo and Tokuda, Keiji. 1994. "Groundwater Exploration and Development in Desert Area; Yemen." Tsuchi-to-Kiso JSSMFE = Soil Mechanics and Foundation Engineering. Japanese Society of Soil Mechanics and Foundation Engineering, Tokyo, Japan: Japan. Volume 42, Issue 1(432), Pages 33-36. Descriptors: Arabian Peninsula; Asia; desertification; deserts; development; eolian features; exploration; ground water; preventive measures; water balance; water resources; Yemen. References: 5; illus. incl. 2 tables, geol. sketch maps. Database: GeoRef. ISSN: 0041-3798.

Walker, Godfrey J. A., Hogerzeil, Hans V., Sallami, Ali O., Alwan, Ala'din A. S., Fernando, George and Kassem, Fahdl A. 1990. "Evaluation of Rational Drug Prescribing in Democratic Yemen." Soc. Sci. Med. Volume 31, Issue 7, Pages 823-828. Descriptors: evaluation methods; essential drugs; drug prescription; Democratic Yemen. Abstract: The government of Democratic Yemen started an essential drugs programme in 1984. Every month quantities of 30 drugs are delivered in prepacked kits to health units and standard treatment schedules have been agreed. The quantities of each drug were estimated by applying the standard treatment schedules to the typical morbidity patterns seen at these facilities. Most health workers attended a training course on the correct use of the standard treatment schedules. Hospital and health centres have been included in the programme to a more limited extent. ISSN: 0277-9536.

Wallis, R. S. and Giles, B. J. 2010. "Design Aspects of an LNG Loadout Jetty in Yemen." Australian Journal of Structural Engineering. Engineers Media Pty. Ltd: 09. Volume 10, Issue 2, Pages 111-120. Descriptors: Structural engineering; Jetties; Contractors; Facilities; Trestles; Piling (Civil engineering); Pipelines; Dolphins; Design & construction; Yemen, South. Abstract: This paper discusses the design problems associated with the site and how they were overcome in consultation with the construction contractor to best suit their expertise and equipment. The facility consists of an 800 m long approach trestle giving vehicular access to the loading platform and carrying the product pipelines, six mooring dolphins, four berthing dolphins, and a multi-level loading platform with four LNG loading arms. Conventional piled headstocks were chosen for the approach trestle, but deeper water along the berthing face led to jacket structures for each of the berthing and mooring dolphins, and the loading platform. The site geology generally consists of sandy sediments overlying Basaltic rock, with the depth of overburden varying from around 15 m at the berth to exposed rock onshore. Low tension capacity of driven piles required a significant number of tension anchors to be drilled into rock. The 7.8 m design wave at the site was a breaking wave over about one-third of the length of the trestle, and the headstock level was chosen to clear the wave crest by 1.5 m. The design of the topworks was being carried out by the main contractor at the same time, which resulted in uncertain pipe loads during the preliminary design phase. Prefabrication was carried out in Malaysia and transported to Yemen by barge, along with all equipment and construction materials. Provisions for sea transport of the fabricated jacket structures and the mechanics of their handling and installation were important parts of the design process. ISSN: 1328-7982.

Geology of Yemen

URL: <http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=59255966&site=ehost-live&scope=site>.

Walter Reed Army Medical Center Washington D C. 1962. Health Data Publications no. 16. Yemen. Ft. Belvoir Defense Technical Information Center: Descriptors: Medicine and Medical Research; Public health; Yemen; Transportation; Natural resources; Maps; Animals; Waste disposal; Medical services; Food; Nutrition; Epidemiology; Water supplies; Health surveys; Health care facilities. Abstract: Contents: Minerals, industry, transportation and communications; Food and nutrition, water supply; Animals of medical importance; Diseases of Yemen; Health services and medical facilities. Notes: 21 p. General Info: APPROVED FOR PUBLIC RELEASE. OCLC Accession Number: 227365399.

Walter, Robert C., Buffler, Richard T., Berhe, Seife, Vondra, Carl, Yemane, Tesfaye and Andemariam, Tesfalidet. 1997. "Rift Tectonics and Sedimentation in the Southern Red Sea and Northern Danakil of Eritrea; Geological Society of America, 1997 Annual Meeting." Abstracts with Programs - Geological Society of America. Geological Society of America, Boulder, CO. Volume 29, Issue 6, Pages 47. Descriptors: absolute age; Afar; Afar Depression; Africa; Alid; Ar/Ar; Arabian Peninsula; Asia; Badda Beds; Buri Peninsula; Cenozoic; Cretaceous; dates; East Africa; Egypt; Eritrea; Ethiopia; faults; grabens; Indian Ocean; marine environment; marine terraces; Mesozoic; nearshore environment; North Africa; plate tectonics; Pleistocene; processes; Quaternary; Red Sea; reefs; rifting; Saudi Arabia; sebkha environment; sedimentation; shallow-water environment; shelf environment; shore features; southern Red Sea; structural controls; systems; tectonics; terrestrial environment; Tertiary; uplifts; upper Pleistocene; volcanism; volcanoes; Yemen. Abstract: Our objective is to study the origin and evolution of tectonism, volcanism, and sedimentation in an area where oceanic and continental rift processes merge. There are four major regions in our study area: (1) The Foro/Zula Basin shows evidence for significant tectonic uplift during the late Pleistocene. At least four raised fluvial terraces are exposed, the highest of which is over one hundred meters above sea level; (2) The southwestern coast of the Buri Peninsula, contains a series of late Pleistocene reef terraces, ranging between 5 and 20 m above sea level. The 5 m terrace is ubiquitous along the Red Sea coast of Egypt, Saudi Arabia, and Yemen, where it has been dated at about 125 ka; (3) The rhyolite volcano of Alid resides in a NE-SW trending graben between the Eritrean escarpment and the Red Sea Coast. New (super 40) Ar/ (super 39) Ar dates from Alid suggest ages from 100 ka to 10 ka. Fossil-bearing terrestrial sediments in tectonic basins south and west of Alid range from roughly 2.0 Ma to 100 ka; (4) The late Pleistocene shallow marine "Badda Beds" are exposed along the Red Sea Escarpment in the northern Danakil. The sediments show large scale cross-stratified and convoluted beds that have discordant relationships to similar overlying and underlying strata. These sediments may record a deeper shelf environment and movement along syn-depositional faults. The Badda Beds may be equivalent in age to fossil reef limestones that are exposed 7 to 10 km east of Badda in the north-central Danakil Depression. Laterally and vertically the limestones become gypsiferous, and are eventually entirely replaced by gypsum. The presence of obsidian artifacts in the limestones suggest a very shallow marine, near shore or subaerial sabkha environment. Database: GeoRef. ISSN: 0016-7592.

Walz, Jonathan David. 2010. Islamic Foundations for Effective Water Management Four Case Studies. Austin, Tex: University of Texas. Descriptors: Water management; Islam; Nile; Tigris-Euphrates; Jordan; Yemen; Shariah; Nile river basin; Tigris-Euphrates river basin. Abstract: This thesis project addresses Islamic water management by presenting case studies on regional water issues and analyzing the extent to which Muslim-majority states behave in a way

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consistent with Islamic shariah law. The case studies presented in this thesis address both international cooperation related to the management of trans-boundary water basins (the Nile and Tigris-Euphrates River Basins) and domestic water management strategies employed by Muslim-majority states in the MENA region (Jordan and Yemen). In each case, it is not clear that there is consistency between the Islamic ideals discussed by academics and the actual techniques employed by various states. In international attempts at managing the shared waters of the Nile and Tigris-Euphrates Basins, the fact that many riparian states have Muslim-majority populations does not appear to make the management of trans-boundary resources any easier or more successful. The implications for Islamic water management at the domestic level is also unclear - with shariah playing a positive role in Jordanian attempts at water conservation but promoting the over-exploitation of resources in Yemen. Although shariah appears to play a limited role in the management of trans-boundary water resources, it seems to be better suited for informing how states internally manage their endowments of freshwater resources. Notes: 1 online resource (viii, 64 leaves): ill., maps; Dissertation: Thesis (M.A.)--University of Texas at Austin, 2010. Note(s): Title from PDF title page (University of Texas Digital Repository, viewed on Feb. 16, 2011). Includes bibliographical references. OCLC Accession Number: 702155667.

Walz, Jonathon David. 2008. Yemen, Qat, and the Water Supply: A Strategy for the Efficient Allocation of Water Resources. Descriptors: Sustainable development -- Yemen; (Republic); Water-supply, Agricultural -- Yemen; Khat -- Economic aspects -- Yemen; Yemen (Republic) -- Economic policy; Thesis/dissertation; Manuscript;. Notes: ii, IV, 55 leaves: col. ill., maps; 29 cm. Dissertation: Thesis (Honors)--University of South Dakota, 2008. Note(s): Typescript (offset copy). Bibliography: leaves 52-55. Responsibility: by Jonathon David Walz. OCLC Accession Number: 698456746.

Waraqat Al-Jumhuriyah Al-Yamaniyah: Al-Lajnah Al-Iqtisadiyah Wa-Al-Ijtim'iyah Li-Gharbi Asiyah: Al-Ijtima' Al-Istishari Al-Mukhasas Li-Insha Fariq 'Amil Ma'Ni Bi-Al-Idarah Al-Rashidah Lil-Mawarid Al-Maiyah, Bairut 12-13 Novambar/Tishrin Al-Thani 2001. 2001. Beirut: UN. Page(s): 8. Descriptors: Water Resources; Water Policy; Yemen; Government publication; International government publication. Notes: table. Note(s): "Islahat al-siyasah fi-qita' al-miyah fi-al-Jumhuriyah al-Yamaniyah: mulakhas". Material type: Reports/studies. General Info: Distribution: Limited. Other Titles: Islahat al-siyasah fi-qita' al-miyah fi-al-Jumhuriyah al-Yamaniyah: mulakhas. OCLC Accession Number: 82968187.

Waraqat Dawlat Al-Yaman: Al-Lajnah Al-Iqtisadiyah Wa-Al-Ijtim'iyah Li-Gharbi Asiyah: Al-Ijtima' Al-Istishari Al-Mukhasas Li-Insha Fariq 'Amil Ma'Ni Bi-Al-Idarah Al-Rashidah Lil-Mawarid Al-Maiyah, Bairut 12-13 Novambar/Tishrin Al-Thani 2001. 2001. Beirut: UN. Page(s): 15. Descriptors: Groundwater; Saline Waters; Water Conservation; Yemen; Government publication; International government publication. Notes: charts, tables. Note(s): Includes bibliographical references. Material type: Reports/studies. General Info: Distribution: Limited. OCLC Accession Number: 83334422.

Ward, C.; Ueda, S.; McPhail, A. 2000 Water Resource Management in Yemen (Draft). World Bank- Contribution to the CDR Yemen. URL: <http://siteresources.worldbank.org/INTYEMEN/Overview/20150274/YE-Water.pdf>

Warner, Dennis B. Varisco, Daniel Martin and Water and Sanitation for Health Project (U.S.). 1988. Feasibility of Handpump Installation and Manufacture in the Yemen Arab Republic. Arlington, Va: Water and Sanitation for Health Project. Page(s): 81. Descriptors: Sanitary Engineering -- Yemen; Water Supply -- Yemen. Notes: ix; ill. 28 cm. Note(s): "Prepared for the USAID Mission to the Yemen Arab Republic under WASH Activity No.

Geology of Yemen

372.”/ “January 1988.”/ “Contract No. 5942-C-00-4085-00, Project No. 936-5942.” Includes bibliographical references. OCLC Accession Number: 54352938.

Water Resources Planning, Management, use and Conservation in the ESCWA Region. 1993. New York: UN. Descriptors: Water Resources; Water Resources Development; Water Policy; Egypt; Jordan; Yemen; Gulf States; Water Conservation; Water Management; Water Consumption; Water Supply; Groundwater; Shared Water Resources; Water Law; Regional Programmes; Regional Cooperation; Western Asia; Persian Gulf Region; Conferences; Recommendations. Notes: vii, charts, tables. “Based on the National papers presented at the [Regional] Symposium [on Water Use and Conservation, held in Amman from 28 Nov. to 2 Dec. 1993]”. UN Job no.: I9400033 E. Material type: Reports/studies. General Info: Distribution: General. OCLC Accession Number: 123386610.

Watson, J. C. E. 2006. “Yemen: Language Situation.” Oxford: Elsevier. Page(s): 729-730. Descriptors: Ancient South Arabian; Arabic; Hobyōt; lexicon; Mehri; Modern South Arabian; morphology; phonology; Somali; Suquri; Yemen. Abstract: The Republic of Yemen is situated in the southeast corner of the Arabian Peninsula, bordering Saudi Arabia to the north and Oman to the east, including the island of Suqura and its neighboring islets Abd al-Kūri and Sama. Most Yemenis speak one of many dialects of Yemeni Arabic. The three Modern South Arabian languages spoken in Yemen are Mehri, Hobyōt, and Suquri. Over the past couple of decades, immigrants from Somalia have formed Somali-speaking communities. ISSN/ISBN: 978-0-08-044854-1.

Watts, S. 1998. “Perceptions and Priorities in Disease Eradication: Dracunculiasis Eradication in Africa.” Soc. Sci. Med. Volume 46, Issue 7, Pages 799-810. Descriptors: Africa; Disease eradication; Dracunculiasis; History of medicine. Notes: Cited By (since 1996): 8. Abstract: Dracunculiasis, guinea worm disease, is an incapacitating disease affecting people in poor, remote areas of Africa, in Yemen, and a few remaining areas of the Indian subcontinent where there is poor access to protected water sources. The neglect of this preventable disease and its belated recognition are analyzed within the context of changing priorities for health since the 1870s, especially the shift from the paradigm of Imperial Medicine to Primary Health Care. A global eradication effort took off during the 1980s, and, although the original target date of December 1995 has passed, the program has achieved a remarkable recent diminution in the number of recorded cases, over 99% of which are now found in Africa. Eradication policies in Africa are briefly explored in relation to current concerns such as the incorporation of dracunculiasis eradication measures in cash-starved primary health care programs. The wider implications of an eradication campaign which is on the verge of success are also considered. Database: SCOPUS. ISSN: 0277-9536.

Weather Bureau Washington D C And Grimes, Annie, E. 1960. “An Annotated Bibliography On The Climate Of The Arabian Peninsula,” Dec. Page(s): 42 Report Number: WB/BC-42. Abstract: The bibliography consists of sources containing meteorological and climatological data for the Arabian Peninsula. This peninsula includes Saudi Arabia, Kuwait, Qatar, Yemen, Oman, Trucial Oman, Aden Colony and Aden Protectorate. The document lists 124 reports by title and author, and includes descriptive comments concerning the content of these reports. Abstract Classification: Unclassified Technical Reports Collection. DTIC Accession Number: AD0664696.

Weir, Shelagh. 2007. *A Tribal Order: Politics and Law in the Mountains of Yemen*. Austin: University of Texas. Modern Middle East Series, number 23. Descriptors: Tribes, Tribal Law, Tribal Government, Jabal Rāzih. Abstract: *A Tribal Order* describes the politico-legal

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system of Jabal Razih, a remote massif in northern Yemen inhabited by farmers and traders. Contrary to the popular image of Middle Eastern tribes as warlike, lawless, and invariably opposed to states, the tribes of Razih have stable structures of governance and elaborate laws and procedures for maintaining order and resolving conflicts with a minimum of physical violence. Razihi leaders also historically cooperated with states, provided the latter respected their customs, ideals, and interests. Weir considers this system in the context of the rugged environment and productive agricultural economy of Razih, and of centuries of continuous rule by Zaydi Muslim regimes and (latterly) the republican governments of Yemen. The book is based on Weir's extended anthropological fieldwork on Jabal Razih, and on her detailed study of hundreds of handwritten contracts and treaties among and between the tribes and rulers of Razih. These documents provide a fascinating insight into tribal politics and law, as well as state-tribe relations, from the early seventeenth to the late twentieth century. *A Tribal Order* is also enriched by case histories that vividly illuminate tribal practices. Overall, this unusually wide-ranging work provides an accessible account of a remarkable Arabian society through time. ISBN: 978-0-292-71423-6.

Weidner, J. and Benzinger, S. 2001. "Water Supply and Wastewater Disposal in Sana'a, Capital City of Yemen." GWF Wasser Abwasser. Volume 142, Issue 15, Pages 15-18. Abstract: Water resources in and for Sana'a, Capital City of Yemen, are scarce due to low annual rainfall, small amounts of natural replenishment, and high evaporation. There is currently no integrated water resources management plan. Strong efforts towards water recycling and saving actions are started by investigating reuse of effluent from existing Wastewater Treatment Plant. Solutions and measures on preliminary design base have been explained. Additional actual studies on groundwater recharge are mentioned. Descriptors: Arabian Peninsula; artificial recharge; Asia; ground water; recharge; recycling; Sana'a Yemen; surface water; waste disposal; waste water; water supply; Yemen. Database: SCOPUS. ISSN: 00163651.

Weiss, Christian. 2008. "Basin Platform Transitions in Upper Jurassic Carbonates of the Amran Group, Yemen; GEO 2008 Conference Abstracts." GeoArabia (Manama). Gulf Petrolink in Bahrain, Manama, Bahrain. Volume 13, Issue 1, Pages 257-258. Descriptors: Amran Group; Arabian Peninsula; Asia; bars; basin analysis; basins; carbonate platforms; carbonate ramps; carbonate rocks; chemostratigraphy; depositional environment; Foraminifera; geochemistry; Invertebrata; Jurassic; lagoonal environment; lithofacies; lithostratigraphy; Marib Yemen; Mesozoic; microfossils; paleoenvironment; Protista; reconstruction; reefs; sedimentary basins; sedimentary rocks; sedimentation; shallow-water environment; transition zones; Upper Jurassic; X-ray diffraction data; Yemen; Yemen Mountains. Database: GeoRef. ISSN: 1025-6059. URL: <http://www.gulfpetrolink.net/publication/geoarabia.htm>.

"When Fish and Farmland are Scarce: Yemen and the Horn of Africa." 2010. *New York Times*. 12/12. Pages 3. Descriptors: climatic changes; petroleum; water; desertification; Yemen (Republic); Qaida (Organization). Abstract: The political issue climate change feeds anarchy in poor societies resources at play Arable land, water, oil, sea lanes. ISSN: 0362-4331. URL: <http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=55733853&site=ehost-live&scope=site>.

Whitehouse, Martin J., Windley, Brian F., Stoesser, Douglas B., Al-Khribash, Salah, Babbat, Mahfood A. O. and Haider, Abdullah. 2001. "Precambrian Basement Character of Yemen and Correlations with Saudi Arabia and Somalia." *Precambrian Res.* 1/31. Volume 105, Issue 2-4, Pages 357-369. Descriptors: Pb- and Nd-isotopes; Precambrian; Yemen. Abstract: The Precambrian basement of Yemen occupies a key location in the Pan-African orogen of

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Gondwana. This paper reviews geological, isotopic and geochronological data and presents new Pb- and Nd-isotope data which help define distinct gneiss terranes within this basement, constraining correlations of these terranes with neighbouring regions of Saudi Arabia and Somalia. Existing whole-rock Pb- and Nd-isotopic data are also summarised. These data should facilitate a more objective assessment of the contribution of the Yemen Precambrian to Cenozoic magmatism associated with the opening of the Red Sea and the Gulf of Aden. ISSN: 0301-9268.

Whitman, CE; Parr, J. Papendick, R. and Meyer, R. 1986. Soil, Water and Crop/Livestock Management Systems for Rainfed Agriculture in the Near East Region. Proceedings of the Workshop at Amman, Jordan on January 18-23, 1986. Performer: Department of Agriculture, Washington, DC. Sponsor: Agency for International Development, Washington, DC. International Center for Agricultural Research in the Dry Areas. 1986. 359p. Abstract: The dryland areas of the Near East Region are a major source of food and fiber for millions of people. However, current yields are very low compared to yields of the same crops in developed countries. The principal reasons for this are: (1) new and improved technologies that might increase crop production are not being readily adopted; (2) improved soil and water conservation methods are not being implemented; (3) there are severe economic constraints to the acceptance of new technologies; (4) the long-term and continued erosion of agricultural soils by both wind and water, and the subsequent loss of soil productivity; (5) limited and often erratic rainfall; (6) inadequate use of chemical fertilizers in the dryland areas; and (7) the low level of crop residue that is returned to the land because of its competitive use as feed for small ruminant animals, mainly sheep. Thus, with the creation of the USDA/USAID Dryland Agriculture Project, also referred to as Technology for Soil Moisture Management (TSM), and with strong encouragement by a number of regional and international organizations, a work shop was organized to address the overall problem of declining yields and its multifaceted, complex components. Database: NTIS Database (National Technical Information Service). URL: <http://search.proquest.com/docview/87027666?accountid=12084>.

Wiermann, S. Fasbender, K. Borrmann, A. Kebschull, D. Naini, A. and Stanzel, K. 1988. Entwicklung Laendlicher Regionen Nordafrikas Und Des Nahen Und Mittleren Ostens; Ueberlegungen Zur Entwicklung Arider Und Semi-Arider Gebiete. Land Evolution of the North African, Near and Middle East Regions; Reflections on the Development of Arid and Semi-Arid Areas. Federal Republic of Germany Deutsch. Ges. Tech. Zusammenarb. (GTZ), HWWA, Inst. Wirtschaftsforsch, Hamburg, Federal Republic of Germany. Descriptors: Africa; agriculture; Arabian Peninsula; arid environment; Asia; bibliography; classification; climate; developing countries; Egypt; environment; environmental geology; erosion; ground water; hydrogeology; international cooperation; irrigation; Jordan; Middle East; Morocco; North Africa; planning; review; semi-arid environment; soil erosion; soils; surface water; Syria; terrestrial environment; Tunisia; water storage; Yemen. Notes: References: 372; illus. incl. 23 tables, geol. sketch maps. Database: GeoRef in Process. GeoRef Accession Number: 7031-1.

Wilkie, David I. 1993. "Special ESP Configurations Designed to Test and Produce Yemen Oil Field." Oil & Gas Journal. PennWell, Tulsa, OK, United States: United States. 27 Sep. Volume 91, Issue 39, Pages 67-70. Descriptors: Arabian Peninsula; Asia; electric submersible pumps; instruments; oil and gas fields; petroleum; petroleum exploration; wells; Yemen. Notes: CD: OIGJAV; Based on 2 papers presented at the Soc. Pet. Eng. Electric submersible pump workshop, Houston, Tex., April 28-30, 1993. Database: GeoRef. ISSN: 0030-1388. URL: <http://ogj.pennnet.com/home.cfm>.

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Willis, John M. 2007. *Unmaking North and South: Spatial Histories of Modern Yemen*. Abstract: This dissertation explores the spatial construction of modern Yemen, based on a comparison between colonial indirect rule in the south and the rule of the Zaydi Imamate in the north in the period between 1839 and 1934. Drawing on archival research in Britain and Yemen, this study attempts to locate the relationship between the geographical imagination and everyday practices of rule in the constitution of the Aden Protectorate and the late Zaydi Imamate. These two case studies are linked by the theoretical assumption that space is an effect of particular constellations of knowledge, power, and practice. I argue that colonial rule in the south was based on the production of difference in the form of pre-modern tribal society and the elaboration of a complex of discourses and practices that made this difference real. In contrast, Imam Yah[dotbelow]ya H[dotbelow]amid al-Din (r. 1904-48) reconstituted the Zaydi Imamate of North Yemen in the early twentieth century as a hybrid state which combined new technologies of power with a moral geography based in an earlier Zaydi Islamic tradition. The dissertation begins with an analysis of the production of the Aden Protectorate as tribal space. Looking at the fields of colonial ethnography, imperial ritual, cartography, and policing, I locate colonial rule in Aden in the larger histories of British rule in the independent “princely states” of India. I follow with an analysis of the hybrid state of Imam Yah[dotbelow]ya in the same period. On the basis of elite historiography, official proclamations, court documents, records of taxation, and poetry I locate the production of the modern Imamate at the intersection of an Ottoman military legacy and the monarchical legacy of the Zaydi Qasimi dynasty of the late eighteenth century. The study concludes with an analysis of the undeclared war between the British and Imam Yah[dotbelow]ya over the space of the Aden Protectorate and the conclusion of the Anglo-Yemeni treaty of 1934. ProQuest Dissertations & Theses: 3283369. URL: <http://search.proquest.com/docview/304830322?accountid=12084>.

Wilson, G., Price, A. R. G., Huntington, T. and Wilson, S. C. 2003. “Environmental Status of Yemen’s Gulf of Aden Coast Determined from Rapid Field Assessment and Satellite Imagery.” *Aquat. Ecosyst. Health Manage.* Volume 6, Issue 2, Pages 119. Descriptors: Biotic communities; Ecology; Bays -- Middle East; Aden, Gulf of -- Environmental conditions; Yemen (Republic) -- Environmental conditions; Yemen (Republic); Middle East; cluster analysis; coastal ecosystems; resource-use conflicts. Abstract: Ninety-one sites covering 1400 km of the Gulf of Aden coast of Yemen were examined by rapid field assessment, yielding ordinal data on the extent of habitats, abundance of species groups and magnitude of human uses/environmental impacts. Satellite imagery was used to determine sea surface chlorophyll concentrations. Mangroves and seagrasses were largely absent, due to the high-energy conditions and unstable substrata. Coral development was also limited, principally because of cold upwelling sea temperatures. Macroalgal prevalence and abundance were greater on account of high nutrient levels. Nesting sites of three turtle species (Green, Hawksbill, and Loggerhead) were all impacted at low levels. Coastal construction was small-scale and located near larger towns (Al Mukalla, Foua and Shehir), while water- and land-based pollution and fishing were widespread but minimal. Fish abundance showed significant positive correlation with chlorophyll concentration. These and other associations observed probably involve causal links, although habitat effects and other factors may also be important. Classification of sites by cluster analysis using biological data and use/impact data separately revealed considerable environmental heterogeneity. The lack of clear geographical patterns contrasts with results from the Red Sea, where latitudinal related groupings using comparable biological data are evident. ISSN: 1463-4988. URL:

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<http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=10726029&site=ehost-live&scope=site>.

Wilson, G., Price, ARG*, Huntington, T. and Wilson, SC. 2003. "Environmental Status of Yemen's Gulf of Aden Coast Determined from Rapid Field Assessment and Satellite Imagery." *Aquat. Ecosyst. Health Manage.* Volume 6, Issue 2, Pages 119-129. Descriptors: Article Subject Terms: Aquatic reptiles; Classification systems; Coastal zone management; Environmental impact; Fishing mortality; Habitat; Man-induced effects; Nesting; Phytoplankton; Pollution effects; Remote sensing; Satellite sensing; Satellites; Seaweeds; Article Taxonomic Terms: *Caretta caretta*; *Chelonia mydas*; Cheloniidae; *Eretmochelys imbricata*; Article Geographic Terms: Indian Ocean, Aden Gulf; Yemen; Yemen; *Caretta caretta*; Green sea turtle; Green turtle; Hawksbill; Hawksbill sea turtle; Loggerhead; Loggerhead sea turtle; Marine turtles; Modern sea turtles; Sea turtles. Notes: Special Issue: Barometers of Aquatic Ecosystem Health & Integrity. TR: CS0317985. Abstract: Ninety-one sites covering 1400 km of the Gulf of Aden coast of Yemen were examined by rapid field assessment, yielding ordinal data on the extent of habitats, abundance of species groups and magnitude of human uses/environmental impacts. Satellite imagery was used to determine sea surface chlorophyll concentrations. Mangroves and seagrasses were largely absent, due to the high-energy conditions and unstable substrata. Coral development was also limited, principally because of cold upwelling sea temperatures. Macroalgal prevalence and abundance were greater on account of high nutrient levels. Nesting sites of three turtle species (Green, Hawksbill, and Loggerhead) were all impacted at low levels. Coastal construction was small-scale and located near larger towns (Al Mukalla, Foua and Shehir), while water- and land-based pollution and fishing were widespread but minimal. Fish abundance showed significant positive correlation with chlorophyll concentration. These and other associations observed probably involve causal links, although habitat effects and other factors may also be important. Classification of sites by cluster analysis using biological data and use/impact data separately revealed considerable environmental heterogeneity. The lack of clear geographical patterns contrasts with results from the Red Sea, where latitudinal related groupings using comparable biological data are evident. Database: ASFA: Aquatic Sciences and Fisheries Abstracts. ISSN: 1463-4988.

Geology of Yemen

Wilson, R. T. 2003. "Biodiversity of Domestic Livestock in the Republic of Yemen." *Trop. Anim. Health Prod.* Volume 35, Issue 1, Pages 27-46. Descriptors: Breeds; Camel; Cattle; Donkey; Genotype; Goat; Poultry; Sheep. Abstract: This paper describes the domestic livestock of the Republic of Yemen and aspires complement earlier sources listing or describing 'breeds'. It attempts to species and provide indications of parameters through a literature review field observations made by the author Information is provided on livestock and the economic importance of production. Most animals are kept in mixed crop-livestock production transhumant systems have the next number of stock; with nomadic being of least and declining Yemen's livestock appear to comprise breeds of sheep, 5 breeds of goat, 2 cattle, 4 breeds of camel, 2 breeds of 1 breed of horse. There are no data on poultry but domestic fowl (where considerable diversity exists) and kept. There is little formal information history and relationships of most Some appear to be of ancient local origin, whereas others show affinities with those of neighbouring and other countries. None of the identified types is considered endangered, so conservation would be premature. A more formal and detailed genetic characterization, to add to the largely morphological and traditional classification, may, however, reveal such a need. Database: SCOPUS. ISSN: 0049-4747.



to partially cover all production and via in 1999. numbers animal sedentary systems; greatest systems importance. at least 11 breeds of donkey and breeds of clearly pigeons are on the breeds.

Photo Credit: Senior Airman Sarah Stegman, 40th Public Affairs Detachment. Staff Sgt. Meghan Groth (left), a veterinary technician from Third Army, U.S. Army Central, shows an animal worker in Yemen a treatment procedure during a veterinary assistance program. URL: <http://www.army.mil/media/3053/>

Wissmann, H. von. 1976. "Die Geschichte des Säbaerreichs und der Felzug des Æelius Gallus". Haase ed. Munchen, 1976

Wissmann, Hermann von. 1975. *Die Geschichte Von Saba'*. Wien: Sammlung Eduard Glaser, 13. Sitzungsberichte (Österreichische Akademie der Wissenschaften. Philosophisch-Historische Klasse), 301. Bd., Abh. 5. Contents: 1. Über die frühe Geschichte Arabiens und das Entstehen des Sabäerreiches; 2. Das Grossreich der Sabäer bis zu seinem Ende im Frühen 4. Jh. v. Chr. (History of the [Kingdom of] Sheba) OCLC: 2374659. ISBN: 3700101376; 9783700101376.

Wissmann, Hermann von. 1957-1958. *Southern Arabia [cartographic material]: part of Aden Protectorate from Shuqra to al-shihr and Baihan to Hadramaut.* [London]: The Royal Geographical Society, 1957-58, 1957. Abstract: Two adjoining maps of Southern Arabia in what is now Yemen, showing international boundaries, transportation, ruins, shrines, tombs, tribes and populated places. Relief shown by hachures and contours.; 4 insets: Inset A. Dathinah; B. Wadi

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Hurdan; C. Wadi Hadram aut; D. Mouth of Wadi al-Kasar.; Includes sheet location diagram and glossary. Sheet 1 "8,000/7/57 S.P.C., R.E."; sheet 2 "8,000/8/58/3818/R". National Library of Australia index only available in an electronic version via the Internet at:

<http://nla.gov.au/nla.map-vn52508>. OCLC: 751966611. URL: <http://nla.gov.au/nla.map-vn52508>.

Woods Hole Oceanographic Institution, Mass; Dept of Geology and Geophysics and Swift, Stephen A; Ross, David A. 2002. "Interpretation of Seafloor Characteristics in the Western Arabian Sea." Jan. Page(s): 8 Report Number: XB-ONR Contract Number: N00014-02-1-0414 Monitor Series: ONR. Abstract: The objective of this study was to provide a regional geologic interpretation of seafloor geotechnical composition, shallow subbottom stratigraphy, and geomorphology of the western Arabian Sea. Too few samples of the seafloor have been taken in this area to map the region from direct measurement. To provide regional coverage we used data from bathymetry, GLORIA side-scan, and echo sounding lines to supplement core samples obtained by academic institutions and NAVOCEANO. Much of the western Arabian sea basin is covered with pelagic-to-hemipelagic sediments to depths of 2-3 m. The exceptions are (1) the shelves and the current-swept shoal area near Socotra Island where carbonate sand and hardgrounds are more common; (2) canyons and gullies on the continental slope where slumping exposes over-consolidated deposits and contributes coarse, poorly-sorted debris to the canyon axes; (3) ridge crest regions; and (4) lobes of massive sands at the mouths of distributary channels on the Indus Fan. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: View Full Text (pdf); File: /U2/a412925.pdf; Size: 933 KB; Final rept. 15 Mar-31 Dec 2002. DTIC Accession Number: ADA412925.

Woods Hole Oceanographic Institution, MA. Dept of Geology And Geophysics and Swift Stephen, A. Ross David. 2001. "Interpretation of Seafloor Characteristics in the Gulf of Aden." Dec. Page(s): 9 Report Number: XB-ONR Contract Number: N00014-00-1-0748 Monitor Series: ONR. Abstract: We collected multibeam bathymetry on two physical oceanographic cruises to the Gulf of Aden and a transit leg through the Gulf. These data have been edited, corrected for speed of sound and merged into a single data set with information from NGDC trackline bathymetry and ETOPO2 estimated water depths to fill in gaps. For the first time, these data define the shape of the seafloor along channels carrying saline overflow water from the Bab al Mandeb Strait into the Gulf of Aden above the Tadjoura Rift. The along-axis gradient and shape affect the degree and rate of mixing between overflow water and the ambient water in the Gulf. Abstract Classification: Unclassified Technical Reports Collection. Notes: Full Text (pdf) Availability: View Full Text (pdf); File: /U2/a400624.pdf; Size: 624 KB; Final rept. 1 Jun 2000-31 Dec 2001. DTIC Accession Number: ADA400624.

Woods Hole Oceanographic Institution MA and Furey, Heather H; Bower Amy S; Fratantoni, David M. 2005. "Red Sea Outflow Experiment (REDSOX): DLD2 RAFOS Float Data Report February 2001 - March 2003." Jan. Page(s): 141 Report Number: WHOI-2005-01 XJ-NSF Contract Number: OCE-9818464 Monitor Series: NSF. Abstract: This is the final data report of all acoustically tracked second-generation Deep Lagrangian Drifter (DLD2) RAFOS float data collected by the Woods Hole Oceanographic Institution in 2001-2003 during the Red Sea Outflow Experiment (REDSOX). The float component of REDSOX was comprised of two deployments on the R/V Knorr and R/V Ewing: the first in February-March 2001, with 26 floats, and the second in August-September 2001, with 27 floats. The isobaric floats were ballasted for 650 decibars to target the intermediate-depth, high-salinity outflow waters from the Red Sea. The objectives of the Lagrangian float study were: (1) to identify the spreading pathways of the

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equilibrated Red Sea outflow, and to quantify the velocities and eddy variability typical of this outflow and of the background oceanic environment in the Gulf of Aden, and (2) to identify and describe the mesoscale processes which contribute to the seaward transport of Red Sea Overflow Water properties through the Gulf of Aden and into the western Indian Ocean. In addition to floats activated and launched during the two cruises, four time-series sites were chosen for dual-release float moorings. The dual-release floats were released every two months between cruises and every two months after the second cruise, with the final release in March 2002. A pirate attack on the R/V Ewing forced some modification of the float deployment plan during the second cruise. Abstract Classification: Unclassified Technical Reports Collection. View Full Text (pdf); File: /U2/a432810.pdf; Size: 7 MB; Final technical rept. Feb 2001-Mar 2003; Distribution Statement: Approved for public release; distribution is unlimited. DTIC Accession Number: ADA432810.

Woods Hole Oceanographic Institution MA and Pratt, Lawrence. 1999. "Red Sea Studies." 05 May. Page(s): 4 Report Number: WHOI-13045600 XB-ONR Contract Number: N00014-95-1-0456 Monitor Series: ONR. Abstract: This work was focused on the dynamics of stratified flow in sea straits, primarily the Bab al Mandab (BAM). Possible hydraulic control of the exchange flow in the BAM was investigated by analyzing data collected by Drs. Steve Murray and Bill Johns as part of a recent 2-year field program The analysis centered on the calculation of long wave speeds for the first and second baroclinic modes of the stratified shear flows at the sill and narrowest section of the Strait. Doing so required advancements in the theory of internal long waves in straits with nonuniform cross-channel topography. The hydraulic character of the flow is vital in the understanding of the stratification in the BAM and in the neighboring Red Sea and Gulf of Aden. Theoretical studies of the effects of rotation on hydraulically controlled flows in straits were also carried out. The results reveal some remarkable structural features such as transverse hydraulic jumps, recirculations and splitting of the flow. Abstract Classification: Unclassified Technical Reports Collection. View Full Text (pdf); File: /U2/a363049.pdf; Size: 229 KB; Final rept. 1 Mar 95-31 Dec 98. DTIC Accession Number: ADA363049.

Woods Hole Oceanographic Institution Mass and Knott, ST; Bunce, ET; Bowin, CO; Hersey, JB; Chase, RL. 1965. "Narrative of Chain Cruise No. 43, 15 February - 21 August 1964." Feb. Page(s): 187 Report Number: REF-65-9 Contract Number: Nonr-4029(00) NSF-GP-2370. Abstract: On Chain Cruise 43, 15 February to 21 August 1964, geophysical and geological observations were made in the North Atlantic Ocean, the Mediterranean and Red Seas, and the Western part of the Indian Ocean, along the track Woods Hole - Ceuta (Spanish Africa) - La Spezia - Port Said Aden - Victoria (Seychelles Islands) - Port Louis (Mauritius) - Victoria (Seychelles Islands) - Port Said Beirut - La Spezia - Monaco - Plymouth (England) - Woods Hole. This report contains (1) a narrative of the cruise, (2) a list of stations, (3) statements of the scientific objectives of the cruise, (4) a summary of the geological and geophysical observations, (5) end-of-cruise reports on equipment and some phases of the research program, and (6) a selection of bottom photographs. WHOI Ref. No. 64-51 contains a detailed navigational plot of the entire cruise, including soundings and the locations of other observations. (Author) Abstract Classification: Unclassified Technical Reports Collection. Notes: Summary rept. DTIC Accession Number: AD0616392.

Worden, Richard H. 2006. "Dawsonite Cement in the Triassic Lam Formation, Shabwa Basin, Yemen: A Natural Analogue for a Potential Mineral Product of Subsurface CO₂ Storage for Greenhouse Gas Reduction." Mar. Pet. Geol. 1. Volume 23, Issue 1, Pages 61-77.

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Descriptors: Dawsonite; Yemen; Carbon dioxide; Diagenesis; Cement; Shabwa Basin. Abstract: The origin and permeability effects of carbonate cement, blamed for poor reservoir quality in the Upper Triassic turbidite sandstones of the Lam Formation in Yemen, have been investigated using petrography, X-ray diffraction, stable isotopes, fluid inclusions and thermodynamic modelling. In order of growth in the sandstone, the carbonate cements include ferroan calcite, dawsonite ($\text{NaAlCO}_3(\text{OH})_2$), ferroan dolomite and siderite. Ferroan dolomite is the most abundant cement. There is an inverse correlation between permeability and total carbonate cement volume supporting the earlier assertion that carbonate cements are the main control on reservoir quality in these sandstones. Ferroan calcite replaced, and was sourced by, marine limestone rock fragments that are abundant in the turbidite sandstone. The later cements were probably also at least partly sourced from the marine limestone rock fragments. Stable isotope data from ferroan calcite, ferroan dolomite and siderite show that diagenesis occurred in formation water with oxygen isotopes typical of closed-system diagenesis and that only minor organic-derived carbon dioxide was involved in diagenesis. Dawsonite, while not common as a diagenetic mineral in sandstones, has recently been suspected of being a routine consequence of CO_2 storage in the subsurface for greenhouse gas reduction. In the Lam Formation, dawsonite, found at concentrations of up to 8 vol% of the rock, grew at the expense of detrital feldspar minerals under conditions of elevated partial pressure of carbon dioxide. Isotopic data show that dawsonite grew in the presence of carbon dioxide with a $\delta^{13}\text{C}$ value of about -4 to -2% . This is distinctly different from the carbon isotope ratio of the gas phase carbon dioxide now present in the sandstone (-27%), which had an organic source rock origin. The dawsonite $\delta^{13}\text{C}$ data probably represent a mixture between carbonate from detrital marine limestone rock fragments and carbon dioxide from a moderately negative source, possibly of magmatic or basement origins. Dawsonite may thus be the result of a mass influx of deep (e.g. magmatic) carbon dioxide that pushed the Lam Formation into the dawsonite stability field at the expense of albite. ISSN: 0264-8172.

Worden, Richard H. 2006. "Dawsonite Cement in the Triassic Lam Formation, Shabwa Basin, Yemen; a Natural Analogue for a Potential Mineral Product of Subsurface CO_2 (Sub 2) Storage for Greenhouse Gas Reduction." *Mar. Pet. Geol.* Jan. Volume 23, Issue 1, Pages 61-77. Descriptors: Arabian Peninsula; Asia; carbon dioxide; carbonates; cement; cementation; chemical reactions; clastic rocks; dawsonite; diagenesis; dolomite; gas storage; Lam Formation; Mesozoic; reservoir properties; sandstone; sedimentary rocks; Shabwa Basin; Triassic; turbidite; underground installations; underground storage; Yemen. References: 68; illus. incl. geol. sketch map, sect. Abstract: The origin and permeability effects of carbonate cement, blamed for poor reservoir quality in the Upper Triassic turbidite sandstones of the Lam Formation in Yemen, have been investigated using petrography, X-ray diffraction, stable isotopes, fluid inclusions and thermodynamic modelling. In order of growth in the sandstone, the carbonate cements include ferroan calcite, dawsonite ($\text{NaAlCO}_3(\text{OH})_2$), ferroan dolomite and siderite. Ferroan dolomite is the most abundant cement. There is an inverse correlation between permeability and total carbonate cement volume supporting the earlier assertion that carbonate cements are the main control on reservoir quality in these sandstones. Ferroan calcite replaced, and was sourced by, marine limestone rock fragments that are abundant in the turbidite sandstone. The later cements were probably also at least partly sourced from the marine limestone rock fragments. Stable isotope data from ferroan calcite, ferroan dolomite and siderite show that diagenesis occurred in formation water with oxygen isotopes typical of closed-system diagenesis and that only minor organic-derived carbon dioxide was involved in diagenesis.

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Dawsonite, while not common as a diagenetic mineral in sandstones, has recently been suspected of being a routine consequence of CO₂ (sub 2) storage in the subsurface for greenhouse gas reduction. In the Lam Formation, dawsonite, found at concentrations of up to 8 vol% of the rock, grew at the expense of detrital feldspar minerals under conditions of elevated partial pressure of carbon dioxide. Isotopic data show that dawsonite grew in the presence of carbon dioxide with a delta (super 13) C value of about -4 to -2 per mil. This is distinctly different from the carbon isotope ratio of the gas phase carbon dioxide now present in the sandstone (-27 per mil), which had an organic source rock origin. The dawsonite delta (super 13) C data probably represent a mixture between carbonate from detrital marine limestone rock fragments and carbon dioxide from a moderately negative source, possibly of magmatic or basement origins. Dawsonite may thus be the result of a mass influx of deep (e.g. magmatic) carbon dioxide that pushed the Lam Formation into the dawsonite stability field at the expense of albite. Database: GeoRef. ISSN: 0264-8172. URL: <http://www.sciencedirect.com/science/journal/02648172>.

World Bank. 2011. "Republic of Yemen - Rural Water Supply and Sanitation Project." Report number: ICR1844. 76 pages. Abstract: Ratings for the Rural Water Supply and Sanitation Project for Republic of Yemen were as follows: outcomes were moderately satisfactory; the risk to development outcome was moderate; the Bank's performance was moderately satisfactory; and the Borrower's performance was also moderately satisfactory. Some lessons learned included: sustainability of outcomes is dependent on sustainable water resources management. The sustainability of existing water sources was questioned at the time of appraisal and during early supervision of the project. Reaching the poor requires adaptation of demand-responsive approaches. Household connections and metering is often not affordable in poor areas and by the poorest households. Sanitation components can be complex and require close supervision attention. Harmonization between projects in a programmatic approach can provide more comprehensive and sustainable outcomes. Package contracts for sub-projects are relatively fast and efficient. Monitoring and evaluation should be embedded in community-based projects to provide communities with feedback. Water user associations need ongoing support. Community-based, demand-responsive approaches work in Yemen. URL: <http://go.worldbank.org/P5595Z5LE0>.

World Bank. Middle East and North Africa Region. Rural Development, Water, and Environment Dept. 1997. Yemen Towards a Water Strategy: An Agenda for Action. Washington, D.C.: Middle East and North Africa Region, Rural Development, Water, and Environment Sector. Descriptors: Water-supply -- Yemen (Republic); Water resources development -- Yemen (Republic); Water conservation -- Yemen (Republic); Government publication; International government publication. Notes: col. map; 28 cm. Cover title. "Document of the World Bank." In accordance with the World Bank's policy on disclosure of information, this document is available to the public. "August 13, 1997." OCLC Accession Number: 38251492.

World Bank. 2011. "Yemen - Water Sector Support Project: restructuring." Report number: 61629. 28 pages. Abstract: The objective of the Water Sector Support Project (WSSP) for Yemen is to support the recipient's implementation of the National Water Sector Strategy and Investment Program (NWSSIP) to: (i) strengthen institutions for sustainable water resources management; (ii) improve community-based water resource management; (iii) increase access to water supply and sanitation services; (iv) increase returns to water use in agriculture; and (v) stabilize and reduces groundwater abstraction for agricultural use in critical water basins. These changes include: a) simplification of the current financing modality. WSSP is currently jointly

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co-financed by a number of donors (the Netherlands and Germany); b) accommodate a differential financing percentage for certain agreed activities for water and sanitation under component three or part C of the project; c) make changes to the results framework; and d) add additional procurement methods for the procurement of goods and works, namely 'community participation', 'direct contracting' and 'force account' contracts, in order to enable National Irrigation Program (NIP) and the General Authority for Rural Water Supply Projects (GARWSP) to better implement small activities in more remote areas. URL:

<http://go.worldbank.org/KWY4WYCO40>.

World Bank and International Development Association. 1986. Report and Recommendations of the President of the International Development Association to the Executive Directors on a Proposed Development Credit in an Amount Equivalent to SDR 5.3 Million to the People's Democratic Republic of Yemen for a Greater Aden Second Water Supply Project. Washington: World Bank. Page(s): 21. Descriptors: Water-supply -- Yemen (Republic); Loans, Foreign -- Yemen (Republic); Government publication; International government publication. Notes: ii; [2] folded leaves of plates: col. maps; 28 cm. Cover title. "For official use only." "October 14, 1986." "Report No. P-4399-YDR." Other Titles: Yemen for a Greater Aden second water supply project. OCLC Accession Number: 52958527.

World Bank; Middle East and North Africa Region and Country Dept. II. 1992. Staff Appraisal Report: Republic of Yemen Land and Water Conservation Project. Washington: World Bank. Page(s): 89. Descriptors: Agriculture and state -- Yemen (Republic); Sustainable agriculture -- Yemen (Republic); Irrigation projects -- Yemen (Republic); Water conservation -- Yemen (Republic); Forests and forestry -- Yemen (Republic); Loans, Foreign -- Yemen (Republic); Government publication; International government publication. Notes: iv, [1] folded leaf of plates: ill., col. map; 28 cm. Cover title. "May 7, 1992." "Report No. 9842-YEM." Includes bibliographical references (p. 81). Other Titles: Republic of Yemen land and water conservation project; Responsibility: Middle East and North Africa Region, Country Department II, Agriculture Operations Division. OCLC Accession Number: 47068220.

"World Bank Loan Supports Water-Scarce Yemen." 2003. Pump Industry Analyst. 07. Volume: 2003, no. 7, page(s): 4. Descriptors: Banks & banking; Water quality management; Water-supply; Yemen (Republic); World Bank Group. Abstract: The World Bank has approved a US\$24 million credit to help the Government of Yemen to improve water management in the Sana'a Basin. This is a short news story only. Visit www.worldpumps.com for the latest pump industry news. Notes: Editorial. ISSN: 1359-6128. OCLC Accession Number: 10365667.

World Bank Publications. 2004. "What the New Sector Strategy might Mean for Yemen." IN: Water resources sector strategy: strategic directions for World Bank engagement. Page(s): 67-67-74. Abstract: Focusing on how to improve the development and management of water resources, this title provides principles that link resource management to the specific water-using sectors. The Strategy emphasizes the difficult and contentious issues upon which World Bank practice needs to improve and suggests that the main management challenge is not a vision of integrated water resources management but a "pragmatic but principled" approach. ISBN: 0821356976. URL:

http://books.google.com/books?id=ITLbnTSPKscC&dq=yemen&lr=&as_drrb_is=b&as_minm_is=0&as_miny_is=1990&as_maxm_is=0&as_maxy_is=2010&num=100&as_brr=1&as_pt=BOOKS&source=gbs_navlinks_s.

World Food Programme and Yemen. 1994-02-17. Interim Evaluation Summary Report on Project Yemen 3442: Soil and Water Conservation. Rome: World Food Programme. Page(s): 20.

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Descriptors: Soil Conservation; Water Conservation; Food Aid; Yemen; Project Management; Project Evaluation; World Food Programme--Programme Management. Notes: tables; Issued under agenda item 6a, agenda document [WFP/]SCP/12/1. At head of title: 37th session, CFA, Rome, 19-27 May 1994. UN development projects. Limited distribution. OCLC Accession Number: 84278107.

World Health Organization; United Nations Development Programme and Italconsult. 1973. Water Supply for Sana'a and Hodeida: Report. Volume 1, Hodeida Area Groundwater Studies. Rome: Italconsult. Descriptors: Groundwater -- Yemen (Republic) -- Hudaydah; Water-supply -- Yemen (Republic) -- San`a; Water-supply -- Yemen (Republic) -- Hudaydah; San`a (Yemen) -- Surveys; Hudaydah (Yemen) -- Surveys; Sana' (Yemen) -- Surveys; Al Hudaydah (Yemen) -- Surveys. Notes: 4, iv, 141 leaves: ill. (some folded, col.), folded col. maps; 29 cm. "UNDP: Yem 507."/"WHO: Yemen 3202."/"S 10/372/2 Yemen (3)." Responsibility: prepared for the World Health Organization as executing agency for the United Nations Development Programme by Italconsult. OCLC Accession Number: 42905439.

World Wildlife Fund (WWF), 2006, HydroSHEDS (BAS) - Drainage basins (watershed boundaries) at 15s resolution: U.S. Geological Survey, Sioux Falls, SD. Accessed Online: <http://hydrosheds.cr.usgs.gov/>

Worth, Robert F. 2009. "Thirsty Plant Steals Water in Dry Yemen." *New York Times*. 11. Pages 6. Descriptors: Agriculture; Water shortages; Crops; Droughts; Yemen (Republic). Abstract: More than half of this country's scarce water is used to feed an addiction. Even as drought kills off Yemen's crops, farmers in villages like this one are turning increasingly to a thirsty plant called qat, the leaves of which are chewed every day by most Yemeni men (and some women) for their mild narcotic effect. The farmers have little choice: qat is the only way to make a profit. ISSN: 0362-4331. URL: <http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=44908864&site=ehost-live&scope=site>.

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Yacoob, M. 1991. "Women and Water: The Bucket Stops here." *Agric Inf Dev Bull*. Volume 13, Issue 4, Pages 25-28. Notes: Cited By (since 1996): 2. Abstract: The provision of potable water alone does not significantly reduce the incidence of diarrhea. Yet if potable water is part of an integrated system with commitment by national and local officials and includes improved sanitation and hygiene education, substantial reductions in diarrhea do occur. Hygiene education should be based in existing community ideology, values, religion, and myth to change behavior and involve traditional leaders. Another benefit of projects is that women have more time to spend on other important activities, such as income generation. Since decisions revolving around water use are the responsibility of women in developing countries, their involvement in water supply and sanitation projects is crucial. They should take part in disseminating information and in managing water systems. They should also attend workshops on water and sanitation. For example, a study in Togo showed that the children of women who had participated in water projects were more likely to have complete immunization coverage and the women knew more about oral rehydration than those not involved. Nevertheless the health benefits of a water and sanitation project do not last if sustainability is not built into the project. For instance, water and sanitation specialists need to train community members to be responsible and manage improved water systems. In Yemen, specialists introduced a water and sanitation project to the government as a project serving the entire community since anything focusing on women invites the evil eye. Most health workers, sanitarians, and engineers who had the experience and knowledge to teach women were men, so the project enlisted the women of the women's extension service of the Ministry of Agriculture to teach the women. These Arab women were excellent role models for behavioral change. Database: SCOPUS.

Yemen. 2001. Country Presentation by the Government of Yemen. Geneva: United Nations. Descriptors: Economic assistance -- Yemen (Republic); Yemen (Republic) -- Economic conditions; Yemen (Republic) -- Economic policy; Conference publication (cnp); Government publication; International government publication; Internet resource; eBook. Abstract: Performance in the 1990s. Sectoral indicators. Structure of the economy -- Agriculture -- Oil -- Refinery -- Natural gas -- Electricity and water -- Financial -- Tourism -- Social indicators. Population -- Employment -- Vocational training and program -- Education -- Health care -- Social safety net fund -- Domestic opportunities and constraints. Peace and stability -- Economic infrastructures -- Policy reform -- Conducive environment for private sector development -- Human resource constraints -- Industrial and technology development -- External opportunities and constraints. Official development assistance (ODA) -- External debt burden -- Export sector -- Foreign direct investment -- Vulnerability to shocks -- The program of action for the next decade (2001-2010). Fiscal policy -- Monetary policy -- Foreign trade policy -- Agriculture policy -- Industrial policy -- Tourism policy -- Social development -- Investment for the next decade (2001-2010). Notes: 52 pages; 30 cm. At head of title: Third United Nations Conference on the Least Developed Countries, Brussels, 14-20 May 2001. "A/CONF.191/CP/17." Available both in print and online. Other Titles: Country presentation for Yémen; Action programme for the development of the Republic of Yemen 2001-2010. OCLC Accession Number: 47645996. URL: http://www.unctad.org/en/docs/aconf191cp17_en.pdf; http://www.unctad.org/en/docs/aconf191cp17_en.pdf Note: Connect to online resource.

Yemen. 2000. Warqah Qutriyah: Al-Jumhuriyah Al-Yamaniyah. Beirut: UN. Descriptors: Water Resources; Yemen; Government publication; International government publication.

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Notes: 17 p. tables. Note(s): UN Job no.: N990875 A. Material type: Misc. General Info: Distribution: Limited. OCLC Accession Number: 81013285.

Yemen. 1999. Warqah Qutriyah: Jumhuriyat Al-Yaman. Bayrut: UN. Descriptors: Water Resources; Yemen; Government publication; International government publication. Notes: 27 p. maps, tables. Note(s): Material type: Misc. General Info: Distribution: Limited. OCLC Accession Number: 83379678.

Yemen (Republic) and Hayah al-`Ammah lil-Mawarid al-Maiyah. 1900s. Al-Istratijiyah Al-Wataniyah Lil-Miyah. San`a: al-Jumhuriyah al-Yamaniyah, Riasat Majlis al-Wuzara, al-Hayah al-`Ammah lil-Mawarid al-Maiyah. Page(s): 14. Descriptors: Water-supply -- Yemen (Republic). Notes: 24; Other Titles: National water strategy. OCLC Accession Number: 123354157.

Yemen (Republic) and Hayah al-`Ammah lil-Mawarid al-Maiyah. 1900s. Al-Hifaz `alá Al-Ma Masuliyat Al-Jami`: Mustaqbal Al-Yaman Bayna Yadayka. San`a: al-Jumhuriyah al-Yamaniyah, al-Hayah al-`Ammah lil-Mawarid al-Maiyah. Page(s): 14. Descriptors: Water-supply -- Yemen (Republic). Notes: col. ill. 21 cm. Other Titles: Mustaqbal al-Yaman bayna yadayka. OCLC Accession Number: 170699283.

Yemen (Republic) and Hayah al-`Ammah lil-Mawarid al-Maiyah. 1900s. Al-Hifaz `al Al-Ma Masuliyat Al-Jami`: Mustaqbal Al-Yaman Bayna Yadayka. San`a: al-Jumhuriyah al-Yamaniyah, al-Hayah al-`Ammah lil-Mawarid al-Maiyah. Page(s): 14. Descriptors: Water-supply -- Yemen (Republic). Notes: col. ill. 21 cm. Cover title. Other Titles: Mustaqbal al-Yaman bayna yadayka. OCLC Accession Number: 170699283.

Yemen (Republic) and Idarat Masaqit al-Miyah. 2000. Al-Wad` Al-Rahin Wa-Al-Afaq Al-Mustaqbaliyah Li-Idarat Masaqit Al-Miyah. San`a: al-Jumhuriyah al-Yamaniyah, Wizarat al-Zira`ah wa-al-Rayy, al-Idarah al-`Amm lil-Ghabat wa-Mukafahat al-Tasahhur: al-Hayah al-`Ammah lil-Mawarid al-Maiyah. Page(s): 40. Descriptors: Watershed management -- Yemen (Republic); Water-supply -- Yemen (Republic); Government publication; National government publication. Notes: 32; 24 cm. Cover title. Other Titles: Watershed management present situation and future perspectives; Responsibility: Idarat Masaqit al-Miyah. OCLC Accession Number: 123356762.

Yemen Arab Republic National Water and Sewerage Authority and Leggette, Brashears & Graham. 1976. Preliminary Observations and Evaluation at Sana's Well Field, Yemen Arab Republic, July 1976. Westport, CT: The Firm. Descriptors: Groundwater -- Yemen (Republic) -- San`a; Water resources development -- Yemen (Republic) -- San`a. Notes: 9, 2 leaves; 28 cm. Note(s): Cover title. "August 1976." OCLC Accession Number: 11947748.

"Yemen Gets U.S. Aid in Constructing Public Water System." 1963. International Commerce. December 30, 1963. Volume 69, Pages 22. Descriptors: Water supply/Yemen; Water supply; Water Supply and Irrigation Systems. OCLC: 2401023.

Yemen. High Water Council. 1992. Final Report: [National Water Action Plan]. Sana'a: Technical Secretariat of the High Water Council. Descriptors: Water resources development -- Yemen (Republic); Water-supply -- Yemen (Republic). Abstract: v. 1. Water resources management and economic development -- v. 2. National water legislation and institutional issues -- v. 3. Surface water resources -- v. 4. Groundwater resources -- v. 5. Regional water requirements for different water-consuming sectors -- v. 6. Water supply, wastewater and sanitation -- v. 7. Planning support system, computer hardware and software -- v. 8. Environmental impact assessment for water resources planning sector -- v. 9. Water resources management options in Sanaa basin -- v. 10. Water resources management in the Tihama. Notes:

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10 v.: ill., maps; 30 cm. Note(s): "UNDP/DESD Project YEM/88/001"--Cover. Includes bibliographical references. Responsibility: the Government of the Republic of Yemen, High Water Council. OCLC Accession Number: 39319146.

Yemen; Ministry of Agriculture and Water Resources; Switzerland and Direktion für Entwicklungszusammenarbeit und Humanitäre Hilfe. 1993. Operation and Maintenance of Potable Water Schemes Irrigation Activities: Southern Regional Agricultural Development Project. Yemen Republic; Geneva: Ministry of Agriculture and Water Resources; Swiss Development Cooperation. Descriptors: Irrigation -- Yemen (Republic) -- Management. Notes: 25 leaves; 30 cm. "February 1993." Other Titles: Southern regional agricultural development project. OCLC Accession Number: 33417844.

Yemeni Joint Project for Natural Resources; Institute for Development Anthropology (Binghamton, N.Y.) and United Nations Development Programme. 1980s. Report on a Consultancy Mission for UNDP Project RAB/80/031 to the Yemen Arab Republic and the People's Democratic Republic of the Yemen. Descriptors: Natural resources -- Yemen (Republic) -- Databases; Natural resources -- Yemen (Republic) -- Management -- Databases; Natural resources -- Yemen (Republic) -- Management -- Data processing; Applied anthropology -- Yemen (Republic); Manuscript. Notes: 1 v. (various foliations): ill. 28 cm. Cover title. "The objectives of this part of the [Yemeni Joint Project for Natural Resources] will be to collect, store, analyze and distribute scientific and technical information related to the project, i.e. on water, geothermal and mineral resources, mining, hydrocarbon resources, remote sensing, geophysics, seismics and marine geology"--Abstract. Includes bibliographical references. OCLC Accession Number: 146136427.

Yemen: Possibility to Solve the Yemeni Water Problem. Descriptors: Science and Technology; Geography and Environment; Business; Commerce; Economy; AMED; Yemen. OCLC Accession Number: 50917510. URL: <http://memory.loc.gov/frd/cs/profiles/Yemen.pdf>

"Yemen Taiz Wastewater System Feasibility Study. Final Technical Assistance Report." 2007. Abstract: The Governorate of Taiz, represented by the Taiz Water and Sanitation Local Corporation (TWSLC), in concert with the Ministry of Water and Environment (MWE) of the Republic of Yemen, plans to modernize the wastewater collection and treatment system in the Notes: *B & E Engineers, Southern California. Technical report.* NTIS Order Number: PB2008-105829

Yemen Taiz Wastewater System Feasibility Study. Final Technical Assistance Report. Volume 1, Main Report. 2007. Performer: B & E Engineers, Southern California. Apr 2007. 173p. Abstract: The Governorate of Taiz, represented by the Taiz Water and Sanitation Local Corporation (TWSLC), in concert with the Ministry of Water and Environment (MWE) of the Republic of Yemen, plans to modernize the wastewater collection and treatment system in the City of Taiz, the third largest city in the Republic of Yemen, with a current metropolitan area population of 545,000. The U.S. Trade and Development Agency approved a grant to study the feasibility of providing a wastewater collection conveyance and treatment system to serve the needs of the citizens of the west and north suburbs of the City of Taiz to 2025. Database: NTIS Database. URL: <http://search.proquest.com/docview/86098125?accountid=12084>.

Yemen TAIZ Water and Sanitation Local Corporation Ministry of Water and Environment, Republic of Yemen Feasibility Study--Bidding Documents, Volume 2, Part 1. 2007. Performer: B&E Engineers, Arcadia, CA. Apr 2007. 496 pages. Abstract: The Governorate of Taiz, represented by the Taiz Water and Sanitation Local Corporation (TWSLC), in concert with the Ministry of Water and Environment (MWE) of the Republic of Yemen, plans to

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modernize the wastewater collection and treatment system in the City of Taiz, the third largest city in the Republic of Yemen, with a current metropolitan area population of 545,000. The U.S. Trade and Development Agency approved a grant to study the feasibility of providing a wastewater collection conveyance and treatment system to serve the needs of the citizens of the west and north suburbs of the City of Taiz to 2025. Database: NTIS Database (National Technical Information Service). URL:

<http://search.proquest.com/docview/86106382?accountid=12084>.

Yemen TAIZ Wastewater System Feasibility Study, Republic of Yemen, Volume 4 - Copies of Task Reports. 2007. Performer: B&E Engineers, Arcadia, CA. Apr 2007. 616 pages. Abstract: The Governorate of Taiz, represented by the Taiz Water and Sanitation Local Corporation (TWSLC), in concert with the Ministry of Water and Environment (MWE) of the Republic of Yemen, plans to modernize the wastewater collection and treatment system in the City of Taiz, the third largest city in the Republic of Yemen, with a current metropolitan area population of 545,000. The U.S. Trade and Development Agency approved a grant to study the feasibility of providing a wastewater collection conveyance and treatment system to serve the needs of the citizens of the west and north suburbs of the City of Taiz to 2025. Database: NTIS Database (National Technical Information Service). URL:

<http://search.proquest.com/docview/86107572?accountid=12084>.

Yemen Transmission Upgrade and Expansion Feasibility Study. Volume One. Transmission Reinforcement, Upgrade and Expansion within the Generation Expansion Planning Horizon. Book 3 of 4: Appendices. 2003. Performer: Kuljian Corp., Philadelphia, PA. Sponsor: Trade and Development Agency, Rosslyn, VA. Jan 2003. 398 pages. Report: TDA-2001-10041-A-07; YEMEN2001-10041A-V4. Abstract: The report contains the appendices for Volume 1, Book 1 of the Yemen Transmission Upgrade and Expansion Feasibility study. Database: NTIS Database (National Technical Information Service).

“Yemen Transmission Upgrade and Expansion Feasibility Study. Volume Two: Conceptual Design of Transmission Line and Substations. - Export Trade Information.” 2003. Kuljian Corp., Philadelphia, PA. Jan 2003. Abstract: The Public Electricity Corporation (PEC) under the Ministry of Electricity and Water (MEW) of the Republic of Yemen intends to install one Simple Cycle Gas Turbine Power Station at Marib and upgrade the existing 132 KV transmission grid by introducing a new 400 KV transmission system including upgrading the existing 132 KV system. This is being done in order to meet the future load growth and to achieve better reliability and improved system performance in an economical manner. This Tender Document addresses the substations and transmission system only, as detailed hereinunder. This specification covers the general requirements for design, engineering, supply, manufacture, testing, delivery, storing at the site, installation, testing, commissioning and putting into efficient and trouble-free commercial operation on a turnkey basis of the equipment and materials required for installation of 400 KV substations, 400/132 KV and 132 KV substations along with associated 400 KV and 132 KV transmission lines and auxiliary systems complete with all materials and accessories. Database: NTIS. NTIS Order Number: PB2004-100625.

Yemen Transmission Upgrade and Expansion Feasibility Study. Volume Three: Tender Document. Book 2 of 5: Technical Specifications. 2003. Performer: Kuljian Corp., Philadelphia, PA. Sponsor: Trade and Development Agency, Rosslyn, VA. Jan 2003. 202 pages. Report: TDA-2001-10041-A-08; YEMEN2001-10041A-V8. Abstract: The Public Electricity Corporation (PEC) under the Ministry of Electricity and Water (MEW) of the Republic of Yemen intends to install one Simple Cycle Gas Turbine Power Station at Marib and upgrade the

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existing 132 KV transmission grid by introducing a new 400 KV transmission system including upgrading the existing 132 KV system. This is being done in order to meet the future load growth and to achieve better reliability and improved system performance in an economical manner. This Tender Document addresses the substations and transmission system only, as detailed hereinunder. This specification covers the general requirements for design, engineering, supply, manufacture, testing, delivery, storing at the site, installation, testing, commissioning and putting into efficient and trouble-free commercial operation on a turnkey basis of the equipment and materials required for installation of 400 KV substations, 400/132 KV and 132 KV substations along with associated 400 KV and 132 KV transmission lines and auxiliary systems complete with all materials and accessories. Notes: TY: GEN. Database: NTIS Database (National Technical Information Service).

Yemen Transmission Upgrade and Expansion Feasibility Study. Volume Three: Tender Document. Book 3 of 5: Technical Specifications. 2003. Performer: Kuljian Corp., Philadelphia, PA. Sponsor: Trade and Development Agency, Rosslyn, VA. Jan 2003. 808 pages. Report: TDA-2001-10041-A-09; YEMEN2001-10041A-V9. Abstract: The Public Electricity Corporation (PEC) under the Ministry of Electricity and Water (MEW) of the Republic of Yemen intends to install one Simple Cycle Gas Turbine Power Station at Marib and upgrade the existing 132 KV transmission grid by introducing a new 400 KV transmission system including upgrading the existing 132 KV system. This is being done in order to meet the future load growth and to achieve better reliability and improved system performance in an economic manner. Database: NTIS Database (National Technical Information Service).

Yemen Transmission Upgrade and Expansion Feasibility Study. Volume One. Transmission Reinforcement, Upgrade and Expansion within the Generation Expansion Planning Horizon. Book 1 of 4: Feasibility Study Report. 2003. Kuljian Corp., Philadelphia, PA. Trade and Development Agency, Rosslyn, VA. Jan 2003. 267 pages. Report: TDA-2001-10041-A-02; YEMEN2001-10041A-V2. Abstract: The United States Trade and Development Agency (TDA) provided a grant to the Government of the Republic of Yemen, represented by the Ministry of Electricity and Water (MEW) for the purpose of conducting a feasibility study for a Transmission Upgrade and Expansion in Yemen. MEW is in the process of implementing a new IPP project at Ma'arib to address the country's growing power demands. One of the primary requirements for implementing and financing Ma'arib to the main load center in Sana's by installing a 400KV transmission line, and reinforcing the grid system in other respects, including adding new high voltage capacity, to handle this major new generation capacity. The Kuljian Corporation of Philadelphia, Pennsylvania, in association with Burns and McDonnell International of Kansas City, Missouri (collectively known as 'Kuljian Team') was selected to conduct the Feasibility Study. This report is a comprehensive presentation of the study work performed by the Kuljian Team. Database: NTIS Database (National Technical Information Service).

Yemen Transmission Upgrade and Expansion Feasibility Study. Volume One. Transmission Reinforcement, Upgrade and Expansion within the Generation Expansion Planning Horizon. Book 4 of 4: Appendices. 2003. Kuljian Corp., Philadelphia, PA. Sponsor: Trade and Development Agency, Rosslyn, VA. Jan 2003. 738 pages. Report: TDA-2001-10041-A-05; YEMEN2001-10041A-V5. Abstract: The report contains the appendices for Volume 1, Book 1 of the Yemen Transmission Upgrade and Expansion Feasibility study. Database: NTIS Database (National Technical Information Service).

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“Yemen Water Contract Tests Nerve.” 1986. World Construction English Ed. Volume 39, Issue 12, Pages 40. Descriptors: Water Pipelines; Regional Planning - Water Supply; Water Resources - South Yemen. Abstract: With an ancient history but only independent for 20 years, South Yemen provides a working environment that stretches contractor’s skills and tolerance to the full. With rebuilding identified as a priority by the new government, and benefiting from aid supplied by both eastern block and western nations, the country is tackling its enormous development problems. Some of the aid is being used to build a 56 km long, 800 mm diameter, water pipeline from Wadi Bana, in the east, to Bir Nasir, on the outskirts of Aden. Originally designed by the French, British consultants John Taylor Sons were called in to revise the project, and the British contractor Bovis was in 1983 awarded the contract to build the pipeline, four large steel reservoirs, and associated works. ISSN: 0043-8375.

Yemeni Public Prosecutor. 2002. “Water Law Number 33.” “Water Law No. 33 of 2002, an Arabic copy of which is available on the Yemeni Public Prosecutor’s website, at [http://www.agoye.com/userimages/Image/book/2/2/1\(28\).pdf](http://www.agoye.com/userimages/Image/book/2/2/1(28).pdf), and the second is the Environment Law No. 26 of 1995, an Arabic copy of which is also available on the same website, at [http://www.agoye.com/userimages/Image/book/2/2/1\(23\).pdf](http://www.agoye.com/userimages/Image/book/2/2/1(23).pdf).”⁹³

Young, Penny. 2011. “Aden’s pipe dream.” *History Today* 47.5 (1997): 30+. *Military and Intelligence Database*. Web. 1 Sep. 2011. Abstract: A United Nations Development Program project is restoring the Tawila tanks, an intricate water system probably built by the Himyarites in the first millenium BC. The system is a series of cisterns, **dams** and waterways carved out of volcanic rock. After decades of neglect, the unique series of water tanks of Aden, in **Yemen**, which were hollowed out of the volcanic rock at least 2,000 years ago are to be restored and brought back into use. It is not known who built the Tawila tanks, as they are called. To the frustration of historians, no date of origin nor any inscriptions have ever been found. The taxi drivers, who take tourists from Steamer Point to visit the tanks, tell them they were built during the time of the Queen of Sheba. Although there is no historical evidence for the Queen of Sheba either, the early inhabitants of Aden would have known about the great **dam** of Marib which was built in the eastern deserts of **Yemen** by the Sabaeans around 700 BC. There are many other examples of cisterns and reservoirs in **Yemen** and east Africa across the Red Sea, although none on such a scale as the Tawila tanks. The lack of records or decorative features has made dating the tanks a matter of conjecture. One theory has been that they were built during the Persian occupation of **Yemen** in the sixth century. But the Persians disrupted life in South Arabia, hardly creating the conditions for the construction of a major water catchment system. It is thought more likely that the intricate system was built in the first millennium BC by the highland tribe known as the Himyarites, whose kingdom rivalled that of the Sabaeans and whose power lasted until the arrival of the Persians. With their superior technological skills, the Himyarites managed the precious water sources and controlled the ports in south-west Arabia and the rich trade to and from Egypt.

Youssef, El Sayed A. A. 1998. “Sequence Stratigraphy of the Upper Jurassic Evaporite-Carbonate Sequence at the Western Area of Wadi Al-Jawf-Marib Basin, Yemen.” *Carbonates and Evaporites*. Volume 13, Issue 2, Pages 168-173. Descriptors: Ammonites; Ammonoidea; Amran Group; Arabian Peninsula; Asia; biostratigraphy; carbonate rocks; Cephalopoda; chemically precipitated rocks; depositional environment; evaporites; Invertebrata; Jurassic; limestone; lithofacies; M’qah Sandstone; Madbi Formation; Mesozoic; Mollusca; sedimentary

⁹³ Saliba, Issam. 2012. Private communication. Issam Saliba is a foreign law specialist with the Law Library of Congress.

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rocks; sequence stratigraphy; Shabwa Member; Shuqra Formation; Tetrabranchiata; unconformities; Upper Jurassic; Wadi Al-Jawf-Marib Basin; Yemen. References: 16; illus. incl. sect., strat. col., sketch maps. Abstract: The Upper Jurassic evaporite-carbonate sequence (Sabatayn Formation and its equivalent Madbi Formation or Transition Beds) and its constituent systems tracts have been recognized at the western side of Wadi Al-Jawf-Marib intracratonic rift basin and its adjacent shelf areas. The Sabatayn Formation was subdivided, from the base to the top, into the Shabwa Salt Member, the Layadim Shale Member, the Ayad Gypsum Member and its equivalent M'qah Sandstone Member. The evaporite depositional systems of the lowstand facies (or systems) tract LST began in Middle Kimmeridgian times after the complete drawdown of the shelf area and basin isolation. The effect of ephemeral flooding events of the marine water and/or surface run-off water on the basinal salt pans resulted in the deposition of four or more parasequences (shallowing upward salinas of the Shabwa Salt Member). When the rift was reconnected to the open ocean in Late Kimmeridgian times, the basinal LST and the formerly exposed carbonate sequence of the shelf area were flooded and an onlapping retrogradational transgressive facies tract (TST) represented by the lagoonal-sabkha Layadim Shale and the Ayad Gypsum members and their equivalent shoals, shallow subtidal to intertidal Madbi Formation were established. The continued relative sea-level rise followed by relative sea-level falls due to orogenic movement during Portlandian times resulted in the deposition of aggradational to progradational offlapping strata of early and late highstand facies tract (HST representing part of the Naifa Formation). On the shelf area, the early HST consists of a subtidal ammonitic limestone which changes westwards into a shallow subtidal-intertidal sandy rippled mudstone containing fossil fish remains and varicolored cross bedded sandy mudstone containing plant remains, while the late HST consists of supratidal to sabkha gypsiferous shale and sandstone with gypsum lenses. However, on the shelf slope, a brecciated ammonitic limestone interbedded with calcareous mudstone containing pelagic fauna represent the forced regressive wedge-systems tracts (FRWST). ISSN: 0891-2556.

Youssef, El Sayed A.A. 1991. A note on the geomorphology of the coastal plain between Al Hudaydah and Al Salif Peninsula, Red Sea, coast, Yemen Arab Republic. *The Geographic Journal*, Vol. 157, No. 1 (March), pp. 71-73.

Zarubezhgeologia, 1992, Hydrogeological map of the southern part of the Republic of Yemen. Eight coloured map sheets 1:500,000; Explanatory note (260 pp.); and separate Catalogue of Water Points. Prepared for Ministry of Energy and Minerals, Board of Mineral Exploration, Aden, Yemen. State Committee on Geology and Mineral Resources Zarubezhgeologia, Moscow, Russian Federation.