

NEOGENE STRATIGRAPHIC DEVELOPMENT OF THE PERSIAN GULF

Stephen A. Swift and David A. Ross
Dept. of Geology and Geophysics
Woods Hole Oceanographic Institution
Woods Hole, MA 02543

Swift: ph: 508-289-2626 fax: 508-457-2150 email: sswift@whoi.edu
Ross: ph: 508-289-2578 fax: 508-457-2187 email: dross@whoi.edu
Award Numbers: N00014-96-1-0548 and N00014-97-1-0410

LONG TERM GOALS

The Persian Gulf is a shallow (<110 m), epicontinental basin formed on the Arabian plate in mid-late Miocene. Neogene sediments comprise a northwest-thickening wedge (0.1-2.0 km) of clastics shed from the Zagros uplift. There is little publicly available information on these deposits. Our long-term goal is to understand how variations in source, tectonic subsidence, climate, and sea level affected sedimentary process and stratigraphic development of an arid, shallow-marine environment.

OBJECTIVES

The initial objective of this project was to define the broad lateral and temporal patterns in late Cenozoic stratigraphy in the central portion of the basin. Our objectives also include mapping late Quaternary channels, deltas, and sequence stratigraphy across the entire basin and correlating these to wells and surface sediment cores. These data will be used to test our hypothesis that wet-dry cycles in climate are as important to channel and sediment sequence development as sealevel change. We will also determine the age and origin of linear seafloor microtopography at the head of the Gulf and in the Straits of Hormuz.

APPROACH

The initial objective was addressed with award N00014-96-1-0548 and consisted of a study of existing industry data. Richard Simmons at Navoceano (N5) provided funds (as an expansion to this grant) for purchase from Masera Corp. of logs for 25 Iranian wells in the Gulf and paper copies of ~5,000 km of multi-fold industry seismic profiles. Based on area covered, 50-60% of the seismic profiles are of such low quality in the Cenozoic section (upper 0.5-0.9 sec) that it is difficult to recognize reflectors much less unconformities. In addition to the Masera data, we used seismic profiles from an *Atlantis II* cruise in 1977 and published formation tops for 17 additional wells in the Gulf and Iran and 12 wells in Iraq. At WHOI, Tom Bolmer digitized cdp points and well locations, and Elazar Uchupi provided background for interpretation of results.

The remaining objectives will be addressed under separate funding (N00014-97-0410). We plan a seismic and seafloor mapping cruise in the Gulf using a multi-channel, high-resolution, shallow-water seismic system provided by LDEO (J. Diebold and P. Buhl). We will sail on a Navoceano ship (USN Kane) and use their coring, side-scan, and high-frequency profiler. Sonobuoy data will be recorded to determine shallow sediment velocities (J. Diebold LDEO). E. Uchupi (WHOI) will help interpret seismics, direct age dating of cores, and assist in final reports. P. Demenocal (LDEO) will analyze core material to infer climatic cycles. Ashok Kalra (N5) is our point-of-contact at Navoceano. Use of the Navoceano ship is being coordinated through M. Jarrett and P. Taylor (N3). Dave Powell (N3) provided constraints on cruise tracks.

WORK COMPLETED

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 30 SEP 1997		2. REPORT TYPE		3. DATES COVERED 00-00-1997 to 00-00-1997	
4. TITLE AND SUBTITLE Neogene Stratigraphic Development of the Persian Gulf				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Woods Hole Oceanographic Institution, Department of Geology and Geophysics, Woods Hole, MA, 02543				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 3	19a. NAME OF RESPONSIBLE PERSON
a REPORT unclassified	b ABSTRACT unclassified	c THIS PAGE unclassified			

CDP points for the industry profiles were digitized and plotted. Tables of sonic log velocity, calibrated with check-shot profiles, were typed into computer files and plotted. Both interval and "average" velocities are available. The well reports contain formation tops for only two wells. Cenozoic time datums can be picked from logs in 7 other wells. We identified several Neogene seismic events, but the only feature that can be traced across the central basin is the unconformity at the K/T boundary. Poor quality data in the upper 0.5 sec prevents extensive mapping of any of the younger unconformities. Unit thickness was computed using sonic log velocities calibrated with check-shot profiles.

Planning for our seismics cruise began with a meeting at Navoceanio in March. The cruise was scheduled for August '97 and equipment preparation was completed at WHOI and LDEO. In April, just prior to shipping, the Navy reprioritized Kane's schedule, and the cruise was postponed to October. In late June, the Navy again changed Kane's schedule. We expect the cruise to be scheduled in 1998.

RESULTS

The primary feature of the K/T surface is a deepening from ~0.4 to 2 km towards Iran. Secondary features include uplift due to arches in the Paleozoic basement, Quaternary folding near the Iranian coast, and salt movement. The lower Miocene datum mapped with wells also dips to the northeast in the central Persian Gulf. The northwest-southeast strike changes, however, in the north end of the Gulf where the surface shallows from ~1.8 km near Karg Island to <500 m in southeast Iraq.

The sonic logs, calibrated to seismic frequencies with check shot profiles, indicate vertical velocities at the seafloor are 1.6-1.8 km/s. Below the seafloor, velocity varies vertically by up to 1.5 km/s over 10-20 m, however the fluctuations average over 100-200 m to a simple linear increase in velocity down to the base of the Paleocene. As the Neogene clastic wedge thins southwestward from Iran, the magnitude of the gradient increases and the thickness decreases from 1.5 to 0.8 km below sealevel.

IMPACT/APPLICATIONS

The deepening of the Miocene and K/T horizons towards the northeast reflects tectonic subsidence driven by either flexing of the plate by forces along its edge or the shifting sedimentary load on the plate due to the southwestward sliding of the Zargos Fold Belt along a deep salt layer. The shallowing of Cenozoic datums across the northern end of the Persian Gulf indicates that tectonic subsidence in the Mesopotamian valley of Iraq is slower than subsidence in the Persian Gulf. We infer that the present partition of the depression into water and land areas is due to differences in subsidence rate and not to higher supply rates of sediment in Iraq.

TRANSITIONS

The Geospatial Data Base Department at Navoceanio will use the Masera well velocities in future revisions to their Persian Gulf layered velocity model data base. One of the primary objectives of the 1998 cruise will be to obtain interval velocities from multi-channel semblance data and refraction velocities from the sonobuoys. These data will provide direct, systematic measurements of seafloor velocity data base for Navy operations in the Persian Gulf.

RELATED PRODUCTS

The high-resolution seismic and seafloor mapping study will provide an arid environment end-member to the STARTIFORM field studies.

Amy Bower (WHOI PO) has studied Persian Gulf bottom water outflow using Navoceanio AXBTs. We hope to obtain water temperature data for her on our transits through the Straits of Hormuz.

REFERENCES

We used the Masera well data in the following report in preparation:

Uchupi, E., S.A. Swift, D.A. Ross, Late Quaternary paleoceanography, paleoclimatology, and neotectonism of the Persian Gulf.