Design and Fabrication of Heave Compensation for a Small Off Shore Drilling Rig

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LONG-TERM GOALS

The Strata Formation on Margins (STRATAFORM) program of the Office of Naval Research seeks to better understand continental margin stratigraphic evolution. In particular, the program is investigating the mode of development of the stratigraphy on the shelf and slope portions of the continental margins using field sites offshore northern California and New Jersey. Investigations of these complex environments involved three-dimensional seismic surveys, long-term (5 yrs) oceanographic and sediment transport monitoring, and near seafloor sediment sampling. The program has developed a comprehensive understanding of present day sediment transport and deposition, but lacks samples (cores) from deeper in the margin to equate the detailed seismic stratigraphy to sedimentation events in the past. The problem has not been the lack desire for these cores, but rather the absence of an affordable means of collecting them.

Many of the advances in marine sciences over the past 30 years are based on samples collected by the Ocean Dripping Program (ODP) and its predecessor the Deep Sea Drilling Program (DSDP). These programs have provided scientists with equipment and infrastructure required to collect cores in deep water using technology that has been specifically designed for that purpose. However, the ODP's principal vessel, the JOIDES Resolution (JR), will not drill in waters shallower than 75 m and has restrictions in waters shallower than 300 m. In addition, commercial services to return cores from perhaps 200 m sub-bottom in up to 200 m of water are either not available or too expensive to use on projects where sample quality is of prime importance.

Recently, DOSECC (Drilling, Observation and Sampling of the Earth's Continental Crust, Inc.), a consortium of universities and other research organizations, designed and fabricated a drilling system for the collection of core from modern lakes. This system, the GLAD800 (Global Lake Drilling 800), was designed and built as a joint venture with the International Continental Scientific Drilling Program (ICDP) and many of the projects it will be used on are receiving funding from the National Science Foundation and ICDP. The GLAD800 is designed to support a drill string of 800 m (water + sediment) from an anchored barge.

The GLAD800 uses tools developed by DOSECC to sample a variety of sediment types. These tools collect core of 2.44 inch diameter within plastic liner. This is the standard size for core collected in the Ocean Drilling Program and is compatible with many laboratories worldwide. The tools include the following.

Report Documentation Page

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14. ABSTRACT

The Strata Formation on Margins (STRATAFORM) program of the Office of Naval Research seeks to better understand continental margin stratigraphic evolution. In particular, the program is investigating the mode of development of the stratigraphy on the shelf and slope portions of the continental margins using field sites offshore northern California and New Jersey. Investigations of these complex environments involved three-dimensional seismic surveys, long-term (5 yrs) oceanographic and sediment transport monitoring, and near seafloor sediment sampling. The program has developed a comprehensive understanding of present day sediment transport and deposition, but lacks samples (cores) from deeper in the margin to equate the detailed seismic stratigraphy to sedimentation events in the past. The problem has not been the lack desire for these cores, but rather the absence of an affordable means of collecting them.

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- Shelby “push” tube
- Hydraulic Poston Core (HPC)
- Extended Shoe, non-rotating
- Extended Core Bit, rotating (The Alien)
- Diamond Core Bit (mining)
- Non-sampling (rotary) assembly

The University of Utah has received funding through a DURIP to acquire a heave compensation system for the GLAD800. The heave compensation equipment will be operated by DOSECC and will be available for testing in Fall of 2001.

OBJECTIVES

The following are the design parameters of the heave compensation system. These parameters are based on expected sea state conditions. They do not consider the response of the vessel to these sea conditions. Vessel response will be measured before final tests are completed. Much of the cost of the heave compensation system is directly related to the period and maximum velocity of the boat movement. The criteria for this system are as follows.

- 8 feet of heave in an 8 second period
- Maximum velocity 4 feet per second
- 9 foot Stroke on heave compensation cylinders (2 each)
- 11 foot stroke on feed cylinder
- 40,000 lb. holdback on drill head
- 4 5/8” bore on drill chuck

The rig components themselves are listed below. The heave compensated derrick and base will either be deployed over the fantail or through a moonpool with other components mounted on the working deck. The fixed position components are those whose position is defined by the drilling assembly. The flexible position components are those that must be located in the vicinity of the drilling assembly but can be moved around to fit available deck space.

Fixed Position Components

Heave Compensated Derrick and Base

- Estimated Weight 9,500 lb.
- Stern Mounted with Winch End and Rods Outboard of Rail

Rod and Casing Storage Skid

- Estimated Weight (500 foot hole depth) 12,000 lb.
- Positioned on Long Axis of Ship and Rig within 6 feet of rig floor

- 11’ Long x 7’ Wide x 4’ Tall

Flexible Position Components

Rig Power Pack Skid

- Secured within 75 feet of Rig
- Estimated Weight 5,500 lb.
- 8’ Long x 7’ Wide x 7’ Tall

Heave Compensation Power Pack Skid

- Secured within 60 feet of Rig
- Estimated Weight 8,000 lb.
- 12’ Long x 7’ Wide x 7’ Tall

Mud and Piston Core Pump Skid

- Secured within 25 feet of Rig
- Estimated Weight 1,500 lb.
- 5’ Long x 4’ Wide x 3’ Tall

APPROACH

The acquisition of the Active Heave Compensation system for the GLAD800 drilling rig will allow this drilling system to be used on UNOLS research vessels as well as other platforms of opportunity. To verify this concept, the AHC-GLAD800 is scheduled for sea trials in early November, 2001. For these trials, the rig will be deployed on the *R/V Knorr*, and drilling operations will be performed through the vessel’s moonpool. Following this, this rig is scheduled to drill offshore New Jersey in late summer of 2002.

The active heave compensation components are being acquired and fitted to the GLAD800 drilling rig. The key individual for this effort is Mr. Marshall Pardey, mechanical engineer at QD Tech, Inc. The rig modifications are being done at the shop of Turnsteel of Idaho and Mr. Bruce Howell. Technical coordination with the STRATAFORM program is the responsibility of Dr. Greg Mountain of Lamont-Doherty Earth Observatory

WORK COMPLETED

Components of the active heave compensation system are being acquired and rig conversion is presently in progress.

RESULTS

There are no results at this time.

IMPACT/APPLICATIONS

An AHC-GLAD800 rig will allow efficient collection of continuous core from the continental shelves. This area has seen little scientific investigation because of the absence of appropriate drilling systems.

TRANSITIONS

The GLAD800 was developed at the request of the paleo-climate community (PAGES) and this group is interested in the AHC-GLAD800 for the drilling of large, deep lakes.

RELATED PROJECTS

DOSECC, Inc. is a consortium of 48 universities that is developing drilling systems to implement the unique requirements of the scientific community. The ACHC is being acquired through a grant with the University of Utah, but the AHC will be mounted on a DOSECC rig and operated by DOSECC. DOSECC's web site is www.dosecc.org. This site contains links to other research drilling projects.