SHALDRIL News
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Background

In 1994 a group of 14 scientists and a representative from the National Science Foundation Office of Polar Programs met in Houston, Texas, for a two day workshop to discuss scientific questions that could be addressed by shallow drilling on the Antarctic continental shelf. The participants in the workshop identified a number of important scientific questions but also learned that the technology for sampling the upper few hundred meters of the stratigraphic column was still lacking (Anderson et al., 1994; see also Webb, 1995). The group interested in shallow drilling on the Antarctic shelf remained active and evolved into a working group that now calls itself SHALDRIL. The principle objective of SHALDRIL originally was to monitor technological developments in shallow drilling from conventional ice-breaking research vessels. The technology developed slowly and some promising avenues turned out to be dead ends (see Kristoffersen, 1998, for a history of previous attempts at scientific shallow drilling in the Antarctic and Arctic). In 2000, the SHALDRIL steering committee learned about new and improved drilling systems proven in other high-latitude regions that can core strata including gravelly glacial deposits, in water depths of several hundred meters to subbottom depths of a few hundred meters. These systems can be operated from the NSF research vessel RV/IB *Nathaniel B. Palmer*.

We have now entered the next phase of this long-term project, i.e., testing this drilling technology in Antarctic waters. The area best suited for this phase of the program is the James Ross Basin, located in the northwestern Weddell Sea region, offshore of Seymour Island (Fig. 1). This is the area identified by the Houston workshop participants as having shallow drilling targets of great scientific value, existing site survey data, closest proximity to ports of departure and return, and proximity to auxiliary sites of scientific value.

The principal objective of this initial drilling leg is to test the drilling system using the RV/IB *N.B. Palmer*, but the core acquired will have immense scientific value. The targets include Tertiary strata that should record climate change and cryosphere evolution in the Antarctic Peninsula region, and the faunal and floral changes associated with these events. Other drill sites will include a site targeting a Pleistocene grounding zone wedge and its record of ice flow during the last glacial maximum and a site targeting an expanded Holocene section that bears a record of high frequency climate change.

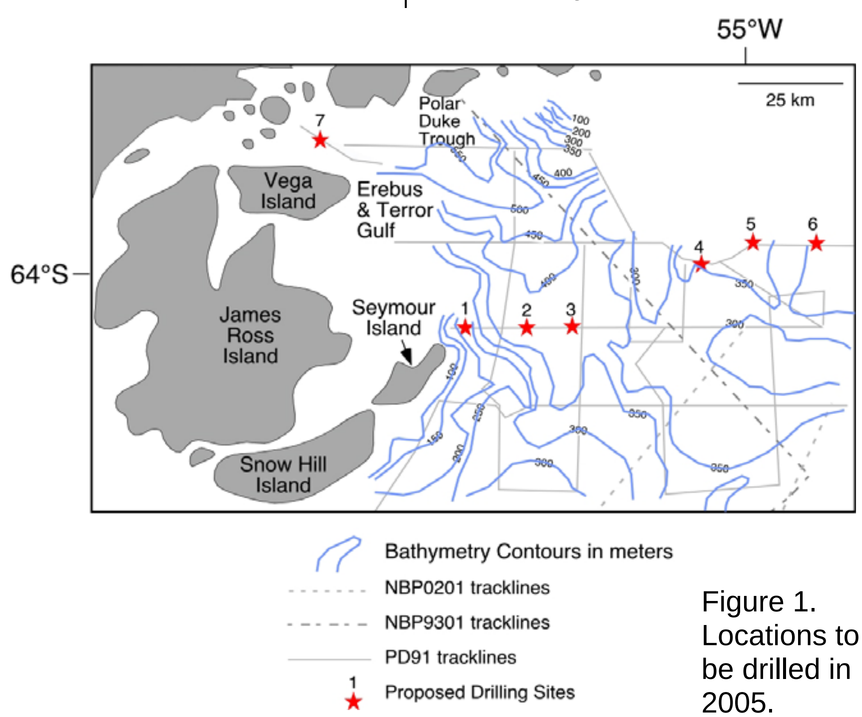

Figure 1. Locations to be drilled in 2005.

Project Schedule

Technical
July 2004: Dynamic Positioning Tests on *NBP*
July-October 2004: Construction of Rig and Planning for Mounting on *NBP*
August-September 2004:Sampling Tools Tested and Finalized

Scientific
August 2004: Science Party Meeting to Finalize Site Plans
February-April 2005: Cruise
Summer 2005: Post-cruise Workshop

Technical Progress

As specified in our last newsletter, this edition will focus on the technical progress that has been made towards achieving the goals of SHALDRIL.

The weight of the drilling equipment for SHALDRIL will be about three times the normal load that the NBP carries. This fact has created several unique challenges for SHALDRIL. An independent naval architect has been commissioned to analyze the placement of equipment on the ship and maximize stability. In addition, plans are being made to refuel during the cruise since full fuel tanks add to the stability of the vessel.

Drill Rig

In 2003 a contract was signed with Seacore Limited (UK) to conduct the drilling operations for SHALDRIL.

Seacore was established in 1976 and is an independent, marine drilling contractor, working on projects all over the world.

Figure 2. The C-100 rig mounted on another vessel.

Seacore employs a dedicated workforce of about 150 people.

Among the key skills that helped lead the SHALDRIL committee to select Seacore are: 1) non-oilfield marine drilling expertise including geological coring, 2) offshore heave compensated drills, 3) the ability to design and engineer specialty equipment, and 4) a skilled and committed workforce.

The details of the rig to be used for SHALDRIL have not yet been finalized. The current plans are for a rig based on Seacore's C-100 rig (Fig. 2). The rig is completely modular and can be rapidly mobilized as container freight. The rig will have the capacity to take 100 m of core in up to 1,000 m of water and longer cores in shallower water. The SHALDRIL rig will have a 3 m heave compensator that will allow drilling to continue in any type of seas in which people can realistically work. The rig will be mounted over the moonpool on the starboard deck. The position of the rig close to mid-ship will help minimize heave as compared to drilling over the stern. The moonpool will protect the drill string from stray bits of floating ice.

Guar gum has been selected for drilling mud for SHALDRIL operations. This material is found in many food products for human consumption and is totally biodegradable. In addition, engineering tests show no loss of viscosity or clumping in the subfreezing conditions that may occur during SHALDRIL.

Sampling Tools

The coring plan for the five sites targeting Tertiary strata will be to begin the hole with a rotary core barrel. The core barrel cuts a 76 mm core x 4.5 m in length. It is expected that the first several meters (0 to 10 m) will be very soft and will be washed through until more competent material can be cored. If the core recovery is good, the hole will be advanced to 100 m. If core recovery is poor or advancement is extremely slow, the hole could be abandoned or restarted using the Piggy Back Coring Hardware (PBCH) system.

The PBCH system utilizes a high-speed thin kerf mining style core barrel that is supported through the API drill string to the seafloor. The core barrel cuts a 61.1 mm core x 3 m in length. The hardware is wireline retrievable and has proven to be highly effective coring hard and fractured formations. The hole size is 96 mm which is considerably less than the larger 250 mm core bit used with the more conventional rotary system. If this system is deployed, it could possibly be initiated as shallow as 3 to 4 m and complete the hole to the required 100 m target depth. This system also allows borehole reentry should the diamond core bits need to be changed due to wear.

Another option is to use the British Geological Survey (BGS) Marine Wireline Coring System under an arrangement between Seacore and BGS. BGS is the coordinator of science operations for the European Consortium for Ocean Research Drilling (ECORD). ECORD is a member of IODP and is the operator of the 2004 Arctic drilling program at the Lomonosov Ridge. This cruise will be the inaugural effort of the international Integrated Ocean Drilling Program. However, BGS has a long history of drilling from non-standard drilling vessels.

The BGS Marine Wireline Coring System encompasses a suite of tools that are all interchangeable. The suite of tools available includes: 1) push sampler- non rotating mode; 2) push sampler – rotating mode; 3) piston sampler; 4) spring loaded extended core; 5) secondary latch in core barrel; and 6) insert bit for full hole drilling advancement. The primary tool that might be used from this suite is the latch in secondary barrel that is advanced in tandem with a larger outer bit. This inner core barrel cuts a 64 mm core x 4.5 m in length. This system offers similar core size to a mining style core barrel but with the advantages of not having to run a double string.

Depending upon the success in the first sites and availability of the three coring options listed above, as well as weather and iceberg conditions, a preferred method will be adopted for approaching the remaining sites with similar lithology. Decisions about which of these options will be employed first will be made after the IODP Arctic cruise where the tools are tested.

The grounding zone wedge site will be started with the new BGS marine wireline system if it is available. Specifically, the piston sampler will be used first, followed by the extended coring system and then the latch in secondary core barrel if more competent material is found. The Holocene site will be sampled with an advanced piston corer type piston sampler to total depth.

Dynamic Positioning

The R/V *N. B. Palmer* (Fig. 3) is equipped with a computerized system of thrusters that can be used to hold position. However, the NBP has never accomplished dynamic positioning because it has not had the needed input from a location beacon. There are no GPS ground stations close enough to the drilling sites that could be used for this purpose. The SHALDRIL working group has thus decided to install and use a seafloor beacon system for dynamic positioning. Raytheon Polar Services Company has purchased a super-short baseline system from Kongsberg. It will be installed and tested in Cape Town in July, 2004. This system will allow the NBP to hold position with the precision needed for drilling operations.

Backup Sites

As is the case almost anywhere in Antarctica, there is a chance that the northwestern Weddell Sea will have ice cover that prevents the NBP from even entering the area, much less holding station long enough to take drill cores (estimated to be around four days per site). Alternate sites within the James Ross Basin have been identified, but the SHALDRIL science party is also selecting alternate sites outside of the James Ross Basin in case plans need to be radically changed. The Pacific margin of the Antarctic Peninsula has a better chance of being free of significant ice cover; there will however be a greater chance of severe weather if these alternate sites are needed. The alternate Holocene sites that are currently being considering are the draping pelagic sediments in the Boyd Straight that cover the glacial bundle structures identified by Canals and others (2000) or the Andvord drift deposit (Harris et al., 1999). The alternate target for the last glacial maximum grounding zone wedge site is southwest of Adelaide Island in the mouth of Marguerite Bay (Bart and Anderson, 1995). Reaching the units which record the onset of glaciation on the western side of the peninsula will be more difficult since there is a much thicker section of Plio-Pleistocene strata (Bart and Anderson, 1995). The best place to sample the preglacial and glacial onset strata on the Pacific margin is offshore of Adelaide Island just seaward of the crystalline-sedimentary strata contact. The Miocene glacial section can be best sampled farther offshore in the margins of Marguerite Trough (Bart and Anderson, 1995).

Figure 3. The R/V *Palmer* in ice.

Other News

Two scientists from Argentina have been added to the science party for the 2005 cruise. Dr. Sergio Marenssi, the director of the Instituto Antártico Argentino, and Dr. Rodolfo del Valle will share their expertise on the James Ross and Seymour Island stratigraphy with the other cruise participants.

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