IODP Expedition 318: Wilkes Land Glacial History
Week 8 Report (21–27 February 2010)

OPERATIONS

Operations this week consisted of (1) a return to Site U1359 (WLRIS-04A) for RCB coring to total depth, (2) a final attempt to occupy one of our shelf sites (WLSHE-12A), and (3) APC/XCB coring at an alternate rise location, Site U1361 (WLRIS-05A).

Site U1359, Hole U1359D (WLRIS-04A):
After arriving at Hole U1359D at 2200 hr on 19 February, we assembled the RCB bottom-hole assembly and lowered it to the seafloor. We tagged the seafloor with the bit at 3023.0 mbrf and started drilling Hole U1359D at 0530 hr on 20 February. We drilled without coring to 152.2 mbsf and then started RCB coring at that depth to overlap with previous APC/XCB coring that had penetrated to 252 mbsf. RCB Cores U1359D-2R to 48R penetrated from 152.2 to 602.2 mbsf and recovered 269.7 m (60%). The last core was recovered on deck at 1145 hr on 23 February.

In preparation for downhole logging, we flushed the hole with a 50-barrel mud sweep and made a wiper trip up to 82.6 mbsf and then back down to 602.2 mbsf. After another 50-barrel sepiolite mud sweep, we released the bit at the bottom of the hole, displaced the hole with 191 barrels of 10.5 ppg mud, and raised the end of the pipe at 96.9 mbsf for logging.

We were able to conduct two very successful logging runs in excellent hole conditions. The triple combo and FMS-sonic tool strings were able to log the entire hole from 602 mbsf up to the end of the pipe. The FMS-sonic tool string was back on deck at 2000 hr on 23 February. In accordance with our marine mammal protocol, we waited until daylight the next day before conducting the check-shot log utilizing the Versatile Seismic Imager (VSI).

We rigged up the VSI and started lowering it downhole at 0745 hr on 24 February. The VSI was able to reach within 5 m of bottom of the hole, but we had to postpone starting the check-shots because a few whales entered within the mammal exclusion zone. Once we were able to start, we discovered that the VSI caliper arm could not be extended to clamp the tool against the borehole wall. However, we were able to set the tool on the bottom of the hole and get good enough coupling with the formation to collect data at that depth. We could have retrieved the VSI tool for repair/replacement, but we decided to conclude logging so we could attempt to reach one of our high priority shelf sites. After we recovered the VSI at 1330 hr on 24 February, we retrieved the drill string with end of the pipe clearing the seafloor at 1440 hr and arriving back on the rig floor at 2050 hr. We departed for the last attempt at the occupation of one of the high priority shelf sites at 2245 hr on 24 February.

Attempt to Reach Alternate Shelf Site WLSHE-12A:
We decided to first attempt to reach alternate Site WLSHE-12A which was 65 nmi to the south of Site U1359 and according to remote sensing analysis at the outer periphery of the ice pack. If this site was accessible, then we would try to move on to Site U1358 (WLSHE-08A) and U1360 (WLSHE-09B). If we could not reach Site WLSHE-12A because of ice, there was no point in proceeding further because the ice coverage was clearly denser over the latter sites.

We adjusted the vessel speed to adapt to the changing visibility during the dark evening hours. By early morning, icebergs began showing up on radar as we sailed south over a nearly flat sea in heavy fog that reduced visibility at times to less than 0.5 nmi. Occasionally, the fog would clear for short periods revealing the icebergs at a distance. We began to see sea ice with the concentration increasing the closer we came to location. At 0640 hr we had to stop to wait for the visibility to improve. When the fog lifted a short time later, we resumed our transit to Site WLSHE-12A and started encountering numerous very small pieces of ice debris. As we continued, the size of the debris slowly increased in size until finally we were greeted with a wide expanse of floating ice of various shapes and size none of which was particularly large, but collectively was very impressive. We proceeded at reduced speed until 0840 hr when we came within 5 nmi of Site WLSHE-12A. At this juncture, we observed ice on the forward horizon that was clearly too thick and too large to allow us to continue safely and we had to abandon our attempts to occupy our high priority shelf sites. We reversed course and began our transit to alternate rise Site U1361 (WLRIS-05A) located 30 nmi north of Site U1359 (WLRIS-04A).

Site U1361 (WLRIS-05A):
We began positioning over Site U1361 (WLRIS-05A) at 1945 hr on 25 February. The total transit distance from Hole U1359D to near shelf site WLSHE-12A and finally to Site U1361 covered 149 nmi at an average speed of 7.1 knots. We lowered the drill string and started coring Hole U1361A at 0710 hr on 26 February. Based on the recovery of the first core, the seafloor depth was 3465.5 mbrf (3454.3 mbsl) or 5.3 m shallower than the corrected PDR depth. APC coring advanced to 151.5 mbsf and recovered 150.9 m (100%). The first core was obtained with a standard steel core barrel, but all subsequent APC cores were taken with non-magnetic core barrels. Temperature measurements were made at 37.5 mbsf (Core U1361A-4H), 66.0 mbsf (Core U1361A -7H), 94.5 mbsf (Core U1361A-10H), and 123.0 (Core U1361A-13H).

We then switched to XCB coring and deepened the hole from 151.5 to 388.0 mbsf by 0130 hr on 28 February. Cores U1361A-17X to 41X recovered 188.0 m of core (79%). After Core 41X was recovered, we had to suspend coring to deploy a free fall funnel (FFF) because an iceberg was moving directly toward the site.

We raised the bit to 90 mbsf and deployed a FFF at 0700 hr on 28 February. At that time, the iceberg was 5.5 nmi away and continuing to move toward the ship. We waited until around 0900 hr to see if it would change course, but it was still heading toward us. At 0945 hr, we pulled the bit out of the hole and started moving the ship to the north and out

of the icebergs path. Once the iceberg passed by, we started moving back to Hole U1361A and will prepare for reentering the hole. Our plan is continue coring and then conduct two downhole logs before departing. We are scheduled to be underway for Hobart no later than 2400 hr on 2 March.

SCIENCE RESULTS

Science results this week cover the final deep RCB coring in Hole U1359D (WLRIS-04A). Results of previous APC/XCB coring at Site U1359 was reported in the Week 6 Report (7-13 Feb). The primary objective at Site U1359 (WLRIS-04A) is to obtain an expanded distal record of paleoceanographic and climate variability during the late Neogene and the Quaternary.

Lithostratigraphy: The two most common lithofacies in Hole U1359D consist of laminated silty clays and bioturbated silty clays (both with dispersed clasts) with variations of these based on changes in the style of laminae or the relative abundance of the biogenic component. The upper 100 m of Hole U1359D overlapped with the deeper portions of Holes U1359A and U1359B, and contain diatom-rich bioturbated silty clays that are interbedded with both massive and laminated silty clays. Below 247.1 mbsf to the bottom of Hole U1359D (596.32 mbsf), sediments are bioturbated diatom-bearing silty clays interbedded with laminated silty clays. The laminated silty clays have more subtle, but persistent, sub-mm- to mm-scale laminae compared with similar laminated facies above 247.1 mbsf. Dispersed clasts occur throughout the core. Clasts more than 2 mm in size are dispersed throughout the entire section at this site in trace to 1% abundance.

Micropaleontology: Samples U1359D-17R-CC through -48R-CC (bottom of the hole) contain well-preserved diatom and radiolarian assemblages for biostratigraphic control. An upper Middle to lower Upper Miocene (12.5 to 10.5 Ma) succession is recovered, with high sedimentation rates (150 m/m.y.). Dinoflagellate and siliceous microfossil assemblages indicate highly productive surface waters during that time.

Paleomagnetism: Measurement of the archive halves and discrete samples from Holes U1359A, U1359B, and U1359C provide a composite polarity log that documents a complete Pliocene section, with a gap including Chron C2 and a period of extremely low sedimentation is suggested from Chron C3Ar to the top of C5n. The stratigraphic interval in Hole 1359D suggest it comprises Chrons C3An to C5n.

Geochemistry: At Site U1359, a total of 71 samples for inorganic geochemistry were taken from 0 to 611 mbsf and analyzed for percent calcium carbonate. Calcium carbonate content for most samples is below detection limit, except for one layer of nannofossil ooze at 372 mbsf (40 wt.% $CaCO_3$). All samples have been prepared for analyses of major and trace element geochemistry. Preliminary results from the upper 200 mbsf show fluctuations in element patterns that are interpreted to reflect different amounts of biogenic vs. terrigenous material in the core as well as changing continental inputs.

Physical Properties and Stratigraphic Correlation: Whole-round natural gamma ray, density, and magnetic susceptibility data allows stratigraphic correlation of the four holes at Site U1359 and the definition of the composite record from the seafloor down to 215 mcd with only a few potential small gaps. Physical properties generally change at lithostratigraphic boundaries. Velocity and density data exhibit a shift to slightly lower values at the Lithostratigraphic Unit II/III boundary. In the lower part of the section, all physical properties exhibit a switch in the rate of change. A prominent interval of low magnetic susceptibility (< 20 instrument units) occurs from 95 to 120 mbsf. Throughout the section, magnetic susceptibility appears to exhibit pronounced cyclicity at several scales.

Downhole Logging: We conducted three downhole logging runs in Hole U1359D with the following tool strings – triple combination, FMS-sonic, and VSI. Each run reached the total depth of the hole (just over 600 m) and collected excellent data in good borehole conditions. Continuous Natural Gamma Ray, density, and FMS data provide valuable information in poorly recovered intervals and clearly delineate diatom-bearing intervals, glacial dropstones, and dipping beds in slumped intervals. Sonic velocity and check shot data provide critical data for correlating core-log data to regional seismic reflection data. Formation temperature measurements give a geothermal gradient of 62°C/km and a heat flow of 62 mW/m^2.

TECHNICAL SUPPORT AND HSE ACTIVITES

Cores from Hole U1359D were processed through the labs. For the downhole logging check shot, we rigged up and deployed the seismic source and implemented the required marine mammal program for seismic source use. An abandon ship drill was held on February 27th for the entire ship's complement.