

**IODP Expedition 318: Wilkes Land Glacial History
Week 9 Report (28 February–8 March 2010)**

OPERATIONS

Operations this week consisted of (1) the continuation of APC/XCB coring at Site U1361 (WLRIS-05A) on the continental rise and (2) the end of expedition transit to Hobart, Australia.

After we had recovered Core U1361A-41X that reached to 388.0 mbsf, we had to deploy a Free-Fall Funnel (FFF) due to an approaching iceberg. We raised the bit to 90 mbsf and deployed the 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.

The ~500-foot wide iceberg passed directly over the hole at 1245 hr. Once the iceberg had cleared the site and was no longer a threat, we moved back over the hole by 1500 hr and the reentry camera/sonar system was deployed. At 1555 hr, the video failed when the system was 200 meters below the ship. When we recovered the camera system we found that water had entered the cable head assembly on the main umbilical cable. As soon as it was repaired we lowered it to the end of the drill string.

We reentered Hole U1361A at 2137 hr on 28 February after 15 minutes of searching and positioning the drill bit over the FFF. We lowered the drill string into the hole as the camera system was retrieved and by 0130 hr on 1 March the bit had reached the bottom of the hole at 388.0 mbsf without having experienced any significant drag while running into the hole. Because of the little time remaining before we had to depart for Hobart, we decided not to continue coring and prepare the hole for the downhole logging.

The hole was flushed with 50-barrels of sepiolite mud and then displaced with 179 barrels of 10.5 ppg heavy mud. The drill string was raised up to 88.6 mbsf for logging. We conducted two successful logging runs with the triple combo and the FMS-sonic tool strings with both reaching the bottom of the hole. Once logging was concluded, the bit was pulled free of the seafloor and the vessel offset 50 m north of Hole U1361A.

APC coring in Hole U1361B started at 0840 hr on 2 March and established the water depth at 3466.9 mbrf. We only had time for two piston cores before the operational time for the expedition ran out – in part due to a delay caused by ice buildup on the APC piston rod. APC Cores U1361B-1H to 2H penetrated to 12.1 mbsf and recovered 12.0 m (100%). We recovered the drill string, disassembled the bottom hole assemble into component parts, and started our transit to Hobart, Australia at 0030 hr on 3 March.

We are scheduled to arrive at the Hobart pilot station at 1000 hr on 8 March.

SCIENCE RESULTS

Site U1361 (WLRIS-05A) is located in the continental rise at 3466 m water depth. Similar to Site U1359, the main objective at Site U1361 was to provide a history of climate and paleoceanographic variability record from the middle Miocene to the Pleistocene and to test the stability of the East Antarctic Ice Sheet during extreme warm periods (e.g., Miocene Climate Optimum, early Pliocene, and Pleistocene Isotopic Stages MIS 31 and MIS 11). Drilling at this site targeted the timing and nature of deposition of the upper seismic units (i.e., above the WL-U6 unconformity) defined on the Wilkes Land margin. Within these units a shift in sedimentary depocenters from the continental rise to the outer shelf is observed, possibly corresponding with the transition from a dynamic wet-based to a more persistent cold-based EAIS, which is inferred to occur during the late Miocene–Pliocene. At Site U1361 unconformities WL-U6, WL-U7 and WL-U8 lie at about 5.13s, 5.03s, and 4.78s two way travel time (TWTT), respectively (about 385, 300 and 100 mbsf, respectively).

Site U1361 is located on the eastern levee of the Jussieu submarine channel downstream from Site U1359. The levee relief at Site U1361 is about 195 m. The fine-grained components of the turbidity flows traveling through the channel and hemipelagic drape are inferred to be the dominant sedimentary processes building these levees. Bottom-currents can further influence sedimentation in this setting. The record from Site U1361 should be complementary to the record from Site U1359. Similar depositional environments were cored during ODP Leg 178 in the Antarctic Peninsula and ODP Leg 188 in Prydz Bay.

Two holes were drilled at Site U1361. Hole U1361A reached a total depth of 388.0 meters below sea floor (mbsf), using the Advanced Piston Corer (APC) system to refusal at 151.5 mbsf, followed by Extended Core Barrel (XCB) drilling to the bottom of the hole at 388.0 mbsf. Hole U1361B reached 12.1 mbsf using the APC. Five lithofacies (designated A through E) were identified at Site U1361 and, based on their distribution in Hole U1361A, two lithostratigraphic units are defined. Facies A and B consist of clays and silty clays with common diatoms and foraminifera, and rare dm-scale sets of mm- to cm-scale silt and clay laminae. These facies are restricted to the interval between 0.0 and 34.9 mbsf (Lithostratigraphic Unit I). Facies A and B were deposited in hemipelagic depositional environments, with isolated sets of silt and clay laminae indicating occasional sedimentation from low-density turbidity currents or saline density flows in a distal levee setting (Escutia et al., 2008). Facies C and D are strongly bioturbated silty clays and diatom/nannofossil oozes with intervals containing dispersed clasts. Facies E consists of laminated clays. Facies C through E are present between 34.9 and 386.3 mbsf (Lithostratigraphic Unit II) and are typical of contourite facies associations, although downslope currents possibly contributed sediment as well.

Samples U1361A-1H-CC through -41X-CC (1.5 to 386.31 mbsf) were analyzed for microfossils. Diatoms and radiolarians provide good age-control for Hole U1361A, resolving an uppermost Pleistocene through uppermost Middle Miocene sedimentary succession with no major breaks in sedimentation.

Miocene diatom assemblages at Site U1361 are indicative of productive, seasonally variable, open marine conditions. Fluctuations in the abundance of marine benthic and tychopelagic taxa such as *Cocconeis* spp., *Diploneis* spp., *Paralia sulcata*, stephanopyxids and *Trinacria excavata* may indicate pulses of shelfal material to the drill site. The presence of well preserved benthic foraminifers in Sample U1361A-34X-CC (321.07 mbsf) suggests that depositional settings were favorable for calcite preservation (i.e., not corrosive) for brief intervals in the Miocene. The persistent presence of reworked Mesozoic/Paleozoic sporomorphs within the palynological associations suggests ongoing erosion in the hinterland.

Late Neogene diatom assemblages from sediments drilled at Site U1361 are typical Southern Ocean open water taxa, with variable abundances of benthic, neritic and sea ice-associated diatoms, indicating a high nutrient-high productivity, sea ice-influenced setting throughout the late Neogene. High abundances of reworked sporomorphs within the palynological associations indicates strong erosion in the hinterland. Dinocysts are absent during this interval. The preservation of planktonic foraminifers in the Pleistocene indicates that bottom waters were favorable to the preservation of calcium carbonate.

Paleomagnetic investigations at Site U1361 document a complete section from the top of Chron C2n to the top of Chron C3n. Below Chron C2n the recovered core was quite disturbed and there is no complete analysis of the discrete samples as of yet. The lower portion of Hole U1361A can plausibly be correlated to the bottom of Chron C5n to C5An.

Forty samples from Hole U1361A were taken for analyses of percent carbonate, carbon, nitrogen and sulfur content, as well as major and trace element analyses. CaCO₃ contents for most samples are well below detection limit (<1 wt%). Between 313.96 and 342.04 mbsf, however, carbonate contents increase to 12.1 - 24.8 wt%. This matches the recognition of nannofossil-bearing clays constituting one of three major facies below 313.2 mbsf (Unit IIb). Carbon, nitrogen and sulfur contents were measured on 15 selected samples covering the full range of CaCO₃ contents (0 – 24.8 wt%). All concentration levels are very low (i.e., <0.5 wt% C, <0.03 wt % N, <0.02 wt% S), except for the four samples with high calcium carbonate contents. Taken together with the CaCO₃ measurements, these samples yield total organic carbon concentrations below 0.3 wt%, which is within the error of the respective measurements.

The magnetic susceptibility data exhibit relatively high amplitude variations and this apparent cyclicity at several scales occurs especially in the upper 165 mbsf and between 305 mbsf and the bottom of the hole. There are two intervals with relatively lower magnetic susceptibility units between 165 to ~185 mbsf and between 265 to 305 mbsf. The variations in GRA density reflect the regular fluctuations in lithology and porosity. The relative moisture content varies between 63 to 22 wt% and porosity from 82 to 42% with gradual decrease with increasing depth and overburden pressure.

Downhole Logging operations started after a successful reentry of Hole U1361A. Runs with the triple combo, followed by the FMS-sonic in Hole U1361 were successful. The

downhole logs at Hole U1361A have high-amplitude 1-5-m-scale variability superimposed on a downhole compaction trend. It is likely that Milankovitch band variability at eccentricity and possibly obliquity periods is recorded at Site U1361. The downhole measurements at Site U1361 included four APCT-3 deployments in Hole U1361A that document a heat flow of 58.2 mW/m².

TECHNICAL SUPPORT AND HSE ACTIVITIES

Technical group focused on the processing of the final cores from Site U1361 and spent the remaining time conducting end of expedition activities (preparing sample and other shipments, backing up data, and cleaning laboratories). A fire and boat drill along with abandon ship drill was held on 4 March for the entire ship's complement.