**IODP Expedition 330: Louisville Seamount Trail**

Week 8 Report (31 January to 6 February 2011)

OPERATIONS

This week started with the successful re-entry into Hole U1376A on Burton Guyot without the aid of a free fall funnel, which could not be deployed because of the lack of soft sediment, at 0435 hr on 31 January. Coring continued without incident until the allocated coring time for this site expired at 1630 hr on 2 February leaving the hole at a final depth of 182.8 mbsf. The total average recovery for the hole was 74.5% with an excellent average recovery in basement of 75.6%. The average rate of penetration in basement was 1.8 m/hr.

Following a wiper trip, which included displacing the borehole with 42 barrels of heavy (10.5 ppg) mud, the bit was released at the bottom of the hole. The end of pipe was positioned at the logging depth of 80.4 mbsf by 2115 hr on 2 February.

The Triple Combo tool string, which comprised spectral gamma ray, neutron porosity, density, caliper and resistivity, was deployed first on 3 February. The tool made two full passes of the hole, and the tool string run was completed at 0511 hr. The second tool string deployed was the Göttingen Borehole Magnetometer (GBM). The GBM begins its log during the orientation (sighting) process on the rig floor and continuously collects data until its return to the rig floor following a down- and up-log portion. The GBM run began at 0531 hr, however, following a report that the pipe was stuck in the hole, the logging run was aborted and the tool returned to the surface. The tool was not totally rigged down and owing to its short length, was placed in one of the core barrel shucks on the rig floor. Once the pipe was worked free, the GBM tool was deployed again at 0726 hr. The tool reached its target depth at 183 mbsf at 0956 hr. The tool returned to the surface at 1145 hr, was successfully sighted and rigged down by 1218 hr. The final tool deployed was the FMS-Sonic. The tool string was run into the hole at 1338 hr and successfully reached a target depth of 182 mbsf. Two full passes were measured with the FMS-Sonic. The tool was rigged down by 1755 hr, and at this time logging operations concluded. All tool strings were

able to reach their target depth in Hole U1376A and none of the tools encountered tight spots.

Once logging was concluded, the drill string was recovered with the end of the pipe clearing the seafloor at 1850 hr on 3 February. After the drill collars were set back in the derrick, the beacon recovered, and the drilling equipment secured, the vessel departed the location for primary Site LOUI-4B (Site U1377) at 2200 hr.

By 0930 hr on 5 February, the vessel was positioning on the new site and Hole U1377A was spudded at 1510 hr. Rotary coring advanced with increasing difficult hole conditions and poor recovery. Finally after coring to a depth of 53.3 mbsf, the hole had to be abandoned because of unstable conditions. The bit cleared the seafloor at 1815 hr on 6 February and was picked up to 1103 mbrf. The average recovery for Hole U1377A was 16.4%.

It was decided to offset the vessel 500 m south of Hole U1377A and attempt to spud another hole at this site. After a 30-minute vessel offset with the bit 159 m above the seafloor, the vessel was on position. The VIT was deployed and a seafloor covered with sediment was observed. Hole U1377B was spudded at 2325 hr on 6 February.

SCIENCE RESULTS

All laboratory groups worked this week to finish their description and analyses of rocks from Site U1376 on Burton Guyot and preparing reports and presentations while already receiving cores at Site U1377 on Hadar Guyot.

The Sedimentology group defined two stratigraphic units for the sedimentary cover of Site U1376 on the basis of compositional and textural characteristics of the sediment at macroscopic and microscopic scales. Stratigraphic Unit I represents a younger sedimentary cover that extends between the seafloor and 23.45 mbsf. This cover is mostly composed of monolithic, juvenile volcaniclastic deposits, which extend between 4.50 and 21.48 mbsf. These deposits are

interpreted as a possible record of a rejuvenated volcanic stage of Burton Guyot in a hemipelagic or pelagic environment. Other deposits of Subunit IA include layered volcanic breccias and sandstones, which are interpreted as turbidites and possible hyperconcentrated flow deposits. Four thin (<3 cm-thick) ferromanganese crusts occur in the uppermost part of the drilled sequence, which also yielded a minor amount of nannofossil and foraminifer-bearing chalk. Stratigraphic Unit II represents an older sedimentary cover of Burton Guyot that extends between 23.45 and 41.93 mbsf. A 15.15 m-thick interval of limestone (classified as boundstone-rudstone) occurs in the upper part of Unit II, which is composed of abundant red algae and minor amounts of other shallow-marine fossils. This interval is interpreted to represent an algal reef that developed in very shallow-marine conditions during subsidence of the drilled seamount. The base of Unit II between 38.60 and 41.93 mbsf is composed of a basalt conglomerate with few shallow-marine bioclasts. The conglomerate emplaced on top of an erosional surface that marks the boundary between the sedimentary cover and underlying volcanic basement of Burton Guyot.

Similarly, the sediment found at Hole U1377A on Hadar Guyot was also divided into two stratigraphic units representing a pelagic cap and an older sedimentary cover. Unit I is composed of nannofossil foraminiferal ooze, which extends from the seafloor to 6.10 mbsf. It is interpreted to represent a pelagic cap on top of the drowned seamount. An older sedimentary cover (Unit II) contains a bioturbated, multicolor foraminiferal limestone with ferromanganese encrustations, which is interpreted to have deposited in a hemipelagic environment after drowning of Hadar Guyot.

Because no soft sediments were recovered from Hole U1376A, the standard procedure for micropaleontology has not been applied at this site. Instead, the Paleontology group took smear slides and thin sections from the consolidated sequence of Subunits IA, IIA, and IIB. Nannofossils found in smear slides taken from Unit IA indicate a preliminary age of middle to late Miocene. The attention focused on the apparent algae reef carbonate in the upper part of Unit II. Several macrofossil fragments, such as bivalves, bryozoans, calcareous algae,

gastropods, were found in thin sections taken from this interval. Nonetheless, only two individuals of planktonic foraminifers were found, which prevents the accurate age estimation of this unit. However, macrofossils found below the carbonate in Subunit IIB indicate a preliminary late Cretaceous age.

Whereas the recovery of the algae reef was the most exiting finding for the Sedimentology and Paleontology groups at Site U1376, the Igneous Petrology group was fascinated by the discovery of a single, 33 m thick lava flow that was found further downhole in Unit III. The flow consists of highly olivine-augite-phyric basalt and the phenocrysts are surprisingly fresh at several intervals. A second massive flow of olivine-augite-phyric basalt was found at 108.07 mbsf. This flow is 2.07 m thick and marks the end of Unit III. Augite disappears as a phenocryst phase below this flow, and the succession of olivine-phyric basalt breccia and thin lobate flows that followed are designated to Unit IV. Immediately on entering Unit IV we encountered the first of two intrusive sheets of aphyric basalt, which have steep contacts and are probably dikes. An aphyric basalt flow encountered at 127.57 mbsf marks the beginning of an interval in which most of the breccia is heterolithic, with clasts of aphyric and olivine-phyric basalt. This interval also includes thin aphyric and olivine-phyric basalt flows. The breccia at the top of Unit IV is also notable for the preservation of fresh, remarkably glassy clasts. Unit IV continues to the bottom of Hole U1376A. The restriction of aphyric basalt flows, clasts and dikes to Unit IV, coupled with the apparent truncation of a thin dike offshoot, or possibly a fragment of dike rock, at the base of Unit III, suggests that the boundary between the two units might be an erosion surface.

The igneous basement in Hole U1377A on Hadar Guyot starts at 15.10 mbsf with an aphyric basalt unit that contains vertical vesicle trails. These may indicate that this unit is a dike, although without any contacts being recovered we cannot be certain. Below this unit, the rock becomes olivine-phyric before grading into a layered rock with subcentimeter thick intervals of olivine-phyric and aphyric lava.

The Alteration Petrology group has identified a variety of alteration grades, from slightly to highly altered, in the rocks recovered from Hole U1376A. Noticeable is

the predominantly greenish color indicating more reducing conditions related to a submarine emplacement environment. Only minor and sporadic intervals in the upper 60 meters of the core show any reddish/brown alteration. Augite is generally well preserved as phenocrysts and in the groundmass throughout the entire igneous portion of the core. Some olivine is completely altered to iddingsite, hematite, and Fe-oxyhydroxide near the top of the core, but large portions of the core contain fresh to slightly to altered olivine. Some olivine in greenish altered rocks is replaced by green clay and carbonates (calcite/magnesite). This site is characterized by a very high abundance of veins. These are dominated by carbonates (Mg-calcite, aragonite, siderite) and clay minerals (saponite, nontronite). Other secondary phases (iddingsite, Fe oxyhydroxides, hematite, goethite) are present and zeolites constitute only a minor amount of the alteration assemblage.

The high abundance of veins in the cores from Hole U1376A kept the Structural Geology group particular busy this week. In fact, this site has the highest vein density of all Louisville seamounts drilled, with a maximum density of 39 veins/meter. Veins are also commonly wider than previously observed, with numerous veins between 5-10 mm wide, up to a maximum of 30 mm, indicating that Hole U1376A experienced the highest levels of fluid flow for all the Louisville Seamounts drilled during Expedition 330. The veins are dominantly shallowly dipping, and often have subvertical fibrous mineral infills, both of which indicate subvertical tension within this part of the seamount. However, observed geopetal infills are overwhelmingly horizontal, indicating that this part of the seamount experienced little or no tilting after these geopetals were filled.

Fifteen igneous samples (one sample from the Hole U1375B microgabbro, 13 from Site U1376, and one from Site U1377) were analyzed by the Geochemistry group for major and trace elements with the ICP-AES. Data reduction and interpretation have commenced. Because no soft sediment was recovered in this week, no samples were collected or analyzed for determination of carbonate, organic carbon, or organic nitrogen content.

The Paleomagnetism group has measured and alternating-field (AF) demagnetized all remaining archive half-cores from Site U1376 (Cores U1376A-6R to -23R) during this week. In addition, 81 discrete samples have been AF or thermally demagnetized. Both the archive half-core and discrete sample remanent magnetizations provide a consistent pattern of moderate to steep positive inclinations, reflecting southern hemisphere reversed polarity. In particular, the 33 m-thick massive lava flow (Lithological Unit 15 in Stratigraphic Unit III) shows very little variation in inclination, suggesting formation over a short time.

The Physical Properties group continued running tests on whole-core and discrete samples from Holes U1376A and U1377A this week. Whole-round and split-half measurements were completed for Cores U1376A-9R to -23R and for Cores U1377A-1R to -5R. Natural gamma ray radiation testing was also completed for these sections using count times of one hour for each. No thermal conductivity measurements were made this week due to the earlier failure of the thermal conductivity probe used for hard rock samples. Discrete samples were chosen from both holes in collaboration with the Paleomagnetism group. The entire set of paleomagnetic, compressional wave velocity, and moisture and density measurements have been completed for Cores U1376A-1R to -15R, and the remaining samples are in the final stages of physical property testing. Reports for Sites U1375 and U1376 were also completed this week, and a final draft of the revised Physical Properties Explanatory Notes (Methods) was produced. Filtered physical property data continue to be produced and made available to other groups to aide interpretations and in the selection of shipboard and personal samples.

The Microbiology group collected five samples from Hole U1376A for cell counts, molecular biology and in situ stable isotopes analysis. In addition, three of these samples were used to inoculate 56 culturing experiments with ten different media. One sample was used to initiate a stable isotope addition bioassay and a different one was seeded with microspheres for evaluation of microbial contamination from drill fluid in whole round samples. Results of these tests

revealed no contamination. Upon arrival at Site U1377, the Microbiology group waited very patiently and finally collected a single sample from the last core of that hole at 47 mbsf. This sample was used for routine sampling and the initiation of a stable isotope addition bioassay. Drill fluid was also collected from this site for analysis of microbial communities in the drill fluid to aid in detection of sample contamination.

Following a thorough hole preparation program for Hole U1376A the Downhole Logging group started operations at 2125 hrs on 2 February. Logging pipe depth was set at 1594.7 mbrf. The Triple-Combo (TC) tool string, which comprised spectral gamma ray, neutron porosity, density, caliper and resistivity, was deployed first. The tool was run into the hole at 2140 hrs and reached a target depth of 1696.6 m wireline below rig floor (WRF) at 0139 hrs (3 February). The TC made two full passes of the hole. The second tool string deployed was the Goettingen Borehole Magnetometer (GBM) and reached its target depth at 1696.7 m WRF at 0956 hrs. The tool ran perfectly with no communication losses or signal errors and returned to the surface at 1145 hrs. The final tool deployed was the FMS-Sonic. The tool string was run into the hole at 1338 hrs and successfully reached a target depth of 1695.8 m WRF (just one meter shallower than the previous tool runs). Two full passes were measured with the FMS-Sonic. The tool was rigged down by 1755 hrs, and at this time logging operations were concluded. All tool strings were able to reach their target depths in Hole U1376A and none of the tools encountered tight spots.

Currently the logging data are being provisionally processed onboard and the standard Schlumberger tool data have been transferred to the Borehole Research Group at Lamont-Doherty Earth Observatory for full processing so it can be made available to the science party.

EDUCATION AND OUTREACH

The expedition education officer has continued posting daily on the JR website and Facebook page. The JR website had 1,561 visits between January 30 – February 5. Of those, 861 were new visitors. The JR Facebook posts had 83,882 views during the week, and have increased its followers from 2,307 fans on

January 29 to 2,309 fans on February 5. Four videoconferences were conducted this week, one with the Auckland Museum and three others with schools in the US. The scientists David Buchs, Patrick Fulton, Joerg Geldmacher, Anthony Koppers, and Nicola Pressling all participated in question-and-answer periods with over 130 participants this week.

The expedition videographer finished final shooting and editing her new video "Visualizing Rock" and uploaded it to the Ocean Leadership YouTube Channel and to the JR Facebook page. She has also written a new song called "Leavin' Louisville" and has made an initial recording. Currently she is working on a script for a "wrap up" video for this expedition. Together with the educator, she has conducted seven profile interviews of expedition participants this week. She also met with camp boss Alex Trota da Silva to discuss and plan a video on the ship's kitchen operation.

TECHNICAL SUPPORT AND HSE ACTIVITES

The technical staff was fully engaged in providing full support for coring operations at Sites U1376 and U1377. The previous sampling backlog has been cleared and all cores will be shipped to College Station at the end of the expedition. In addition minor software upgrades to various applications continued and end of expedition activities were initiated.

The weekly fire and boat drill was held as scheduled. No HSE incidents to report.