

IODP Expedition 330: Louisville Seamount Trail

Week 7 Report (24-30 January 2011)

OPERATIONS

At the beginning of this week the vessel was in transit to Site U1375 (Prospectus Site LOUI-2B) on Achnar Guyot (working name) where the ship arrived at 0330 hr on 25 January. In accordance with the established routine of the expedition, the vibration-isolated television (VIT) camera was deployed prior to spudding the hole. The bit tagged seafloor at a depth of 1258.0 mbsl. Hole U1375A was spudded with the rotary core barrel (RCB) coring assembly at 1345 hr on 25 January. Almost immediately the driller experienced erratic high torque indicating that we were attempting to core through loose rocks and boulders. Frequent overpulls of up to 90 kip were required to keep the drill string rotating freely. At 2130 hr coring was terminated at a depth of 11.5 mbsf because of the unstable hole conditions. The average recovery for only two cores was 13%.

The vessel was offset 300 m at 315 degrees and a second attempt to core at this site was initiated when Hole U1375B was spudded at 2345 hr at the same water depth of 1258.0 mbsl. After penetrating only 8.5 m with increasing difficulty and constantly fighting unstable hole conditions, operations at this site were terminated as well. The lone core had an average recovery of 7%. Evidently, the formation on the top of this seamount consists of a sedimentary breccia loosely held together in a "soft" carbonate matrix that quickly disaggregated during drilling. The vessel departed for an approved alternate site located 91 nmi NNW from Site U1375 at 1945 hr on 26 January. The total time on Site U1375 was 34.3 hours or 1.4 days.

The 91 nmi transit to approved alternate Prospectus Site LOUI-7A on Burton Seamount was accomplished at an average speed of 10.1 knots. The vessel was on station at 2300 hr on 26 January. A 3-stand RCB bottom hole assembly was made up with a new C-4 coring bit and mechanical bit release and deployed. Prior to spudding, the VIT was launched to observe the character of the seafloor and the tagging of the bit on the bottom. A rocky seabed devoid of any

appreciable sediment was observed on the subsea television. From 0300 hr to 0515 hr on 27 January a VIT survey was made looking for an area containing sediment that could support a FFF installation should one be required. After 2.3 hours, a spot with a very small sediment pond was located.

The driller tagged the seafloor at 1514.3 mbrf (1503.3 mbsl) and spudded Hole U1376A at 0705 hr on 27 January. Operations continued without incident until 1530 hr on 30 January when coring was suspended at a depth of 86.8 mbsf to change the bit which had accumulated 72.4 rotating hours. Because of the absence of sediment cover needed to support an FFF installation, a hole marker comprised of a weight, tether, and single glass float was remotely released from the VIT frame via an acoustic release. The bit cleared the seafloor at 1800 hr on 30 January and was on deck at 2215 hr. A new C-4 RCB bit was made up to the BHA along with a refurbished mechanical bit release and deployed. Hole U1376A was successfully re-entered at 0435 hr on January 31.

SCIENCE RESULTS

After the Sedimentology group had finalized their Site U1374 report, their focus shifted to the sedimentary rocks recovered at Site U1375 on Acheron Guyot this week. Sedimentary recovery at Site U1375 was restricted to Hole U1375A, and represents a pelagic cap and an older sediment cover. Two stratigraphic units were defined on the basis of compositional and textural characteristics of the sediment at macroscopic and microscopic scales. The pelagic cap at Hole U1375A (Unit I) was poorly recovered (~2% recovery retrieved in the core catcher of Core U1375A-1R). The material indicates that Unit I probably represents a young sedimentary cover composed of sandy foraminiferal ooze. The sediment resembles that recovered in the uppermost parts at Site U1372 on Canopus Guyot and Site U1374 on Rigil Guyot, and is interpreted to represent a pelagic cap on top of the drowned seamounts. An older sedimentary cover (Unit II) in Hole U1375A was found between 8.50 and 10.11 mbsf, which includes from top to bottom: (1) a ferromanganese-phosphate crust at ~8.50 mbsf; (2) a grain-supported, poorly-sorted, multicolor basalt conglomerate between 8.50 and 9.34 mbsf; and (3) an altered, monolithic, matrix-supported, poorly-sorted, multicolor

basalt breccia between 9.34 and 10.11 mbsf. The composition and texture of the sediment suggest that Unit II includes a hemipelagic interval probably deposited after drowning of Achnar Guyot at Site U1375, and an older volcanoclastic debris flow deposit.

The sedimentological interpretations for Site U1375 were corroborated by the investigations of the Biostratigraphy group; the pelagic sediment recovered from the core catcher of Core U1375A-1R (Unit I) contains calcareous nannofossils and planktonic foraminifera that range in age from latest Miocene to Holocene. Samples of the consolidated carbonate matrix in Unit IIA of Core U1375A-2R analyzed for calcareous nannofossils contains species that indicate a preliminary age assignment of early Paleocene. This is in agreement with thin section analyses for planktonic foraminifers that also indicate an early to middle Paleocene age for Unit IIA. This would indicate that the disconformity between the ferromanganese crust that caps Unit IIA and the overlying pelagic cap represents at least 50 million years.

Although the two cores from Hole U1375A did not recover any igneous basement, five different types of volcanic clasts in the conglomerate of Unit II were identified by the Igneous Petrology group. In contrast, Hole U1375B recovered a short, but interesting interval of entirely igneous rock. This has been identified as a moderately olivine(-augite)-phyric microgabbro, although it could also be called a dolerite or diabase. It is distinguished by its medium-grained texture and abundant olivine and pyroxene phenocrysts, which reach over 10 mm in size. Unfortunately, its upper and lower contacts were not recovered so we are unable to determine if this unit represents an in situ lava flow or intrusion.

By the end of this week, the lab group has described cores down to 86.27 mbsf from Hole U1376A at the new site on Burton Guyot. Below a cap of volcanoclastics (possibly derived from late-stage, post-erosional volcanism), limestone (formed by an algae reef) and some basaltic conglomerate, the igneous basement was reached at 41.93 mbsf beginning with units of hyaloclastite, pillow lavas and fragmented lava. Almost all of the rocks within the igneous basement recovered so far have been moderately to highly phyric, with

conspicuous olivine and augite phenocrysts up to 10 and 8 mm in size, respectively. In the upper units the olivine is moderately to completely altered. However, at around 72 mbsf the rocks gradually become more massive and the olivine phenocrysts become fresh. At the current depth of drilling this highly olivine-augite-phyric basalt lava flow is over 14 m thick.

The main goal of the Alteration Petrology group for this week was to finish core description and report writing for Hole 1374A while simultaneously working on the incoming cores from Sites U1375 and U1376. From the top of Hole U1374A to ~300 mbsf the sequence shows dominantly reddish and/or brown alteration colors, indicating oxidizing conditions under subaerial to transitional shallow marine environments. At depths greater than 370 mbsf, the basalt display a range in alteration, from slightly to highly altered showing greenish colors indicating more reducing conditions related to a submarine emplacement environment. Nevertheless, occurrences of gray and relatively unaltered basalt were encountered throughout Hole U1374A. Overall, three main groups of alteration phases could be distinguished: carbonates (Mg-calcite), clay minerals (saponite, nontronite, celadonite), zeolites and other secondary phases (iddingsite, Fe oxyhydroxides, goethite, pyrite/chalcopyrite, thaumasite). The type of zeolite varies from phillipsite in the upper portions of the core to analcite and gmelinite at depth, apparently indicating a thermal alteration gradient. By the end of this week, the Alteration Petrology group has finished their report for Site U1374 and is currently describing cores from the Hole U1376A, which up to now show a dominant greenish alteration indicating reducing conditions.

Like the other lab groups, the structural geologists have investigated cores from Site U1375 on Archenar Guyot, and from Hole U1376A from Burton Guyot during this week. They also have completed the Site U1374 report and prepared the site report for Site U1375. Despite the short length of cores at Archenar Guyot, several reliable geopotals were observed in the sediment of Hole U1375A, indicating this part of the seamount has not been tilted since deposition of the geopotal material. Several veins and vein networks (up to 8 mm wide, although typically thinner) were also present within the sedimentary clasts in Unit II of Hole U1375A. Also, several conjugate veins are present within the microgabbro of

Hole U1375B. Core descriptions for Site U1376 on Burton Guyot are in progress, with Cores U1376A-1R to -9R described so far. At this site geopetal structures are again horizontal, confirming that this guyot has not been tilted since deposition of the geopetal infilling materials. In the upper parts of the sequence, several intervals of bedded sediment are present. Structural measurements were taken on these features, in conjunction with the Sedimentology group. Lower in the hole, hyaloclastites and basalt breccias of the basement have the highest concentration of veins per meter observed thus far in the Louisville Seamounts. These numerous and large veins (up to 20 mm) indicate that Burton Guyot probably experienced the highest levels of fluid flow for all the Louisville seamounts drilled so far during Expedition 330. Luckily for the structural geologists (and all participants interested in fresh core), the number of veins has dropped markedly in Cores U1376A-8R and -9R, with wide intervals of fresh massive olivine-clinopyroxene-phyric basalt in between.

Due to the nature of their main analytical method (ICP-AES, which requires lengthy sample preparation) the Geochemistry group is usually a few days behind with their investigations. However, one sample of the microgabbro from Hole U1375B was processed for ICP-AES analysis, and processing was begun on one sample from Site U1376. In addition, twenty samples of igneous rocks from Site U1374 were analyzed for major and trace elements, and the necessary data reduction was carried out. Interpretation of the results, together with results for the 13 samples from this site that were analyzed last week, was completed and the Site U1374 report was finalized. No samples were collected or analyzed for determination of carbonate, organic carbon, or organic nitrogen content during this week.

The Physical Properties group continued running tests on whole-core and discrete samples from Holes U1374A, U1375A, U1375B, and U1376A this week. Whole-round and split-half measurements were completed for all three sections recovered from Site U1375 and through Core U1376A-9R. 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

since the thermal conductivity probe pucks required for hard rock testing are still not functioning properly. Discrete samples were chosen from Sites U1375 (one sample from the microgabbro in Hole U1375B) and U1376 (through Section U1376A-5R-7) in collaboration with the Paleomagnetism group. The entire set of paleomagnetic, compressional wave velocity, and moisture and density measurements have been completed for all remaining samples taken from Site U1374 cores during this week, while the earliest samples from Sites U1375 and U1376 are in the preliminary stages of physical properties testing. The automated data-filtering program continues to be revised to account for unforeseen issues and to make it easier to use for future expeditions. Filtered physical property data continues to be produced and made available to other groups to aide in the selection of shipboard and personal samples.

The Paleomagnetism group has alternate-field (AF) demagnetized archive half Cores U1374A-71R through -73R, U1375B-1R, and U1376A-1R through -5R in the cryogenic magnetometer system up to a peak field of 70 mT, and the remanent magnetization measured at 2 cm intervals. Data from the archive half-cores are currently being processed using an automatic PCA picking protocol. In addition, AF demagnetization has been carried out on a total of 25 discrete 8 cm³ cubes up to a peak field of 140 mT, and thermal demagnetization carried out on 35 discrete samples up to a temperature of 600°C. In the cores from the new Hole U1376A on Burton Guyot, reversed polarity remanent magnetizations with moderate to steep inclinations are dominant.

In contrast to all other lab groups, the Microbiology group has not taken any samples from Site U1375 cores due to their shallow depth. Instead, the lab group has focused on writing their Site U1374 Report, updating their "Methods" chapter for the cruise report, and sampling the first time point for the ongoing stable isotope addition bioassays. Since drilling began at Site U1376, five samples were collected for cell counts, molecular biology analyses and ³⁴S and ¹³C stable isotope analysis. Two of these samples were used to inoculate culturing media, and one sample, a hyaloclastite from 61 mbsf, was used to initiate a stable isotope addition bioassay.

The Downhole Logging team has been working the whole week on the data collected from the extensive logging runs in Hole U1374A. On-board provisional processing of all the datasets was done, and most of the fully processed and depth-matched data (from Lamont-Doherty Earth Observatory) was received. The logging team presented their findings to the whole science party and has been writing the Site U1374 report. Following the deployment of the downhole magnetometer tool last week, some minor modifications and checks have been made in preparation for any future logging on this expedition.

EDUCATION AND OUTREACH

The onboard education officer has continued posting daily on the JR website and Facebook pages. The JR website had 1,432 visits between January 16 - January 22. Of those, 757 were new visitors. The JR Facebook posts had 77,834 views during this week, and has increased its followers from 2,285 fans on January 22 to 2,307 fans on January 29. Five videoconferences were conducted this week, one with the Auckland Museum and four others with schools in the US and in Japan. Scientists Christoph Beier, Michael Dorais, Patrick Fulton, Anthony Koppers, Kazu Moriya, Alex Nichols, Nicola Pressling, Jason Sylvan, Becky Williams and Toshi Yamazaki all participated in question-and-answer periods with over 150 participants this week.

The expedition videographer finished the final shooting and editing for the video "Blue Moon Over U1374" and uploaded it to the Ocean Leadership YouTube Channel and to the JR Facebook page. She has also rewritten the script for a new video "Visualizing Rock," shot video footage, recorded scratch narration, and worked with co-chief Anthony Koppers on the rough cut. She has begun a project to interview some of the scientists. Working with Ocean Leadership, she has developed a set of questions for these interviews. Thus far, she has interviewed scientists Godfrey Fitton and Kazu Moriya, with several others scheduled. She also continues to post on the JR Facebook and Twitter pages.

TECHNICAL SUPPORT AND HSE ACTIVITIES

The technical staff was engaged in providing full support for coring operations at Sites U1375 and U1376. In addition, the staff has worked non-stop to eliminate

the expedition's sampling backlog. Shipboard sampling is now current with coring operations. The balance of Site U1374 personal sampling is fully completed. All un-sampled cores (personal samples) have been retrieved from storage, unboxed, removed from their D-tubes, sampled, wrapped, repackaged and returned to storage. Our current backlog for personal sampling for the new sites drilled during this week is now ~63 sections. Personal sampling for the first 41 sections from these cores is scheduled in two days.

Other technical support activities during this week included the following:

1. Minor software upgrades to various applications;
2. Plans for reorganizing the pallet storage area are completed and materials have been ordered;
3. Logistical planning started for upcoming port call and end of expedition activities.

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