

IODP Expedition 330: Louisville Seamount Trail

Week 5 Report (10-16 January 2011)

OPERATIONS

Rotary coring in Hole U1374A advanced to a depth of 130.4 mbsf with an average recovery of 84% by 0345 hr on 10 January. At this time, the bit had acquired 81.3 rotating hours and preparations were made to recover the drill string and replace the bit.

A free fall funnel (FFF) was made up and deployed at 0550 hr on 10 January. The vibration-isolated television (VIT) was launched and the bit extraction from the hole was monitored by the VIT system to ensure that the FFF wasn't dislodged during the process. The used bit was found to be in excellent condition and less than 1/16" under-gage with all inserts intact and exhibiting very minor wear across all rows.

The third FFF of Expedition 330 was reentered at 1635 hr. The bottom hole assembly (BHA) was run in the hole without incident while the driller maintained slow rotation and a low pumping rate. There was no fill at the bottom of the hole. Coring resumed at 1900 hr on 10 January. During the course of the week, the scientific party decided to core with the present bit until destruction and forego a second bit trip at this site.

By midnight on 16 January, Hole U1374A had been cored to a depth of 460.3 mbsf with an average recovery of 87%. The accumulated rotating hours on the bit at this juncture was 111.8 hours.

SCIENCE RESULTS

Core and thin section observations at Site U1374 on Rigil Seamount allowed definition of 14 stratigraphic units and subunits in the sediment cover, and the consolidated sediment intervals below. The uppermost part of the seamount (0-6.64 mbsf) is composed of sandy foraminiferal ooze. The consolidated sediments

below occur between 6.64 and 16.70 mbsf and are capped by manganese encrustments. They include (1) a layered, monomict volcanic sandstone without fossils; (2) a bioturbated volcanic sandstone with abundant gastropods and shell fragments, and rare possible ammonite fragments; (3) a bioclast foraminiferal limestone with manganese encrustments and boreholes; and (4) a basalt conglomerate with shallow-marine bioclasts (e.g., shell-fragments, calcareous algae, and bryozoans). The underlying sequence is predominantly composed of a volcanic sequence composed of minor basalt lava flows and abundant basalt breccias. The interclast spaces in the basalt breccia are partly filled with finer grained basalt and volcanic sandstone with a local bioclast component. Three thick bedded sedimentary intervals were identified between 37.60 and 116.45 mbsf. The first interval occurs between 37.60 and 41.84 mbsf and is composed of, from top to bottom: (1) a polymict basalt sandstone with abundant vitric fragments and few shallow-marine bioclasts, (2) a layered volcanic sandstone with rare fossils, and (3) a monomict basalt breccia with larger, shallow-marine bioclasts. The second sedimentary interval extends from 63.67 to 84.70 mbsf and is devoid of fossil. It includes (1) two polymict basalt breccias and (2) a volcanic sandstone. The third sedimentary interval occurs between 109.87 and 116.45 mbsf and is composed of a volcanic sandstone with few bioclasts, and a basalt conglomerate with abundant shallow-marine fossils. The underlying volcanic deposits include minor occurrences of thin-bedded layers of grain-supported, poorly sorted basalt sandstones breccias, interpreted as sedimentary intervals. Fossils were not observed between 121.28 and 256.74 mbsf. Assessments of depositional environments and geologic history of this previously oceanic island are currently being established in cooperation with the paleontology and igneous petrology laboratory groups.

Preliminary smear slide analyses for nannofossils and thin section studies for planktonic foraminifers revealed that the sedimentary units above the volcanic/volcaniclastic basement (Units IIB-C and IID) can be assigned to the late Maastrichtian and late Campanian, respectively. In addition, an ammonoid fossil fragment indicative of Cretaceous age was also found in Unit IIC. On the other hand, planktonic foraminifers were absent in Core U1374A-4R through -22R,

which may suggest that the paleodepth for this interval was likely very shallow. However, planktonic foraminifers again reappeared in Core U1374A-22R, indicating a more submarine environment.

The description of the volcanic/volcaniclastic basement from Hole U1374A reached 287.31 mbsf by the end of this week. The polyolithic sedimentary breccia extended for a further 11.90 m, giving a total thickness of 21.03 m, before aphyric basalt breccia resumed, consisting of mostly poorly sorted clasts and three intervals, 1.10, 1.15 and 2.71 m, of more massive lava bodies. Downhole (25.16 m deeper in the breccia), another sequence of sedimentary conglomerate was encountered, which is 6.59 m thick. Below this interval 170.98 m of moderately to very poorly sorted volcanic breccia can be found, which occasionally comprise sandier horizons and 36 units of lava units or fragments. The frequency of lava intervals within the breccia decreases towards the bottom of the succession that was described until the end of this week, with the lower 69.28 m containing only four intervals. The lava bodies and fragments range in thickness from 0.13 to 2.16 m but the majority is between 0.20 to 0.50 m thick. As a consequence the confidence that these units represent *in situ* lava flows is rather low. However, six bodies are thicker and/or exhibit jigsaw-fit textured upper surfaces that grade into the breccia meriting greater confidence. The clasts and lava bodies in the upper 29.61 m are highly plagioclase-olivine-augite-phyric basalt, and some contain large plagioclase crystals that show many inclusions. At 146.06 mbsf the distinctive large plagioclase crystals disappear and the clasts and lava become variably olivine-phyric, with occasional intervals where plagioclase and/or augite join the phenocryst assemblage. At 256.75 mbsf olivine largely disappears from the phenocryst assemblage and the basalt clasts in the breccias become aphyric to moderately plagioclase phyric.

During this week the alteration laboratory group continued to become more and more proficient with the specific software (EVA) that is used to characterize XRD patterns. Interestingly, the macroscopic core descriptions and thin sections observations don't define a systematic correlation between the different alteration colors and depth. The cores show alternating oxidation states and alteration processes through the entire volcanic breccias. The same can be said for olivine.

Its alteration varies between iddingsite and green clay/carbonates. Nevertheless, the inner portions of the larger clasts and lava bodies are relatively well-preserved, and periodically contain fresh olivine. As in the previous week, three main groups of alteration phases in veins and vesicles could be distinguished: carbonates, clay minerals (saponite, nontronite, montmorillonite, celadonite, bannisterite), and other secondary phases (such as zeolites, clinocllore, Fe oxyhydroxydes, and some pyrite/chalcopyrite).

The described structures in the igneous rocks are broadly similar to those observed during the previous week, comprising veins, joints, geopetals, and magmatic flow textures. Importantly, all geopetal structures identified have horizontal infillings, indicating this part of the seamount has not tilted since deposition (or infilling). Structural measurements were also made on several packages of layered sediment at Site U1374. Once the core is corrected for core-barrel rotation, these measurements will be useful for the sedimentological reconstruction of this site.

Thirteen samples of igneous rocks from Site U1374 were processed and analyzed by ICP-AES for major and trace element concentrations during this week. Interpretation of the results is underway. Five more samples are currently being prepared for analysis. Six samples from the unconsolidated sediment of Core U1374A-1R were analyzed for determination of carbonate, organic carbon and organic nitrogen content.

The paleomagnetic laboratory group has alternate-field (AF) demagnetized all archive half-cores down to Core U1374A-37R in the cryogenic magnetometer up to a peak field of 70 mT, and the remanent magnetization measured at 2 cm intervals. In addition, AF demagnetization has been carried out on a total of 57 discrete 8 cm³ cubes up to a peak field of 200 mT, and thermal demagnetization carried out on 38 discrete samples up to a peak temperature of 675°C. Both the archive half-core data and the discrete data show both normal and reversed polarities, but the polarity pattern is complex. Anisotropy of magnetic susceptibility (AMS) has been measured on all discrete samples, a number of which have prolate fabrics.

The physical properties group continued running tests this week on whole-core and discrete samples from Hole U1374A. Whole-round and split-half measurements have been completed for all sections up to Core U1347A-46R, along with natural gamma ray testing with total count times ranging from 30 minutes to 90 minutes. Count times as low as 30 minutes were neither anticipated nor preferred, but the unprecedented high recovery and coring rates experienced at this site required such an exception. Sections containing potential lava flow intervals are now measured for one hour, while sections composed entirely of volcanoclastics are limited to 30 minutes. Only two thermal conductivity tests were possible this week (up to Core U1374A-9R) before repeated equipment failure forced this type of testing to be abandoned for Site U1374. Attempts to repair and recalibrate the probe required for hard rock thermal conductivity measurements are still underway. Discrete samples from Cores U1374A-8R through -38R were chosen in collaboration with the paleomagnetism group, and the entire set of paleomagnetic, compressional wave velocity, and moisture and density measurements have been completed for those up to Core U1374A-22R. The automated data-filtering program continues to be revised to make it more user friendly, add new features, and fix bugs. Filtered physical properties data remains useful for identifying changes in magnetic susceptibility, natural gamma ray radiation, and color reflectance, which can guide the selection of shipboard and post-cruise samples.

Fourteen samples of predominately volcanoclastic breccia were collected for microbiology analysis this week. Contamination tests via microsphere deployment and analysis were conducted on one of these samples, with negative results for contamination in the whole round sample collected. The microbiology group's now trademarked "Enhanced Extraction" technique was used to collect enough biomass for the initiation of a stable isotope addition bioassay from one sample. Six of the collected samples were used to inoculate culture experiments, including tests to isolate microbes from a single sample using the same media with two different conditions: low oxygen and saturated oxygen.

EDUCATION AND OUTREACH

The education officer for Exp. 330 continued posting daily blogs on the *JR* website and Facebook page. The *JR* website had 1,277 visits between January 9 - 15. Of those, 592 were new visitors. The *JR* Facebook posts had 85,288 views during the week, and has increased its followers from 2,254 fans on January 8 to 2,274 fans on January 15. The Twitter @theJR account gained 8 new followers. Three videoconferences were conducted this week, one with the Auckland Museum and the other two with 11th-12th grade and sixth grade classes in two separate U.S. schools. Scientists Anthony Koppers, Jason Sylvan, Alex Nichols and Christoff Beier all participated in the question-and-answer periods with the students. Three other planned videoconferences had to be rescheduled because of bad weather (“snow days”) in the U.S. Both the education officer and the expedition videographer participated in a brainstorming meeting with the co-chief scientists and expedition project manager on ideas for a graphic novel of the expedition.

The expedition videographer finished and got final approvals for her new video, “Expedition 330: Our Mission.” It is now posted to the Ocean Leadership YouTube channel and to the JR Facebook page. It has also been posted on the front page of the JR main website. She also finalized an additional video (showing a cut of a multi-layered cake as analogy for seafloor coring) that just passed through review. Planning for the next video with the working title “Visualizing Rock” has started. That video will focus on the different methods and instruments used for photographing rocks and how the images are used on the ship. For this project, an informational interview with IODP senior imaging specialist Bill Crawford was conducted.

TECHNICAL SUPPORT AND HSE ACTIVITIES

Technical staff engaged in providing full support for coring operations at Site U1374. Because of the exceptional core recovery, technical support is now focused on clearing a four-day backlog of cores from our current site. Other support technical activities include the following:

1. Sampling party for previously cored sites (U1372 and U1373), which is in progress;
2. Minor software upgrades to various applications;
3. Software development for the core liner engraver.

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