

IODP Expedition 330: Louisville Seamount Trail

Week 4 Report (3-9 January 2011)

OPERATIONS

Hole U1373A, which was spudded on 1 January, was routinely advanced to a depth of 64.0 mbsf when the bit had accumulated 69.7 rotating hours and required replacement. Basaltic basement was encountered at a depth of 33.9 mbsf. At this juncture, the penetration into basement was 30.1 m with an average penetration rate of 0.9 m/hr. The strategy of pulling half-cores helped to increase the average basement recovery to 91%. The average recovery for the entire hole at this point was 72%. To keep the hole clean of cuttings, the hole was flushed with 20-barrel mud sweeps prior to recovering each core. An additional 40-barrel mud sweep was circulated before initiating the bit trip.

A free fall funnel (FFF) was made up and deployed at 1845 hr on 4 January. The vibration-isolated television (VIT) was launched and the free fall funnel monitored as the bit was withdrawn from the hole. The bit cleared the lip of the funnel at 2005 hr and was on deck by 1210 hr on 5 January. The used bit was found to be in excellent condition exhibiting slight cone wear, no missing inserts, tight bearings, and less than 1/8" under-gage in spite of having accumulated 70 rotating hours. A new bit was made up to the bottom hole assembly (BHA) and deployed along with an additional stand of drill collars.

From 0630 hr to 0845 hr the driller attempted a reentry into the FFF, but the bit appeared to bind about a foot into the throat of the funnel and could not be advanced further. The mud pump flow was increased on the chance that any obstruction would be hydraulically dislodged, but the end result was that the FFF tipped over on its side. It was surmised that the 2.7 m FFF casing was not lodged firmly in the hole when the old bit was withdrawn. The only element holding the FFF vertical was the pile of cuttings.

Although the open hole was not visible on the camera, the driller attempted a blind stab into the hole by lowering the bit into the sediment cover around the periphery of the FFF. This course of action was terminated after 2.25 hours and the decision was made to offset to a recently approved alternate site on the other side of the seamount summit. After the drill string was picked up to 1111 mbrf, the vessel was offset in dynamic positioning (DP) mode to new Site LOUI-6B located 5.6 nmi at a bearing of 253 degrees from Hole U1343A. The 5.6 nmi offset was accomplished in 3.25 hours and by 1630 hr the vessel was positioning on the new location. The VIT was deployed and used to monitor the bit tagging the seafloor at a depth of 1570.0 mbrf or 2.6 m shallower than the corrected PDR depth.

Hole U1374A was spudded with the rotary core barrel (RCB) drill bit at 2035 hr on 5 January. After penetrating a thin (~7 m thick) sedimentary cover, the bit penetrated igneous rocks at 16.7 mbsf. Rotary coring slowing advanced to a depth of 120.8 mbsf with an excellent average recovery of 82% by midnight on 10 January. It is planned to suspend coring the next morning to make up and deploy the third FFF of the expedition to change the bit.

SCIENCE RESULTS

This week was a busy week for all laboratory groups. The site report chapters for Site U1372 had to be finalized and submitted and the Visual Core Description (VCD) sheets for this site had to be reviewed and corrected. In addition, all descriptions of cores from Site U1373, which had to be abandoned unexpectedly early, had to be entered in the database and also the site summary meetings for this site commenced at the end of this week. Due to the short transit, the first core at Site U1374 arrived in the second half of this week and the exceptional high recovery resulted in a large amount of core material that had to be described.

Because the abandoned Site U1373 and the new Site U1374 both retrieved considerable amounts of diverse sediments, the sedimentology laboratory group was particularly busy. The uppermost sediment at Site U1373 was interpreted to

have been a shallow-marine to beach depositional environment at a previously volcanic island. This environment was punctuated by “catastrophic” emplacement of a debris flow deposit, a volcanic interval and lahar(s). Recurrence of such deposits suggests that deposition took place close to the bottom of a valley, most probably close to a river mouth. In contrast to Site U1372, no evidence for subsidence or significant eustatic changes was found in the sedimentary record of Site U1373. At Site U1374, seven different lithologies have been recognized so far based on core observations. A stratigraphic subdivision is currently being established.

Uncemented pelagic sediments were not recovered at Site U1373, with the exception of a miniscule amount of recent pelagics mixed with some ground manganese crust in the core catcher of the first core (U1373A-1R-1). An assemblage of calcareous nannofossils was identified in these few grams of sediment and preliminarily assigned to stratigraphic zones CN14a to 15, mid-Pleistocene to Holocene. Because of the lack of other uncemented sediment, standard paleontological sample procedures could not be applied at this site. Instead of those standard procedures, thin section investigations of potentially microfossil-bearing cemented sediment and biocrusts were conducted. In sedimentary Units I and III, bivalves, bryozoans, calcareous algae, and echinoderms were found. In addition to those organisms, the marine oyster *Flemingostrea* sp. was identified in samples from Unit IIIB. Unfortunately, the stratigraphic distribution of this genus spans over a wide range from Upper Cretaceous to Miocene, which makes it not very suitable for biostratigraphic age determination. In contrast to Site U1373, soft pelagic sediment was recovered at the Site U1374 and yielded calcareous nannofossils and abundant planktonic foraminifers. The preliminary age of this sequence (Unit I) is mid-Pleistocene to Holocene.

In total, 38.36 m of igneous rock were recovered from Hole U1373A. This includes 6.10 m of lava flows in the sedimentary cover and 32.26 m in the igneous basement. The former consists of brecciated lava flows that exhibit jigsaw-fit texture, which are a feature of blocky peperites. The top of the igneous

basement consists of subaerial flows of highly olivine-titanaugite-phyric basalt, with the flows becoming aphyric at 2.75 m downhole, and then peperitic after 3.62 m. Drilling stopped in a >22 m thick inflated sheet flow of aphyric basalt, which had a 22 cm thick peperitic top. The peperites indicate mingling between lava and wet sediment, and the overall sequence in Hole U1373A is interpreted to reflect lava flowing into an area where water and water-saturated sediments were present, but where the water supply was limited.

To date, the description of cores recovered from Hole U1374A has reached 72.80 mbsf, with the first (shallowest) *in situ* lava flow starting at 16.72 mbsf. The sediment immediately overlying the upper flows contains several different types of basaltic clasts. The uppermost lava flow is a 1.32 m thick, highly olivine-phyric basalt. Beneath this, two aphyric basalt lava flows, 9.29 and 3.25 m thick, are separated by 4.29 m of volcanic breccia. Below 37.45 mbsf the succession becomes dominated by thick sequences of volcanic breccia, among which there are two units of lithic-vitric volcanic sand. The lower 9.13 m of breccia is polyolithic and appears to be sedimentary in origin. At the end of this week, drilling in Hole U1374A continues to recover this breccia with occasionally interbedded thin lava flows.

Like the other laboratory groups, the alteration specialists had to deal with wrapping up describing the last cores from Site U1373 while at the same time starting to describe new cores from Site U1374. Macroscopic core descriptions and thin section observations allowed us to define two main units with different types of alteration in Hole U1373A based on color difference. These colors, reddish gray to reddish brown and gray with minor green clay, could be directly related to the oxidation state of alteration processes: oxidizing conditions for the reddish units (seafloor to 35 mbsf) and a small hint for reducing conditions for the more light greenish gray units (35 to 66 mbsf). With a few exceptions in relatively fresh clasts, olivine is generally completely altered to iddingsite in the upper portions of the hole. Below ~30 mbsf, the olivine is systematically replaced by green clay and minor Fe-oxyhydroxides. Additionally, three main groups of alteration phases could be distinguished in veins and vesicles: carbonates, clay

minerals (saponite, nontronite, montmorillonite, celadonite, bannisterite), and other secondary phases (such as zeolites, clinocllore, Fe oxyhydroxides, and some pyrite/chalcopyrite). Besides doing visual observations, the alteration specialist group is also getting progressively familiar with XRD data processing using the specific instrument software (EVA), which results in improved interpretation of the conducted XRD analysis.

The structural geology laboratory group completed the identification and description of veins, joints, geopetals, and flow textures found within core and thin section samples from Hole U1373A and started describing structural features for Hole U1374A cores as well. In Hole U1373A fractures and veins are common to abundant in lava flows, but are rare to absent in breccias. Magmatic foliations in the lowermost unit of Hole U1373A show a range in orientations, from sub-horizontal to near-vertical, indicating that this thick flow (>22 meters) underwent several episodes of lava injection and flow inflation. Dip angles for veins and fractures in Hole U1373A display a bimodal distribution, with the shallow features being sub-parallel to flow boundaries, and steep features representing conjugate structures. Rocks recovered from both Holes U1373A and U1374A contain several horizontal geopetals, which indicate that the entire pile of rocks has not been tilted since formation.

A total of 10 samples of igneous rocks from Site U1373 were analyzed for major and trace element concentrations by ICP-AES. The samples are from stratigraphic Units I, II, IV, VI, and VII and interpretation of the data is underway. In addition, 6 samples were collected from the unconsolidated sediment of Core U1374A-1R (from the new site) for determination of carbonate, organic carbon and organic nitrogen content. Analysis of these samples is planned for the next week.

The Physical Properties group continued running tests this week on whole core and discrete samples from Holes U1372A, U1373A, and U1374A. Whole round and split half core measurements have been completed for all Hole U1373A samples (Cores -1R to -13R) and for Cores U1374A-1R to -12R along with

natural gamma ray testing with a total count time of 1.5 hours. Nondestructive thermal conductivity tests were performed on 12 selected intervals from Cores U1373A-1R to -13R and 5 selected intervals from Cores U1374A-1R to -7R. Discrete samples from Cores U1373A-1R to -13R and U1374A-1R to -7R were chosen in collaboration with the paleomagnetism group, and the entire set of paleomagnetic, P-wave, and moisture and density measurements have been completed for all samples from Hole U1373A. The automated data-filtering program for processing whole round and section half multi-sensor logging (HRMS and SHML) data was revised to make it more user-friendly, as well as to add new features and fix computer bugs. The filtered data have been proven useful for identifying interesting changes in magnetic susceptibility and natural gamma ray counts along the core and changes in color reflectance that correspond with different alteration characteristics.

The paleomagnetism laboratory group has alternating-field (AF) demagnetized all archive half-cores from Site U1373 with the cryogenic magnetometer system up to a peak field of 70 mT, and the remanent magnetization was measured at 2 cm intervals. AF demagnetization was carried out on a total of 23 discrete 8 cm³ cubes up to a peak field of 200 mT, and thermal demagnetization was carried out on 11 discrete samples up to a temperature of 675°C. These data have been processed and analyzed to produce a plot of the variation in inclination downhole. Fisher- and inclination-only statistics have been used to average inclinations within core pieces and also within lithological units. Also this week, remanent magnetization measurements with AF demagnetization have been conducted for the upper 10 archive half-cores from the Site U1374. Fifteen discrete samples have already been AF demagnetized, and 10 discrete samples are undergoing thermal demagnetization.

Sixteen samples of various lithologies were collected for microbiology analysis this week, including unconsolidated sediment, sandstone, volcanic breccia and basalt. Contamination tests via microsphere deployment and analysis were conducted on two samples, one from Hole U1373A and the other from Hole U1374A. Analysis of these tests indicated little to no contamination in the drill

cores. Drill fluid was collected to provide additional data for the contamination testing. In addition to the standard suite of samples collected and preserved for cell counts, molecular biology and stable isotope analysis, five samples were used to inoculate various culturing media, and three samples were used to initiate stable isotope bioassays to measure metabolic rates of subsurface microbes. A special sample processing technique, dubbed "enhanced extraction" and including the use of a blowtorch and hydraulic press, was developed to retrieve larger interior portions from the whole round samples for use in these bioassays. The microbiology group is particularly pleased with this enhanced extraction technique.

EDUCATION AND OUTREACH

As in the previous weeks, the educator ("Teacher at Sea") continued posting daily blogs on the *JOIDES Resolution (JR)* website and Facebook page. The *JR* website had 1,418 visits between January 2 and January 8. Of those, 641 were new visitors. The *JR* Facebook posts increased from 11,500 to over 20,000 views a day during the week, and increased its followers from 2,245 fans on January 1 to 2,254 fans on January 8. The twitter account "@TheJR" gained 6 new followers.

Three videoconferences with separate fifth grade, eighth grade and ninth grade classes at three different U.S. schools were conducted this week. The scientists Patrick Fulton, Alex Nichols and Christoph Beier participated in question-and-answer periods with the students.

The videographer worked with co-chief scientist Anthony Koppers to refine the "Mission of Expedition 330" video, recorded semifinal narration, and is working on an important but complex animation demonstrating mantle plumes, plate motion, and seamount chains. She arranged and shot video of the "coring" of a spectacular seafloor cake with 7 layers, specifically baked for the purpose by the ship's catering crew. She also got permission to mount a miniature camera to a helmet worn by a drill floor worker who then went into the rigging. This produced about an hour of amazing video footage with a bird's eye view from the derrick. In

preparation for videoconferences and other interviews that happened during this week, she fitted neutral density film to the window in the paleontology laboratory, and tested it out with a brief interview with shipboard scientist Jeff Gee. She continues to shoot various moments as they occur, like the dropping of the free fall funnel, and posts daily on the JR Facebook and twitter pages. In addition, she organized and prioritized her video plans with the help of Ocean Leadership's educational department (Deep Earth Academy).

TECHNICAL SUPPORT AND HSE ACTIVITES

Technical staff engaged in providing full support for coring operations at Sites U1373 and U1374. Other activities include the following:

1. Completed relocation of whole core track amplifiers;
2. Continued work on minor software upgrades to various applications;
3. Continued effort on software development for the core liner engraver continues, and prepping installation site in core entry.

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