IODP Expedition 324: Shastky Rise Formation
Week 6 Report (11–17 October 2009)

18 October 2009

OPERATIONS

At the beginning of this week basement coring at Site U1349 was completed at a depth of 250.4 m DSF (85.4 m into basement) on 11 October. The hole was prepared for logging and the bit was released at the bottom of the hole. The first log of Hole U1349A was made with the triple combo and the second log was conducted with the FMS-sonic. The hole was found in good condition and both the triple combo and FMS-sonic runs retrieved excellent data.

After the logging equipment, drill string and beacon were recovered and secured, the vessel departed for the next site at 1930 hr on 12 October. The time expended on Hole U1349A was 126.8 hours or 5.3 days. Based on shipboard investigations of available cores from ODP Leg 198 (igneous portion of Hole 1213B) it was assumed that Site SRSH-8, which was originally planned as last drill site, would penetrate the very same flows that were drilled during Leg 198. Therefore, a decision was made to drill the approved alternate Site SRCH-4 on the flank of Ori Massif, which would become Site U1350, the last drill site of this expedition.

The vessel was positioning on Site U1350 at 0115 hr on 13 October. The driller tagged the seafloor at 4067.0 m DRF at 1030 hr. Hole U1350A was spudded with a wash barrel in place drilled to a depth of 104.6 m DSF where rotary coring was initiated. The sediment portion (48.0 m) of the hole was cored with poor recovery (1.6%). Igneous basement was reached at the top of Core U1350A-7R at 152.6 m DSF, which was consistent with the expected depth of ~157 mbsf calculated from the site survey seismic data. Rotary coring into basement has deepened the hole to 287.0 m DSF by midnight on 17 October. This depth corresponds to a basement penetration of 134.4 m. Thus far, the basement recovery averages 39%.

SCIENCE RESULTS

Before arriving at Site U1350, core description continued on Site U1349 samples. Four sedimentary units were defined at Site U1349, including one unit within the basaltic flow succession. The first sedimentary unit consists of chert, chalk and nannofossil ooze with foraminifera. The following units contain volcaniclastic sandstones, lapillistones and conglomerates. Bedding and internal structures suggest that these beds were deposited in a shallow marine environment. A thin pinkish-orange bed at the top of Section U1349A-6R-2 has been interpreted as a paleosol, which indicates that the volcanic conglomerate below may have been subaerially exposed for an extended period of time. The last observed sedimentary unit, an oolitic, bioclastic limestone located between two oxidized, vesicular basalt flows, implies a very shallow marine depositional environment.

Consistent with the sedimentary evidence of a possible paleosol, the occurrence of pervasive flow-top reddening at the top of a number of units between cores U1349A-9R through to -13R, indicates periodic weathering of the basalt units, and may indicate dominantly subaerial eruption for this succession. The eruptive units are typically 0.5 to 2.0 m in thickness, but also contain 5 thicker units of 2 to 6 m thickness. Core recovery at the topmost part of this lava succession is poor (16%), but ranges between 50 and 80% downhole. With the beginning of Core U1349A-14R (at ~220 m CSF-A) a complex series of brecciated basaltic clast material intercalated with and intruded by lava pods was cored with high core recovery of 75-90%. This succession is interpreted as an entirely sub-aqueous eruptive sequence of volcanic flow breccias, formed by submarine autobrecciation processes. Drilling terminated in the autobrecciated succession at Core U1349A-16R-1 at 250 m CSF-A.

All recovered basaltic rocks are highly to completely altered to various clay minerals and show variations in color, from a characteristic red at the top of the hole (subaerial succession?) to a green-greenish blue at the bottom (submarine succession). In Cores

U1349A-7R to U1349A-11R, relatively fresh plagioclase and pyroxene are preserved, whereas olivine is completely altered to iddingsite. Glassy mesostasis is also completely altered to brown clays and hematite, whereas magnetite is relatively fresh. Vesicles are generally filled with calcite and minor Fe-oxyhydroxides and zeolites, and rarely brown clays. Numerous veins containing calcite, brown clays, Fe-oxyhydroxides and occasionally zeolites are observed throughout the hole and all veins were structurally described. Almost no unfilled joints were observed.

Drilling at subsequent Site U1350, on the flank of Ori Massif, yielded only sparse material from the overlying sedimentary succession. Cores U1350A-1W to U1350A-6R recovered only few black, radiolarian chert fragments with occasional brownish-white encrusting (silicified) chalk coatings. Calcareous nannofossils retrieved from the coatings are moderately to poorly preserved but show frequent to high abundances. Both planktonic and benthic foraminifera are almost barren (with only trace amounts of silica-replaced individuals), and instead the radiolarian content is high. The age of Cores U1350A-1W and -9R is assignable to the early to mid-Cretaceous based on calcareous nannofossils. However, the investigated samples from Cores U1350A-6R to -9R are derived from discrete pieces of cherts found between basalts, and they are most likely from the upper sediment sequence rather than sediments deposited in situ. Intercalated sediment pieces from beneath this interval are barren of microfossils.

Basaltic basement was encountered at ~150 m CSF-A. Cores U1350A-7R to -24R recovered surprisingly fresh basalt with fresh glass preserved at the flow margins. Although vesicles and veins are common, and generally filled with calcite, green clay and pyrite, the overall alteration is very low (10-15%), which is in marked contrast to the rocks recovered at Site U1350 on the summit of the massif.

Recovery is variable, starting very low in the top succession, which consists of thin pods of aphyric basalt lava flows and pillows. Due to the initially poor recovery it is feared that many of the pillow packages, which contain small lava pods primarily, are

incompletely recovered, as evidenced by many sections full of only pillow margin fragments, spallation remnants but no continuous pieces of the massive pillow cores. However, toward the bottom of the hole, the inflation units are becoming increasingly massive, and also sparsely plagioclase-phyric, a familiar development when compared to Site U1347 on TAMU Massif.

Also this week, the geochemistry lab group completed ICP-AES major and trace element measurements, as well as reduction of the data and interpretation of results, on the batch of 13 Site U1348 samples. Preparation for ICP-AES analysis of 13 samples from Site U1349 also commenced, as did preparation for 18 samples from Site U1350. No analyses of samples for carbonate or total carbon were conducted this week.

The physical properties group has completed discrete sample measurements of the rocks from Site U1349 and begun discrete sample measurements for site U1350 during this week. At Site U1349, average P-wave velocities range from ~3.3 km/s in the upper sedimentary rocks up to ~5.2 km/s in the lower vesicular basalts with a single highest velocity measurement of 7 km/s. At Site U1349, average porosity ranged from ~30% in the upper sedimentary rocks down to less than 10% in the lower vesicular basalts. Porosity values increased back up to ~20% in the lower portion of Hole U1349A (autobrecciated basalts).

Whole round track data for Sites U1348 and U1349 were filtered to remove erroneous lows from cracks and gaps between pieces of the core. Magnetic susceptibility data from the volcaniclastic-sedimentary rocks from Hole U1348A were uniformly low (below 100 x 10^{-5} SI). Magnetic susceptibility data from sedimentary rocks and massive basaltic rocks from Hole U1349A ranged from ~40 x 10^{-5} SI up to nearly 4,000 x 10^{-5} SI. GRA Bulk density averages ranged from ~1.8 - 2.0 g/cm^3 for Hole U1349A.

The paleomagnetism group carried out AF and thermal demagnetizations for basalt samples from Hole U1349A. A total of 32 samples were demagnetized (18 AF and 14

thermal). Samples from volcaniclastic units shows dimagnetization results in which a characteristic remanent magnetization is difficult to isolate. These samples likely carry a depositional remanent magnetization, which makes the interpretation more complicated. Samples from the upper amygdoloidal basalt succession (Cores U1349-7R to ~14R) were characterized by high coercivity and a high unblocking temperature magnetization carrier. It is still unclear whether this magnetization is carried by (titano-)magnetite, which is a true thermoremanent magnetization, or by hematite, which is a chemical remanent magnetization. Both minerals have been identified in thin section observations. Inclinations from all samples from this type are negative and shallow. Rock magnetism measurements are necessary in order to interpret these results.

Logging operations, carried out at the beginning of this week at Site U1349, consisted of two deployments, the triple combo and the FMS-sonic. The hole was found in good condition except for a tight spot directly below the end of the pipe. Both toolstrings were run successfully and retrieved excellent data. The triple combo and FMS-sonic both completed two passes to with three meters of the total depth of the hole and also logged the basement/sediment interface. FMS images clearly showed numerous veins and fractures in the basaltic basement section that should allow re-orientation core sections postcruise.

TECHNICAL SUPPORT AND HSE ACTIVITES

During the short, 40 nm transit to Site U1350A the magnetometer was deployed. Labs are busy processing cores. An internal review of the shipboard systems document was received and distributed to the IODP shipboard personnel. A fire and boat drill was held on October 13 for the entire ship's complement.