

IODP Expedition 324: Shastky Rise Formation
Week 7 Report (18–24 October, 2009)

25 October 09

OPERATIONS

Drilling time in Hole U1350A ended on 18 October at a final depth of 315.8 m DSF (corresponding to 163.2 m basement penetration). The total interval was cored with an average recovery of 35.6% at an average ROP of 3.5 m/hr. Average recovery in basement was of 45.6%, with an average ROP of 1.9 m/hr.

In preparation for logging, the hole was flushed with a 50-barrel mud sweep followed by a wiper trip up to 84 m DSF and back to 316 m DSF. Following another 50-barrel sweep, the bit was released with the rotary shifting tool and the hole displaced with 90 barrels of heavy mud. The pipe was then pulled back in the hole with the end of pipe placed at the logging depth of 117 m DSF.

Logging operations in Hole U1350A consisted of two attempts to deploy one tool string and took place in deteriorating weather with initial ship heave conditions of ~2 m and changing to ~4 m and wind gusts of up to 56 knots. Downhole logging operations began at 0510 h on 19 October and were concluded at 0030 h on 20 October after the tool string was rigged down. The triple combo toolstring was rigged up and lowered at a speed of 2200 m/h to a depth of 3600 m DRF. At this depth, the head tension decreased dramatically and the cable speed was reduced to approximately 90 to 120 m/hr to avoid potential damage to the wireline. The slow progress required pumping pressure down the drill pipe to aid the descent. After making very slow progress to a depth of 4000 m DRF it was decided to pull out of the hole to check the toolstring and cable for damage. With the toolstring on at the rig floor it was decided to pump down to remove any potential obstruction. The toolstring was deployed a second time with similar results, reaching a depth of 4122 m DRF. As time was running out and without knowing the cause of the low-tension problem it was decided terminate the logging operation. The tool was

recovered at 2330 hr and after the logging equipment was rigged down, the drill string was pulled out of the hole and secured and the beacon was recovered, the vessel started its long voyage to Townsville at 1245 hr on 20 October. The total time on Site U1350 was 7.5 days.

SCIENCE RESULTS

Drilling for Expedition 324 concluded this week at Site U1350 on the southeast flank of Ori massif, less than 40 miles downslope from Site U1349. This final drill site also achieved the deepest penetration into volcanic basement during Expedition 324. In total we penetrated ~163 m into a series of massive lava inflation units not thicker than ~5 m that are intercalated with many smaller pillow basalts and often well-preserved carbonate sediment pockets.

Sediments, in various quantities, were present in all igneous units, but were absent from ~265 m to 295 m CSF-A. The recovered sediments are predominantly fine-grained, radiolarian-bearing carbonates with volcanoclastic components. The radiolarians are usually poor to moderately well preserved and replaced by calcite. One ~15 cm interval of bedded sandstone, consisting almost exclusively of carbonate-cemented volcanic glass, was recovered in Section U1350A-25R-1. Occasional bivalve and brachiopod fossils were observed in the lower cores, in particular Core U1350A-26R, which also contains abundant rounded shell fragments. In the lower igneous units, many small micritic limestone pockets are found interbedded between pillow basalts. The heat of the magma during emplacement caused the soft sediment to bake, leaving blackened margins near the igneous-sedimentary contact. Unfortunately, none of the limestone samples contain calcareous nannofossils or foraminifera. Radiolaria species were found but, as seen in the sediments further up, are very poorly preserved.

Towards the bottom of the hole, the proportion of pillow lava basalts increases whilst the number of massive flows decreases gradually. Also downhole, the petrography of the basalts changes from largely aphyric basalt to a plagioclase-phyric pillow basalt, with up to ~6-10% plagioclase phenocrysts that are up to 6 mm in size. The last two cores (Cores

U1350A- 25R and -26R) provided a very appropriate ending to the drilling during Expedition 324 with better than 90% recovery and a host of textbook examples of contacts between the still-fluidal and soupy micritic sediment and many small (~20-50 cm) pillows that rolled into or toppled over these very soft sediment intercalations. As a result the pillows exhibit many nicely preserved chilled margins, structures showcasing sediment-basalt interactions, and pervasive baking of the sediment pockets.

From an alteration point of view, the basalts are only moderately altered but the degree of alteration increases in the plagioclase-phyric pillow succession at the bottom of the hole. Clay minerals are the predominant secondary minerals completely replacing the glassy mesostasis and, to various extents, groundmass primary minerals (plagioclase and pyroxene). Plagioclase phenocrysts commonly remain relatively fresh, except for one igneous unit (IV), where they are almost completely altered to various secondary minerals (smectites and likely zeolites). Olivine phenocrysts, when present, are always completely replaced by saponite or by an assemblage of saponite and calcite.

A large numbers of vein and joints were found, which generally show steep dipping angles. Two main types of veins are present: calcite \pm saponite veins and pyrite veins. Calcite veins show either a blocky or a fibrous morphology. Most veins display complex structures (e.g., network, curved, anastomosing, branched). Some of calcite veins conspicuously show cross-fiber texture, which are cut by other kinds of veins (e.g., polycrystalline and composite textures). Vesicles are commonly filled with the same mineralogy as the veins: calcite, saponite, and pyrite.

Discrete samples from Cores U1350A-9R through -26R were processed for moisture and density data (bulk density, porosity, etc) and compressional (P-) wave velocities (in all, 40 total samples). Porosity is variable downhole with lows in Core U1350A-22R and highs in Core U1350A-16R. There is good positive correlation between P-wave velocity and density, good anti-correlation between P-wave velocity and porosity, but no consistent correlation of any of these data with changes in rock type or petrographic units.

Besides physical properties determinations, the discrete samples were also used for paleomagnetic measurements. Both alternating field and thermal demagnetization methods were used to characterize the magnetic remanence of the Hole U1350A igneous section. Most of the 40 samples show fairly stable components in demagnetization steps and univectorial decays toward the origin. A shallow positive inclinations in igneous Unit IIa, IIb, and IIc was found, and shallow negative inclination in igneous Unit IV.

After the termination of drilling operations at the beginning of this week, describing and analyzing samples from the last Site U1350 cores continued until the end of this week. The geochemistry lab group completed ICP-AES analysis, data reduction, and interpretation and write-up of results for 13 Site U1349 lava and autobreccia samples. Preparation of forty-two lava samples from Site U1350 was initiated, and ICP-AES measurement of 22 of these samples was completed.

At the end of the week, the focus of all lab groups shifted entirely to report writing, finishing database entries, and most importantly, sampling for shore-based studies and coordination of the individual research efforts. On Saturday, 24 October, the first Expedition 324 sampling party (for postcruise research) was conducted for all cores recovered at Site U1346.

TECHNICAL SUPPORT AND HSE ACTIVITIES

During this week the final hole of the expedition at Site U1350 was completed. The shipboard labs are processing samples and preparing for personal sampling parties of the cores. The transit to Townsville, Australia commenced on about 12:30 on November 20. The magnetometer was deployed and the ship was steered across Shatsky Rise to collect magnetic data during the transit. A fire and boat drill was held on October 21 for the entire ship's complement.