

December 5, 2005

**IODP EXPEDITION 312:
SUPERFAST SPREADING RATE CRUST 3
WEEK 5 REPORT**

OPERATIONS

Reentry No. 5: Hole 1256D was reentered with the fourth rotary bit of Expedition 312 at 1418 hr on 28 November. After the formation took weight at 1247 mbsf, the top drive was picked up and the hole was washed and reamed from this depth to the bottom of the hole. Rotary coring in the hole resumed at 1830 hr on 28 November and advanced with good hole conditions to 1367.5 mbsf by 0300 hr on 1 December. After only 40.2 hr of rotation, the C-9 bit was retrieved in order to switch to a C-7 rotary bit. It was hoped that the more aggressive cutting structure of a C-7 bit would increase the rate of penetration as well as recovery. The C-9 bit pulled free of the seafloor at 0620 hr on 1 December and was recovered on deck by 1215 hr. The used C-9 bit was slightly less worn than previous bits and was under gauge by 1/8 inch. There were a few missing and chipped inserts on the gauge row of the cones. The fourth rotary bit used during the expedition cored 24.0 m and recovered 1.31 m for an average recovery of 5.5%. The average rate of penetration for the cored interval was 0.6 m/hr.

Reentry No. 6: Hole 1256D was reentered with the fifth rotary bit of the expedition at 1938 hr on 1 December. After the formation took weight at 1285 mbsf, the top drive was picked up and the hole was washed and reamed from this depth to the bottom of the hole at 1367.5 mbsf. Rotary coring in the hole resumed at 0345 hr on 2 December and advanced to 1372.8 mbsf at a grueling average penetration rate of 0.3 m/hr. The driller then experienced erratically high torque and was unable to penetrate further because the top drive stalled each time the bit was placed on bottom. The decision was made to recover the drill string and inspect the condition of the bit. The drill string was pulled free of the seafloor at 1200 hr on 3 December and the C-7 bit recovered at 1745 hr. The bit was missing three cones and most of the fourth cone due to premature bit failure; the bit had only accumulated 21 rotating hours. The average recovery of the 5.3 m cored interval was 10.0%.

Reentry No. 7: Before coring could resume, it was necessary to clean out the metal debris from the bottom of Hole 1256D. A fishing array was assembled consisting of a 9 inch Bowen fishing magnet and two junk baskets affixed to a bottom-hole assembly of eleven 8¼ inch drill collars. The fishing array was deployed and entered the reentry cone at 0225 hr on 4 December. After the formation took weight at 1278 mbsf, the top drive was picked up and the drill string washed ahead without incident to the bottom of the hole at 1372.8 mbsf. The driller gently set the magnet on bottom frequently and used varied circulation rates in an attempt to capture in the junk baskets the smaller cone fragments not entrapped by the magnet. The drill string was recovered at 1730 hr and several large fragments of cone and bearing material were removed from the magnet face. In addition to a few smaller metal fragments found in the junk baskets, the scientific crew was rewarded for their patience with several pounds of fine-grained basaltic silt, sand, and gravel. The plan is to run in next with another fishing array consisting of a 9½ inch concave mill and a double junk basket array. The mill will be used to grind any remaining chunks of metal into finer fragments and capture them in the junk baskets. This process could require multiple round trips before the hole is considered clean enough to resume coring.

SCIENCE UPDATE

Coring at Hole 1256D continued in predominantly aphyric fine-grained to microcrystalline basalts with rare cryptocrystalline intrusive dike margins. Although recovery is sparse, Unit 77 grades inward from upper and lower microcrystalline marginal zones to a fine- to medium-grained central zone. The boundary between Units 77 and 78 is defined by an abrupt grain size increase at 1348.3 mbsf. In contrast to shallower units that are texturally distinct from one another, Units 77 and 78 are lithologically indistinguishable and may represent a single dike.

A total of eight samples from four igneous units (Units 75–78) were taken for ICP-AES analysis, including two samples from Unit 77 and three from Unit 78 that represent intervals where recovery was low. The chosen samples were generally aphanitic and cryptocrystalline to microcrystalline with an absence of alteration visible in hand specimens. One sample was taken specifically in an altered section to examine element mobility in the dikes. Overall geochemical characteristics in major and trace elements are very consistent with Leg 206 and Expedition 309 data. The Mg#s (~60–44) of the dike samples span the entire range of fractionation (from more primitive to more evolved) of rocks recovered higher up in Hole 1256D during Leg 206 and Expedition 309. This suggests we may be penetrating many thin dikes rather than following single larger dikes. In general, these basalts are more evolved than rocks recovered at Hole 504B (near the Galapagos Spreading Center). Fractional crystallization appears to be the dominant control over both major and trace element systematics in the dikes, as interpreted from variation diagrams such as Zr/Y vs. MgO wt% or Sc/Y vs. Sr/Y.

The basalts exhibit dark gray to dark gray-green moderate background alteration with common more intensely altered patches and halos flanking veins. Actinolite is the most common secondary mineral, present in veins, background alteration, alteration halos, and generally circular patches. Clinopyroxene in many samples is dusty and partially altered to actinolite and common secondary magnetite. Chlorite, albite, and titanite remain common groundmass phases. Green-brown amphibole has been identified in thin sections from Section 192R-1, perhaps indicating an increase in alteration temperatures. Secondary calcic plagioclase has not yet been observed. Chlorite and actinolite are the most common vein fillings, but 1 mm thick quartz-chlorite-pyrite veins are also common and some veins have light gray or composite dark green to light gray halos. Section 194R-1, 3–14 cm, is cut by a sheared quartz-calcite-laumontite-anhydrite vein with common sphalerite, pyrite, and chalcopyrite. The margins of this vein are strongly recrystallized to chlorite and quartz, obscuring the primary igneous context.

From 1309.7 mbsf (Core 183R) through 1367.5 mbsf (Core 197R), 22 oriented pieces having a total length of 246 cm were recovered. In those oriented pieces, 78 measurements were made, mostly of veins bearing some combination of chlorite, actinolite, quartz, prehnite, and sulfides. An analysis of all vein measurements since the beginning of Expedition 312 yields no correlation between either vein composition and orientation or relative age of veins and composition. Veins have an average dip of 65° and fractures have an average dip of 35°. Intrusive contacts are commonly incompletely preserved. At 1357.9 mbsf in Core 194R there is an interval that has many characteristics of a chilled margin, although there is no recovered juxtaposition of different units and alteration and deformation have overprinted the intrusive structure. Inspection of thin sections from samples above 1309 mbsf confirms that breccias adjacent to intrusive contacts are roughly contemporaneous with intrusion.

Measurements with the MultiSensor Track reveal unusual magnetic properties in two narrow intervals in Hole 1256D. An error in the way the Bartington MS2-C 80 mm loop reports magnetic susceptibility (MS) was rediscovered. Corrected data for both Expedition 309 and

Expedition 312 indicate MS of 12,000–14,000 SI units in Sections 309-1256D-78R-3, 42.5 cm (766.8 mbsf), to 79R-2, 97.5 cm (772.1 mbsf), and 312-1256D-187R-1, 92.5 cm (1325.3 mbsf), to 187R-2, 40.0 cm (1326.1 mbsf). These values are more than twice as high as average values elsewhere. Bulk density from gamma ray attenuation remains lower (2.4–2.6 g/cc) than in the dikes sampled on Expedition 309, with the exception of values of near 3.0 g/cc in Section 312-1256D-184R-1, 5–7.5 cm (1314.6 mbsf). Two spikes in natural gamma ray (7–10 corrected counts) were found in Sections 312-1256D-184R-1, 95 cm (1315.4 mbsf), and 189R-1, 71-91 cm (1334.8 mbsf). Measurements taken from six 8 cc minicubes yielded bulk densities of 2.88–2.96 g/cc, porosities of 0.1%–1.8%, and compressional velocities of 5067–5782 m/s (average = 5480 m/s). These values continue the trend of increasing values with increasing depth found in the Expedition 309 dikes. Thermal conductivity remains in the range of 2.0–2.5 W/(m·K), consistent with the rest of the values in the high-temperature hydrothermal alteration zone below 1028 mbsf.

Paleomagnetic results from discrete and archive samples from 1300–1369 mbsf show variable drilling overprint. The shallowest inclinations after demagnetization were close to 6°. Overprint from 1314 to 1334 mbsf was generally not removed. High MS in the interval from 1324 to 1330 mbsf seems associated with remanence carried by low coercivity grains, perhaps reflecting the presence of superparamagnetic grains formed by locally different alteration.

Nine oriented pieces from Cores 189R, 190R, and 196R–198R were scanned with the DMT core scanner. Lengths of scanned pieces vary from 60 to 210 mm, averaging 109 mm. A few distinctive veins and fractures on surfaces of oriented pieces are promising and may allow reorientation of the pieces when compared with FMS and UBI logs.

TECHNICAL SUPPORT ACTIVITIES

Low recovery revealed Excel macro errors relating to differences in recovered and curated core measurements. Samples with very high MS values exceeded the instruments' range limit where it generated wraparound values resulting in some anomalous database values. The MS data was visually inspected and the readings corrected. MS data from Expedition 309 has also been reviewed for this occurrence. An accident in the petrology lab led to the repair and replacement of several Expedition 309 thin sections. The lack of hot water was a problem for the photo lab for a few hours.

HSE: An all-hands abandon-ship drill was conducted where three lifeboats were lowered to the gunwales. The fourth boat was lowered in the evening with the assistance of the night shifts. Preparations are in progress for a lab stack drill and a security drill next week.