December 12, 2005

IODP EXPEDITION 312:
SUPERFAST SPREADING RATE CRUST 3
WEEK 6 REPORT

OPERATIONS

Reentry No. 8: After the fishing magnet was deployed, a second fishing array was made up with a 9½ inch concave mill and two junk baskets affixed to a bottom-hole assembly of 11 8¼ inch drill collars. The fishing array was deployed and passed the reentry cone at 0020 hr on 5 December. After the formation took weight at 1298 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. Milling operations to grind up any metal debris remaining at the bottom of the hole began at 0630 hr on 5 December and continued until 1230 hr. A 50 bbl high-viscosity mud flush was circulated in between milling and working the junk baskets to sweep small cuttings out of the hole. The drill string was recovered at 2130 hr, and smaller fragments of cone and bearing material were removed from the junk baskets. A circular impression in the center of the mill face corresponding to the radius of a recovered cone indicated that the first magnet run did not recover all of the metal debris at the bottom of the hole. The junk baskets contained sand and basalt fragments that were sieved, sorted, and curated for shipboard analysis. Metal fragments grading from small chunks to filings were magnetically separated.

Reentry No. 9: The third fishing array was made up of a 9½ inch concave mill and a single junk basket affixed to a bottom-hole assembly of 11 8¼ inch drill collars. The fishing array was deployed and entered the reentry cone at 0530 hr on 6 December. After the formation took weight at 1294 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. Milling operations resumed at 1015 hr on 6 December and continued until 1630 hr. At the end of milling, a 50 bbl high-viscosity mud flush was circulated. The mud sweep was circulated out of the hole by displacing the pipe with an amount of seawater equivalent to twice the volume of the open hole. The drill string was recovered at 0200 hr and very small pieces of cone and bearing material were removed from the junk basket. The recovered material was again sieved, sorted, and curated for shipboard analysis.

Reentry No. 10: The fourth and final fishing array was made up of a 9 inch Bowen fishing magnet and two junk baskets affixed to the same bottom-hole assembly of 11 8¼ inch drill collars.. The fishing array was deployed and entered the reentry cone at 0904 hr on 7 December. After the formation took weight at 1295 mbsf, the top drive was picked up and the drill string washed ahead without incident to the bottom of the hole. The magnet and junk baskets were worked at the bottom of the hole from 1430 hr to 1530 hr on 7 December. The drill string was recovered at 0003 hr on 8 December. Because the metal recovered in the magnet consisted only of very fine metal filings with no solid fragments, the hole was considered clean of cone debris.

Reentry No. 11: Hole 1256D was reentered with the sixth rotary bit of the expedition at 0754 hr on 8 December. After the formation took weight at 1294 mbsf, the top drive was picked up and the hole was washed and reamed to bottom. Rotary coring in the hole resumed at 1300 hr on 8 December and advanced with good hole conditions to 1398.6 mbsf by 0500 hr on 11 December. A 75 bbl high-viscosity mud flush of the hole was circulated every 15 m of advance. There were two round trips of the deplugger to insure that the bit throat was not obstructed with basaltic fragments. The C9 bit was pulled free of the seafloor at 0820 hr on 11 December and was recovered by 1346 hr. The sixth rotary bit used during

Expedition 312 cored 25.8 m and recovered 1.39 m for an average recovery of 5.4%. The average rate of penetration for the cored interval was 0.6 m/hr. The used C9 bit exhibited uniform wear on the cones and was undergauge by 1/8 inch, both details consistent with the rotating hours. There were chipped inserts on the middle and gauge rows. There was no evidence of damage attributable to downhole metal fragments.

Reentry No. 12: Hole 1256D was reentered with the seventh coring bit at 2146 hr on 11 December. After the formation took weight at 1326 mbsf, the top drive was picked up and the drill string washed ahead without incident to the bottom of the hole at 1398.6 mbsf. Rotary coring resumed in the hole at 0415 hr on 12 December.

SCIENCE UPDATE

Hole-cleaning activities for much of the week returned several kilograms of rock material in the junk baskets. This material, ranging in size from several centimeter basalt fragments to fine crushed material was consolidated and preserved as Ghost Core 201G. Rock samples in the ghost core were predominantly of two types: (1) tabular samples, commonly with sharp edges, bounded on one side by iron-oxide–stained fracture surfaces and on the other by freshly broken, slightly curved (almost conchoidal) fractures; and, (2) drill-rounded, equant blocks bounded by pre-existing fracture surfaces with black (saponite?) coatings. Type 1 fractured samples are actinolite-bearing, dense, microcrystalline to fine-grained basalts that appear from their metamorphic assemblages to have come from various levels within the sheeted dike section. Type 2 blocky samples are from shallower depths, mostly within the lava sequence.

In addition to the basaltic samples, leucocratic igneous samples are relatively abundant (~1%) in the coarse-sand–size fraction of the junk basket material. These samples are typically fine grained with a variety of primary, intergranular textural types. They consist of quartz, highly altered feldspar, and actinolitic hornblende, presumably replacing a primary mafic phase. They display deformation lamellae, undulose extinction, and partial to complete recrystallization, indicating intracrystalline strain. Samples of this type have not been recovered in core samples at this site.

After the hole was cleared, coring continued at Hole 1256D with low recoveries of aphyric fine-grained to cryptocrystalline basalts, but with no clearly identifiable dike margins. Although recovery is sparse, Unit 79 appears to be a continuation of Unit 78. Unit 80 is defined by an abrupt grain size decrease in the core at 1373.2 mbsf.

Six new samples from Units 79 and 80 and four samples from Core 201G were selected for ICP-AES analysis. Additionally, three samples were selected from Expedition 309 cores at locations of pre-existing ICP-AES analyses for a quality-control check.

Data for the first 18 dike samples indicate that Unit 77 dikes are among the most primitive rocks recovered from Hole 1256D thus far, having Mg#s of 61.2 and 61.1. This unit is also distinguished by having high Zr/Y (~3.4). Variable Zr/Y ratios found in the Hole 1256D samples, relative to a given MgO wt. %, suggest a heterogeneous mantle source. Other geochemical trends in major and trace elements appear to be largely controlled by fractional crystallization. The Hole 1256D rocks have compositions that are comparable to present-day mid-ocean ridge basalts forming along the northern East Pacific Rise (EPR) in the location predicted for formation of the Hole 1256D crust ~15 million years ago (~9°N). Both the Hole 1256D and northern EPR rocks are more fractionated than those sampled during drilling at Hole 504B near the Galapagos Spreading Center.

All the basalt samples recovered during Expedition 312 have a metamorphic overprint, and both alteration intensity and metamorphic grade continue to increase downhole. Most of the basalts are moderately to highly altered with the patchy development of cm-scale dark green-gray amphibole-rich zones, and common veins filled with mixtures of actinolite, pyrite, quartz, and/or chlorite. Many of these veins have highly recrystallized dark green to light gray alteration halos as large as 10 mm wide. Late-stage, cross-cutting laumontite veins are also common. In thin section, significant proportions of these basalts are thoroughly recrystallized both texturally and mineralogically to microcrystalline, granular aggregates of secondary clinopyroxene, orthopyroxene, Mg-hornblende, calcic plagioclase, and subrounded blebs of magnetite and ilmenite. Where first encountered (~1340 mbsf), this secondary assemblage partially mimics the original igneous texture. Deeper in the hole, the equigranular texture is more intensely developed and the primary igneous fabric more difficult to discern suggesting there has been significant reheating of these rocks.

From 1367.5 through 1377.3 mbsf, 2 alteration patches, 10 fractures, 19 veins, and a prominent shear vein were described. Oriented pieces contain the shear vein and a steeply-dipping fault with normal-sense striae and slickenfibers. Populations of fractures, veins, and intrusive contacts each have preferred orientations. Veins are subparallel to intrusive contacts, and both are steeply dipping whereas fractures are more shallowly dipping. Fractures tend to have orientations similar to those of features tentatively identified as fractures in the logging data from Expedition 309. Further exploration of the logging data from Expedition 309 found that one interval containing a dike-margin breccia is imaged in both FMS and UBI images.

Trends in physical properties continued downhole. Porosity of mincubes is <1%, bulk density is 2.90–2.95 gm/cc, and *P*-wave velocity is 5.5–5.8 km/s. Thermal conductivity values remain in the range of 2.2–2.4 W/mK. Bulk density from gamma ray attenuation continues to increase downhole, reaching 3.0–3.2 gm/cc. Magnetic susceptibility also continues to increase, reaching 14,000 SI units in Core 202. *P*-wave velocity of six samples from 1237–1255 mbsf initially measured on Expedition 309 were remeasured, revealing an average offset of 0.42 km/s to lower velocities on Expedition 312. This difference is likely due to recalibration done at the start of Expedition 312. An offset to lower bulk density from gamma ray attenuation also occurred at the top of Expedition 312 sampling, but remains unexplained.

Paleomagnetic efforts for the week have focused on testing whether a 10 cm fragment of the outer borehole wall recovered in the second junk basket shows drilling overprint comparable to the material conventionally recovered in the core barrel. Preliminary results suggest a moderate overprint is present, but it appears more easily demagnetized than in normal cores.

Three oriented pieces with lengths from 80 to 210 mm (average = 146 mm) from Core 202 were scanned with the DMT core scanner. A few distinctive veins and fractures in the oriented pieces are promising and may allow reorientation of the pieces when compared with FMS and UBI logs.

TECHNICAL SUPPORT ACTIVITIES

There have been enough samples selected from the cores to keep the thin section and chemistry laboratories active. The hazardous chemicals we are keeping are being isolated for eventual return to TAMU. The ship's welder has added lengths of chain inside the lab doors to secure them when the ship moves to Security Level 3. Lab water temperatures were adjusted down to normal standards.

HSE: The weekly fire drill began at 10:30 a.m. and turned into a chemical spill drill for the METs team. This drill was staged on the mezzanine where the product was identified, neutralized, and cleaned up. A briefing was presented to the ship's emergency response team. The *JOIDES Resolution* was brought to Security Level 2. Technical staff members were involved with searching spaces in the lab stack for a "suspicious package." The Captain briefed the technical staff, and search areas were assigned. An unfamiliar package was eventually found on the Main Deck behind a "never closed" door. The ship then went to Security Level 3; only those directly contacted by the Bridge officers were involved. The drill was concluded at about noon.