July 25, 2005

IODP EXPEDITION 309:
SUPERFAST SPREADING RATE CRUST 2
WEEK 2 REPORT

OPERATIONS

LOGGING: Our first operations on Expedition 309 were to make a temperature profile of the hole and sample the borehole fluid from the bottom of the hole using the WSTP. Hole 1256D was then logged using the Triple Combo and the FMS Sonic tools to determine the hole condition and gauge prior to beginning coring operations. The tools were lowered into the drill string on Sunday, 17 July. The hole was logged from 724.4 mbsf to casing depth. The tools were removed from the drill string at 0530 hr on 18 July. The logging BHA was then retrieved and an RCB coring assembly was prepared.

REENTRY #2 (BIT #1): At 2325 Hole 1256D was reentered with an RCB assembly. The drill string was lowered to a depth of 4370 mbrf and a center bit dropped. The hole was then washed and reamed of ~27 m of rubble and silt to a depth of 4395 mbrf. The center bit was pulled and the first core barrel was dropped. A 50 barrel mud sweep was circulated and coring operations began. The hole was cored without incident to a depth of 4466.5 mbrf (821.1 mbsf). A total of 69.1 meters were cored with a recovery of 25.2 meters (36.5%). The bit accumulated a total of 51.7 rotating hours with an average ROP of 1.34 m/hr.

The bit was pulled with 51.7 hrs and was back on deck at 1000 hrs on 22 July and quickly replaced with a new C-9 bit. The bit was in relatively good condition with two trimming inserts missing from one cone, the seals effective and 1/16" under gage. To minimize the risk of downhole bit failure and to insure that the hole diameter was in gage, it was decided that subsequent bits would be changed approximately every 50 hours.

REENTRY #3 (BIT #2): The drill string was redeployed and reentered Hole 1256D at 1911 hr on 22 July. The bit was lowered to bottom and coring was resumed at 2330 that day. Core 86R was recovered with 3.65 m recovery. All core catcher dogs were missing and it appeared that some of the core had fallen into the drill string. The next core barrel was dropped and high pump pressures were noted. The barrel was pulled and a deplugger was deployed twice to clear any obstructions. A core barrel was dropped again and pressures had returned to a normal range. Coring was resumed at 1045hr on 23 July. The bottom of the hole is now in excess of 864 mbsf. At 614 m sub-basement, Hole 1256D is now the longest penetration of extrusive rocks ever cored into the oceanic crust.

SCIENCE UPDATE

Two borehole fluid samples from the bottom of Hole 1256D were taken using the WSTP. The initial sample was murky with a high concentration of suspended particles that clogged the filters on the WSTP, suggesting it was taken within the unconsolidated fill at the bottom of the hole (724.6 mbsf). Whilst the WSTP was being cleaned and prepared for a second sampling attempt, the Adara tool was lowered and recorded a maximum temperature of 65.8°C at 724.6 mbsf. A second clear fluid sample was returned by the WSTP from 712.6 mbsf. The basement fluid has seawater-like salinity and chlorinity but significantly reduced sulfate concentration (24 mM) and pH closer to neutral (7.4). The fluid has higher concentrations of Ca, Sr, Li, B, Mn, and Fe but lower Mg and K concentrations compared to standard seawater, typical of low temperature basement fluids and in agreement with the common occurrence of Mg-saponite and celadonite in the basement cores.

The Triple Combo tool string recovered excellent data in very good agreement with logs made at the end of ODP Leg 206. The maximum temperature measured by the TAP tool is 68.7°C at 727 mbsf. Good quality FMS images and acoustic velocity data were recorded during a single pass of the FMS tool string and the calipers indicate the hole is in excellent condition with similar shape to measurements from Leg 206. The FMS/Sonic tool string rotation provided an increase in coverage from Leg 206 and the acoustic velocity measurements (P-wave, S-wave and Stoneley wave) appear to be higher quality compared to the Leg 206 measurements.

From July 19 to July 24, 97.8 m of basaltic oceanic basement was cored (Cores 75R-88R) yielding a total of 33.46 m of recovery (34.2 %). Six igneous units (27-32) have been identified based on phenocryst contents and textural changes such as chilled margins or glassy rims. Units 27 to 29 are thin sheet flows composed of numerous different cooling units. Units 30 and 31 comprise thick intervals of fine to medium grained basalt, the former being more than 10 meters thick. The basalts are generally non-vesicular and aphyric, except for Unit 28, which is sparsely to moderately olivine-plagioclase-clinopyroxene-phyric and Unit 31, which is moderately vesicular. Unit 32 marks the return to thin sheet flows. The overall petrographic characteristics of the cores recovered are very similar to the overlying rocks described at the end of Leg 206.

Dark grey background alteration is pervasive throughout the basalts recovered in Cores 75R-88R. Numerous veins are present, filled with combinations of Mg-saponite, celadonite, iron oxyhydroxides, amorphous silica, quartz and minor pyrite. Veins are between 0.1 - 15 mm thick and are commonly flanked by cm-scale mixed or single brown, black, or green halos. Downhole from Core 85R there is a reduction in the number of iron oxyhydroxide-filled veins and related mixed alteration halos with Mg-saponite and pyrite being the dominant secondary minerals.

Brittle structures are mostly linked to the cooling of lava with magmatic layering linked to the flow of lava also observed. Structures consist of curved, radial, Y-shaped and irregular veins, vein networks, shear veins, microfaults, and breccia comparable to those recorded during Leg 206. The intensity of fracturing is slight to moderate and evenly distributed with local planar and straight fractures in fine grained basalt intervals. Minor breccias include hyaloclastite and clast-supported, monogenic breccias, with angular clasts, commonly associated with vein networks. Fracturing is more heterogeneously distributed and partitioned below Core 85R. Five 20-40 mm-thick microfault zones with minor offsets (mm-scale) occur every 1-2 m that are characterized by arrays of nearly parallel and anastomosed veins and shear veins locally isolating millimetric lenses of crushed microbreccia and cataclasite. Slickenfibers in the microfaults are consistent with a normal sense of shear.

Paleomagnetic measurements on samples from 752 to 821 mbsf generally show significant drilling overprint. Negative inclinations from a few archive half-round samples at flow boundaries or pillow rims give hope that careful discrete sampling will find stable directions.

Physical properties measurements are consistent with results from the lower units of Hole 1256D during Leg 206. The most distinctive change in physical properties is a reduction in NGR in the more massive lavas (Core 85R) compared to the sheet flows. TC and P-wave velocity measurements on discrete samples indicate average thermal conductivities of 1.8 W $m^{-1} K^{-1}$ and Vp of 5.6 km/s respectively.

Approximately 64% of the core consists of pieces that range in size from 80 mm to 1420 mm, with an average length of 193 mm, and are large enough to be scanned by the DMT

Scanner. Images from the scanner are high resolution but slightly darker than expected. Important features such as veins and fractures are still very visible.

LAB REPORT
Core recovery >30% has engaged all of the specialists processing the recovery. All equipment is performing satisfactorily. A pipe trip for a bit change provided some time for all to catch up and allowed a few to attend a Photoshop presentation.

The bead maker supporting the ICP and X-ray is again plumbed to potable water after re-discovering that drill water can carry too much entrained air. A request to be included in discussion leading to laboratory infrastructure changes was made to the Chief Engineer.

Planning is in progress for an imminent sample party as some 44 sections have been collected with layout space limited to some 70+ sections.

Difficulty viewing the black basalts at the description table led to a request from the scientists for addition to the lighting. Moments after a fire drill, the transformer supplying the lamps overheated and failed, emitting acrid brown smoke. An inquiry as to why the smoke detectors failed was answered by the observation that heat detectors protect the labs. Only the accommodations and house offices have been retrofitted with smoke detectors.

HSE: A simulation of a crash and fire on the helideck was the focus of the weekly emergency drill. The METS team dressed out and collected air packs to support the fire teams if needed. The remainder of the ship compliment rallied at their life boat. For demonstration, a parachute red flare was launched by the Operations Manager.