

**IODP Expedition 304**  
**Oceanic Core Complex Formation, Atlantis Massif**  
Site Summary: Site U1310

**December 28, 2004**

Hole U1310A: Latitude: 30° 11.485' N, Longitude: 42° 03.927' W, 2584 mbsl

Hole U1310B: Latitude: 30° 11.484' N, Longitude: 42° 03.920' W, 2583 mbsl

Site U1310 is located in the hanging wall to the hypothesized detachment fault, approximately 9.3 km west of the center of the rift valley. The site is on a small fault-bound horst, about 600 m east of the break in slope inferred to mark the termination of the detachment fault exposed on the central dome. Numerous small NE-striking scarps (both southeast and northwest facing) expose pillow basalt in the vicinity. The motivation for drilling at Site U1310 was to assess the petrogenetic relationship between these volcanic rocks and the potential source rocks cored in the footwall, and to document faulting and rotation within the hanging wall block. In addition, if drilling to depth were successful, there was an opportunity to sample an unexposed portion of the detachment fault from just below the base of the volcanic succession; seismic reflection data suggest this interface could be encountered 250-350 mbsf.

**SCIENCE SUMMARY**

No coring was attempted at Hole 1310A, but approximately 1 Kg of broken basaltic material was recovered from the hammer drill casing when it returned to the rig floor. The dominant rock type is sparsely plagioclase-phyric, fine-grained pillow basalt. A single ~10 cm pillow fragment has a palagonitized glass rim grading through a spherulitic zone to a microcrystalline interior. The remaining material ranges in size from ~5 cm to dust. It includes palagonitized glass fragments, some of which are encrusted by calcareous sediment and/or iron-manganese oxides, drill-rounded and angular fine-grained basalt fragments, and minor calcareous sediment and iron-manganese oxides. The finer material includes separate fragments and coatings of ferrous and siliceous welding slag derived from assembly and disassembly of the bottom-hole assembly. Recognizable slag pieces were discarded.

The first core recovered from Hole U1310B is 1.3 m of fist-sized, and smaller, pieces of basalt from the 13.5 m interval below a 5 m thick sediment cover. Although we cored as deep as 23 m, the second core barrel was still in the lower BHA when the coring line parted and no rock was recovered from below 18.5 mbsf. Most of the basalt fragments were broken, alteration along these fracture surfaces being minimal and the interior less than 1% altered, suggesting they are derived from in situ pillows. The piece interiors are also almost unaltered. Vesicles comprise 3-5% of the pieces recovered. Vesicles close to fracture surfaces are internally discolored brown but not filled; spherulitic zones appear light brown in places and within these zones, plagioclase appears white, rather than transparent. Some fragments have a glassy rim 1-3 mm thick, with relatively fresh glass. Thin zones of palagonite are mostly confined to the outer pillow surfaces. Glass samples were taken for onshore analysis prior to the post-cruise sample party.

In thin section, the pillow interiors appear fresh, with 5-10% seriate plagioclase needles and radiating clusters in a glassy groundmass characterized by branching, feathery quench textures. Sparse anhedral olivine and prismatic plagioclase microphenocrysts are no more than 0.5 mm in size, with rare grains up to several mm in long dimension. Crystal clots composed of subophitic intergrowths of plagioclase and olivine are relatively common. The one sample of pillow basalt (Sample U1310B-1R-1, 16-18 cm) analyzed for major and trace element geochemistry suggests that the basalt is a primitive tholeiite. This sample is characterized by high MgO (10.23%) and low trace element abundances, consistent with the observation of olivine microphenocrysts noted in thin section.

## **OPERATIONS SUMMARY**

### **Hole U1310A**

A subsea camera survey revealed about 2000 m<sup>2</sup> of smooth, featureless sediment sloping gently to the west, with rare, meter-sized outcrops of breadcrust-textured rock. The HRRS was deployed with a prototype nonagon pilot and ring bit assembly and ~20 m of casing. Nearly 7 hours of rotation resulted in negligible penetration, so we recovered the HRRS and determined that the pilot bit had pushed through the ring bit and jammed. The nonagon bit system was replaced with a wing-style reamer bit and casing shoe. We deployed this new assembly at the same location and drilling continued for the next 6 hours until we were unable to maintain rotation of the drill string. We pulled the HRRS out of the seabed and moved 10 m north. After 5 hours and less than 6 m of penetration, we seemed to be making no progress so the HRRS was again brought to the surface. The bit was missing gauge buttons from the outside of the wings, but was otherwise undamaged. The casing length was reduced by half, a new wing-style reaming bit installed, and the casing shoe removed. We made a successful reentry into the previously drilled 6 m deep hole and were able to advance the bit to 13 mbsf before penetration effectively ceased. When we tried to recover the hammer assembly, it would not separate from the casing, and eventually the entire assembly (including casing) was recovered. Inspection revealed that the casing running tool had released, but the reamer arms of the wing bit were open and wedged into the lower part of the casing. One wing bit arm was missing and presumed to be lost in Hole U1310A.

### **Hole U1310B**

We offset the vessel 10 m east of Hole U1310A and initiated Hole U1310B with an RCB BHA. The first coring interval was 18.5 m and required 30 hours to complete. Coring during this interval was characterized by constant high torque and many intervals had to be drilled and then redrilled as rock fell into the hole. After retrieving the first core barrel there was at least 3 m of fill in the hole that took several hours to clear. A wire line run to recover the second core barrel failed and damaged the core line at the sinker bars. A second wire line run was similarly unsuccessful, suggesting that the lower part of the drill string had been severed. Once the pipe had been recovered, we confirmed the bit and the lower part of the BHA were missing and presumed lost in Hole U1310B.