IODP Expedition 304
Oceanic Core Complex Formation, Atlantis Massif
Site Summary: Site U1311

December 29, 2004

Hole U1311A: Latitude: 30° 10.609' N, Longitude: 42° 04.190' W, 2541 mbsl
Hole U1311B: Latitude: 30° 10.660' N, Longitude: 42° 04.217' W, 2505 mbsl

Site 1311 is located on a small knoll near the break in slope where the lower, eastern flank of the corrugated dome meets the adjacent volcanic, hanging wall block. Drilling at this site was directed toward recovering a small amount of volcanic rock, fault rocks associated with the presumed underlying detachment fault, and a shallow portion of the footwall.

SCIENCE SUMMARY
Hole U1311A
Hole 1311A is located on the southern slope of the knoll. A 60 x 60 m survey with the VIT camera, documented a ~3600 m^2 area of mud-and rubble-covered seafloor, with a moderate slope to the south-southeast. Along the northeastern corner of the survey area, a moderately to steeply SE dipping, 20+ m high scarp oriented ENE (~075°) crops out, and is characterized by rounded pillow structures. Scarp retreat has eroded any planar fault surface; the lack of an unsedimented talus/debris fan at the base of the slope suggests that the scarp may be relatively old.

One attempt to drill at this site penetrated 12 mbsf, including 3.5 m of unconsolidated mud. Recovery from the hole produced 1.5 m (13%) of fresh, vesicular, moderately plagioclase-olivine phyric basalt pillows, with sparse glass preserved. Almost all pieces are angular and have broken along fracture surfaces within pillows – few, if any, were cut by the drill. The fracture surfaces are discolored dark brown, and minimally altered. These observations suggest that the core is derived from in situ pillows. Some piece interiors include multiple, gray Liesegang bands indicating pervasive minor or incipient alteration. Vesicles close to fracture surfaces are internally discolored brown but not filled.

The basalt is dark gray to black in color, and characterized by abundant (5-10%) seriate plagioclase that often occurs in radiating clumps. Sparse euhedral plagioclase phenocrysts range upward in size to ~ 2 mm. In thin sections from pillow interiors, the basalt appears fresh, with minimal darkening of the matrix and occasional occurrences of orange to green smectites, either in vesicles or in the vicinity of olivine. Randomly oriented, acicular to prismatic plagioclase, ranging in size from <0.1 - 0.5 mm, makes up ~ 40 % of the sample. Many of the plagioclase crystals have hollow or swallowtail quench morphologies. Olivine microphenocrysts (~ 5%) occur either in subophitic crystal clots with plagioclase or as euhedral microphenocrysts ranging in size from 0.1-0.3 mm, and in shape from larger prisms to smaller diamonds and more complex quenched forms. The remainder of the rock is the devitrified glass matrix, dominated by plumose,

quenched clinopyroxene with anhedral interstitial plagioclase. Oxides are abundant, up to 2%, in the matrix and commonly occur as complex quench morphologies, most likely ilmenite. Vesicles occupy 3-5% of total volume. They occur in two forms: round (~0.1 mm) and elongate, irregular, and commonly interconnected. Most are unfilled, but a few are completely or partially filled by devitrified glass and a few, especially near fracture surfaces, are filled by secondary green or orange smectite. They generally range in size up to 0.5 mm, but in places are as large as 2 mm (e.g., Section 304-1311A-1R-1 (Piece 6, 40-46 cm)). Where present, glass is 1-3 mm thick with 50-100% palagonitization close to outer surfaces. Small, but useful, volumes of fresh glass are preserved within the palagonite.

The one sample of pillow basalt (Sample U1311A-1R-1, 34-36 cm) analyzed for major and trace element geochemistry suggests that the basalt is a primitive tholeiite, with a Mg# (100 molar Mg/Mg+Fe) of 66. The Site U1311 is geochemically similar to the basalt sampled in Hole 1310B and the composition plots at the most depleted end of the field of Mid-Atlantic Ridge volcanic glasses.

OPERATIONS SUMMARY

Hole U1311A

A subsea camera survey revealed a smooth, sedimented surface, with rare accumulations of angular to surrounded, submeter sized boulders. Hole U1311A was initiated with an RCB BHA at 2040 hr 18 December 2004, in a region of our survey area devoid of visible rubble. High and erratic torque were constant during the 25 hours required to drill Core U1311A-1R, and rock falling into the hole had to be redrilled several times. Running the bit back to bottom after recovering Core U1311A-1R, the driller determined there was at least 3 m of fill in the 12 m hole. After several hours attempting to clear the hole proved unsuccessful, Hole U1311A was abandoned.

Hole U1311B

After a second subsea camera survey starting ~100 m northwest of Hole U1311A, we attempted to establish a hole by drilling without coring using a large diameter bit. We hoped that the large diameter bit would be more efficient at clearing the rubble falling into the hole, and we could begin coring with additional weight on bit to allow faster and deeper penetration. Since drilling with any rotary system was likely to encounter the same poor drilling conditions we suffered with the RCB, we decided to attempt to drill the large diameter hole with a wing-style reaming hammer bit. Even though we were not convinced the hammer system with a wing-style bit could set casing in this environment, we had seen it open a hole, and felt our attempt had a higher chance of success than using a large diameter rotary bit. However, after 10 m of penetration, forward motion with the bit ceased while we attempted to hammer through rubble falling into the hole. After 19 hours, we were not able to advance the bit to the bottom of the hole, so the attempt was abandoned.