

February 21, 2005

**IODP EXPEDITION 305:  
OCEAN CORE COMPLEX FORMATION, ATLANTIS MASSIF  
WEEK 6 REPORT**

**OPERATIONS**

This week began during the eighth bit run of Expedition 305 in Hole U1309D. Rotary coring during the week advanced the hole to 1225.5 mbsf by 16 February. For this bit run, the average ROP was 2.4 m/hr with 123.9 m cored and 67% recovery. Owing to elevated borehole temperatures measured during our logging run, we elected to improvise a temperature measurement at 1162 mbsf with an assortment of adhesive temperature recorder tabs affixed to a modified APC brass core catcher spacer deployed in a dedicated core barrel run. After the core barrel landed, the pumps were shut off and the tabs recorded a minimum borehole temperature of 70°C. Before starting our next coring run, the WSTP was deployed at ~1220 mbsf (a few m above the bottom of the hole) to collect a water sample and attempt to ascertain a minimum borehole temperature. Prior to deployment, the thermistor on the WSTP was determined to be faulty and was replaced. Since we were uncertain of the performance of the new WSTP thermistor, the water sampler was adapted to deploy an APC temperature tool (APCT) as a redundant measurement. Adhesive temperature recorder tabs were also installed on the WSTP. The temperature record from the WSTP flat-lined at ~60°C, later determined to be the maximum recording temperature of the new thermistor. The APCT flooded (because of a split o-ring) and no data were recorded. The adhesive temperature tabs indicated a minimum temperature of 110°C. Rotary coring advanced to a depth of 1326.3 mbsf by 0130 hr on 20 February. During the ninth bit run in Hole U1309D of Expedition 305, a total of 100.8 was cored with 62% recovery. The average ROP with this bit was 1.8 m/hr. The week begins with our tenth bit run in Hole U1309D, with coring advancing through 1340 mbsf.

**Initial Scientific Results**

From February 14 to February 20, Hole U1309D was deepened to 1339.2 mbsf (Cores U1309D-238R to U1309D-278R, average recovery 64.8 %). The upper part of this interval continues with fine- to medium-grained dunitic and wehrlitic troctolite, and troctolite alternating with sequences of medium- to coarse-grained olivine gabbro and gabbro. Plagioclase abundance in the troctolite is variable, locally less than 10%, and has a distinct interstitial character. Contacts between the troctolite and gabbro range from sharp, where thin intervals of gabbro crosscut the serpentine foliation in the troctolite, to gradational, where thicker intervals of gabbro are present. Three troctolitic sequences, approximately 10 m thick, were recovered this week, at ~ 1155, 1187 and 1230 mbsf. Below 1230 mbsf, the core contains gabbro, oxide gabbro, and olivine gabbro. Olivine gabbro predominates between ~ 1285 and 1301 mbsf (Cores U1309D-267R to U1309D-270R). In the interval from 1240 to 1280 mbsf (Cores U1309D-258R to U1309D-264R, oxide gabbro represents ~ 55% on average of the recovered rocks, and locally as much as 80% to 90% in Cores U1309D-258R, U1309D-260R, and U1309D-264R.

Dunitic troctolite and gabbro show variable degrees of alteration from Cores U1309D-238R to -270R. There are short intervals of relatively fresh (locally <10%) dunitic troctolite and gabbro, but also zones of intense serpentinization and serpentine foliation. Strongly veined and highly altered intervals are confined to gabbroic intervals. Gabbroic intrusions are altered to rodingite where they cut the highly serpentinized dunitic troctolite. Saponite, a waxy, translucent, green clay mineral that is easily mistaken for talc, was recognized as a major component of veins throughout the cores recovered during Expedition 305, especially

in areas of olivine-rich rock. The identification of this mineral significantly changed the appraisal of talc abundance in the vein assemblage.

Magmatic foliations in gabbros are commonly present, weak, and moderately to steeply dipping. This foliation is locally overprinted by weak, high temperature crystal-plastic strain. A few mylonitic, steeply dipping to subvertical shear zones were recovered in gabbro, in Cores U1309D-269R, U1309D-270R, and U1309D-271R (~ 1293, 1301, and 1303 mbsf, respectively). The troctolitic rocks have cumulate textures, and do not show any evidence of magmatic or crystal-plastic deformation.

Bulk rock compositions remain some of the most primitive gabbros sampled by drilling on the MAR, with Mg# ranging from 70 to 87 for all but more evolved oxide gabbros and late felsic intrusions. Mg# is fairly constant with depth, although it is lower between 800 and 1000 mbsf, where olivine abundance is low. Orthopyroxene joins the mineral assemblage of plagioclase,  $\pm$ olivine,  $\pm$ clinopyroxene when the bulk rock Mg# drops below 78. We also analyzed the first of the fresh, olivine-rich troctolites recovered from Core U1309D-227R. The low LOI (2.9%) is indicative of the low degree of serpentinization in this sample relative to other ultramafic rocks sampled during Expeditions 304/305. The bulk composition of this sample (41% SiO<sub>2</sub>, 35% MgO, 13% Fe<sub>2</sub>O<sub>3</sub>, 6% Al<sub>2</sub>O<sub>3</sub>, 4% CaO) reflects a mineralogy of ~10% plagioclase and 90% olivine. The sample has 3200 ppm Cr (abundant Cr-spinel in thin section) and 1600 ppm Ni.

Average, atmospheric pressure bulk densities, porosities, and P-wave velocities in gabbroic rocks and variously altered troctolite are similar. Overall, they average 2.96 g/cm<sup>3</sup>, <1%, and 5.7 km/s, respectively. The P-wave velocity of the freshest sampled troctolite (<2% serpentinization, ~ 80% olivine) is 6.6 km/s (average of measurements in three perpendicular directions).

Stable inclinations from the fresh gabbroic rocks continue to show reversely magnetized inclinations. Olivine-rich lithologies commonly display positive inclination polarity. The olivine-rich rocks typically have one order higher natural remanent magnetization intensity and magnetic susceptibility than those of fresh gabbroic rocks, but with much lower MDF, as indicated by a rapid decrease in intensity during lower steps of AF demagnetization experiment. Preliminary shipboard measurements also indicate that the mean inclination for the bottom part of the hole (~950-1100 mbsf) becomes slightly steeper than the average value above the interval. Possible causes of this slightly steeper inclination are paleosecular variation or tectonic rotation/tilting, which will be investigated by postcruise studies.

### **LABORATORY STATUS**

With hole conditions stable and core on deck approximately every 3 hours the shipboard labs are busy processing the hard rock cores of Site U1309.

### **HSE**

A fire and lifeboat drill was held on Monday for all the ships crew.