Petrography and geochemistry of basalt and diabase from IODP Expeditions 304 and 305, Atlantis Massif, Mid-Atlantic Ridge

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Seafloor drilling during Integrated Ocean Drilling Program (IODP) Expeditions 304 and 305 was designed to investigate the processes that control formation of oceanic core complexes as well as the exposure of ultramafic rocks in very young oceanic lithosphere. Site U1309 is located in the central dome of Atlantis Massif, which is interpreted as a footwall of a detachment fault exposed at the seafloor. The adjacent volcanic block where Site U1310 and U1311 are located, is inferred to be a hanging wall. We will present a preliminary result of shipboard research on petrography and geochemistry of basalt and diabase from Sites U1309 to U1311.

Mafic and ultramafic rocks were recovered from Site U1309 on the central dome of Atlantis Massif. Mafic rocks fall into basalt, diabase and gabbro. Basalt is restricted to the upper part of the footwall at Site U1309, that is fine to medium grained, but becomes increasingly coarse grained with increasingly well-developed ophitic textures downhole. There are a number of intrusive contacts in the cores, and nowhere is there evidence of eruption at the seafloor.

Diabase is characterized by a well-developed, medium-grained ophitic texture. The dominant minerals are plagioclase and clinopyroxene, with only minor olivine. Plagioclase is relatively fresh, although strained grains are common. Clinopyroxene is pervasively altered to amphibole, including tremolite, actinolite, and hornblende, and possibly chlorite. Olivine is completely replaced by chlorite, amphibole, and opaques.

Basalt and diabase from Site U1309 are tholeiitic basalts to basaltic andesites that overlap the compositonal range of basalt glasses from the entire Mid-Atlantic Ridge (MAR). Site U1309 basalt and diabase have wide range of compositions, and are slightly CaO and Al2O3 poor, and Na2O rich, compared to MAR basaltic glass compositions. These differences are possibly related to the pervasive greenschist facies alteration. Mafic minerals in all Site U1309 basalts and diabases were altered to tremolite and actinolite in various extent. This may explain part of the compositional variation.

The dominant rock types recovered from hanging wall, Sites U1310 and U1311, are sparsely plagioclase-phyric fine-grained pillow basalt and fresh, vesicular, moderately plagioclase-olivine phyric pillow basalt, respectively. Fresh glass is presereved in both sites. Chemical compositions of Sites U1310 and U1311 basalts are characterized by high Mg and low trace element contents and plot at the most depleted end of the field of MAR glasses. This suggests that these basalts are primitive tholeiites.