

# Magmatic Products by Ocean Floor Spreading in MAR : Preliminary Analyses of Peridotites from IODP Exp.304/305 at Atlantis Massif, MAR 30 ° N

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**Magmatic Products by Ocean Floor Spreading in MAR:  
Preliminary Analyses of Peridotites from IODP Exp. 304/305  
at Atlantis Massif, MAR 30°N**

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Integrated Ocean Drilling Program (IODP) Expeditions (Exp.) 304 and 305 at the Atlantis Massif, Mid-Atlantic Ridge (MAR) 30°N (Figure 1) intended to investigate the formation mechanism of oceanic core complex and evolution of oceanic lithosphere at slow-spreading ridge as well as to document structural and lithological properties. A 1.5-2 Myr old oceanic core complex is formed on the inside-corner high at the intersection of Atlantis fracture zone and MAR 30°N. The domal, corrugated surface of the massif is interpreted as a detachment fault exposed at the seafloor. High density mantle rocks invoked to explain observed gravity anomalies and high seismic velocities inferred from seismic analysis were interpreted to occur less than 1 km below the seafloor. Two Expeditions were operated as joint science program from 17th November, 2004 to 2nd March, 2005, and drilled two sites: one in the footwall at and below the detachment fault (Site U1309), and one in the hanging wall of the adjacent crustal block (Sites U1310 and U1311). Holes U1309B and U1309D at the footwall site successfully penetrated and recovered a long gabbroic section of ocean floor material.

The main hole, Hole U1309D, penetrated 1415.5 meter below seafloor (mbsf) with an average recovery rate of 74.8%. Over 96% of Hole U1309D is made up of gabbroic lithologies, which comprise amongst the most primitive as well as fresh plutonic rocks known from the ocean floor (Figure 2). The gabbroic rocks are highly variable in grain size and modal composition, and classified into gabbro, gabbro-norite, olivine gabbro, troctolite, "olivine-rich troctolite" and oxide gabbro. Serpentinized peridotite, on the other hand, constitutes only 0.3% of the hole. Diabase and basalt crosscutting the gabbroic sections comprise 2.9%. Medium-grained to pegmatitic gabbros and gabbro-norites, including minor amount of olivine and Fe-Ti oxides and/or orthopyroxene, comprise the most abundant rock type in the gabbroic rocks (55.7%). Oxide gabbro which contains Fe-Ti oxide of more than 2 vol% and rarely exceeding 10 vol% makes up 7.0% of the Hole U1309D. Olivine gabbro is the second most abundant rock type (25.5%), which contains wide ranges of modal olivine (10 to 50 vol%). The olivine gabbro locally grades into troctolitic gabbro and troctolite. More olivine-abundant troctolite (>70 vol% modal olivine), "olivine-rich troctolite", was recovered 5.4% including thicker intervals between 312 and 344 mbsf, and 1092-1236 mbsf. It has a cumulate-like texture with subhedral to rounded olivine and interstitial to poikilitic plagioclase and clinopyroxene in variable proportions.

On the other hand, Hole U1309B penetrated 101.8 mbsf with an average recovery rate of 46%. Gabbroic rocks, peridotite and basalt/diabase constitute 49%, 3% and 48% of the core recovered, respectively. Hole U1309B is characterized by two intrusive series separated by a narrow interval (~2-4 m) of relatively undeformed serpentinized harzburgite. The upper sequence comprises basalt, diabase and gabbro. The lower sequence consists of diabase and gabbro.

The gabbro to olivine-rich troctolite from Site U1309 have wide range in whole rock composition, such as Mg# [=100×Mg/(Mg+Fe)] that varies from 67 to 90 (excluding oxide gabbro).

These gabbros corresponds to the most primitive rocks collected by drilling along the MAR (23°N and 15°20'N) (Agar et al., 1997; Kelemen, Kikawa, Miller et al., 2004) and Southwest Indian Ridge (ODP Hole 735B) (Dick, Natland, Miller et al., 1999 ).

Serpentinized peridotites were, consequently, recovered from both Holes U1309B and U1309D. Four peridotite intervals were collected at different depth of shallower zone, at 61, 155, 172 and 224 mbsf, in Hole U1309D. Their compositions range from lherzolite to dunite. The degree of alteration varies from 10% to 100%, and dunites are the most severely altered. All peridotites show evidence for intensive impregnation, such as interstitial plagioclase, scattered melt-derived clinopyroxenes and olivine chadacrysts in coarse clinopyroxene oikocrysts. Harzburgites from 60 mbsf in Hole U1309B exhibit protogranular texture with alteration of ranging from 60 to 99%. The upper boundary is in direct contact with the coarse-grained gabbro and the lower boundary was not recovered. For whole rock compositions of peridotite, Mg# and Ni content are relatively limited and high, such as ranging from 87.2 to 90.7, and from 1200 to 3000 ppm, respectively.

We report preliminary mineralogical data of the peridotites as well as the result and summary in igneous petrology of IODP EXPs. 304 and 305 .

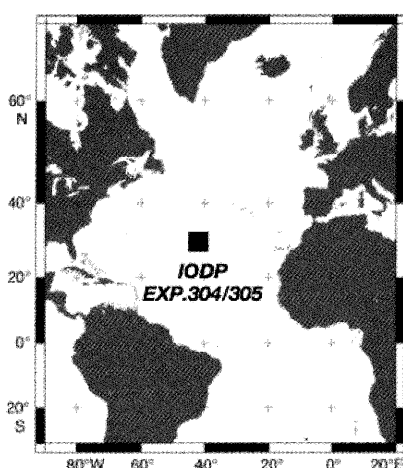


Figure 1. Location of Atlantis massif.

### Hole U1309D

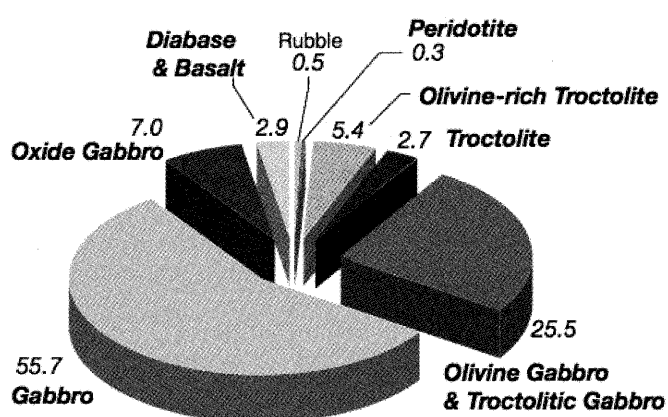


Figure 2. Proportions of lithology for Hole U1309D. Each number refers to the lithologic proportions in percent (modified from IODP Exp.304 and 305 Prelim. Rep., 2005).

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