P-wave velocity reduction toward to the Moho in the oceanic lower crust? : Implications from lithological variation of gabbroic core samples

*Natsue Abe[1]

1. R&D Center for Ocean Drilling Science Japan Agency for Marine-Earth Science and Technology

Variety of gabbroic samples were taken from the Atlantic Ocean (ODP Legs 153 & 209, IODP Exps. 304&305), the Indian Ocean (the Atlantis Bank: ODP Legs 118 & 176) and the Pacific Ocean (Hess Deep: IODP Exp. 345). Those gabbroic core samples were originated from the upper part and lower part of the oceanic crust.
IODP Exp. 360 Phase I of the "Nature of the Lower Crust and Moho at Slower-Spreading Ridges" (SloMo) project, a Multi-Leg Drilling Project, drilled into the lower crustal gabbroic rocks at Atlantis Bank, and penetrated from the ocean floor to 789.7 mbsf. The cored interval is 742.7m and total recovered core length 469.65 m (63.2% recovery). Olivine gabbro is the dominant lithology of the core samples, followed by gabbro, oxide gabbro, and oxide-bearing gabbro. Lithological variation is small in the core samples. In order to understand the petrophysics of the site, we measured physical properties on whole rounds, section halves, and discrete samples. We also achieved three runs of wire-line logging (Triple-combo, sonic/FMS, and UBI). The data suggests that those gabbroic samples show high Vp values (6.0 ~ 7.5km/s) degardless the lithology.
On the other hand, Hole U1309D at the Atlantis Massif at 30 degree N, Mid-Atlantic Ridge was penetrated 1415 mbsf during IODP Exp. 304 and 305 (Blackman et al., 2006). Variable types of gabbroic cores were sampled with high recovery (74.8%). They are mainly gabbro (Cpx + Pl), olivine gabbro, gabbronorite, oxide gabbro, troctolite, olivine-rich troctolite, felsic veins and diabase. The most samples include olivine even gabbro in a narrow sense. The modal composition of olivine varies from less than 5 vol% in gabbro, gabbronorite and oxide gabbro to 85 vol% in the olivine-rich troctolite. On-board measurement of the compression wave velocity of those samples from Hole U1309D shows a slightly slower range (5.0 ~6.7 km/s) than that (6.0 ~ 7.0km/s) of the typical gabbroic rocks.
The total alteration intensity of the samples has a negative correlation with the P wave velocity, and a positive correlation with the porosity in general. Except for the olivine-rich troctolite, the olivine mode of the samples, however, more affects to the porosity and P wave velocity as same as the serpentinization of peridotite samples. This is because that olivine is easier to be altered (serpentinized) compared to other phases in gabbroic rocks. The connectivity of the olivine grains in the samples also influence to reduce the velocity. The result of our study implys the possibility of the reversal velocity structure in the oceanic lower crust if it is olivine-rich and is sufficiently serpentinized, although the pressure effects should be considered.

Keywords: P-wave velocity, Gabbro, Lower crust, IODP, Moho, olivine

