Experimental study on eclogite formation from basaltic oceanic crust

Naoko Doi[1]; Takumi Kato[1]; Tomoaki Kubo[1]

[1] Kyushu Univ.

Physical properties of the subducting oceanic plate are largely influenced by the gabbro-eclogite transformation of the basaltic oceanic crust. High pressure experiments on stability and transformation behavior in basaltic system are crucial to understand the subduction zone structure, together with seismic observation and geodynamic modelling.

We have investigated the mechanism of the gabbro-eclogite transformation in representative mid-oceanic-ridge basalt composition under anhydrous condition. Gabbroic crystalline starting material, consisting mainly of clinopyroxene and plagioclase with about 5um grain size, was prepared at 1.0 GPa and 965^{o}C for 10 hours heating. It was encapsuled with powdered glass with the same compostion and was subjected to 2.0-5.0 GPa and 1010-1270^{o}C for -9 hours duration, by a multi-anvil apparatus, MAX90 at Kyushu University. The recovered samples were analyzed with SEM-EDS and Micro-Raman spectroscopy.

Above the pressure of plagioclase break down (-2 GPa), eclogitic assemblage (clinopyroxene+garnet) is formed from the glass. However, any garnet was not found from the crystalline samples, in which clinopyroxene composition is more aluminous. As reaction proceeds with increasing pressures and temperatures, the proportion of clinopyroxene increases and its composition becomes more jaditic. At 5.0 GPa and 1270^{o}C, clinopyroxene has almost the same composition with the bulk basalt and appeared as a single phase. The reults using the crystalline starting material suggest metastable growth of clinopyroxene before garnet nucleation at the initial stage of the gabbro-eclogite transformation, as the remained clinopyroxene could easily obtain the components from unstabilized plagioclase by chemical diffusion in the fine grained system. Partial melting also seems to enhance this process and not to help the quick achievement of equilibrium.

In order to test the above hypothesis and how this process may work out in the actual basaltic oceanic crust, we needs more detailed analyses on the grain-scale dependent mechanism of the gabbro-eclogite transformation.