Partitioning of H_2O in the mantle transition zone and lower mantle

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Water is the most abundant volatile component on the Earth's surface, and it has been supplied to the Earth's interiors by subducted slab. Water influences the physical properties and melting temperature of minerals. Olivine and garnet are the abundant minerals in the mantle, and it is clarified that the high-pressure polymorphs of olivine, wadsleyite (Wd) and ringwoodite (Rw), can contain ~3wt% H_2O (e.g. Inoue et al., 1995; Kohlstedt et al, 1996). The partitioning of H_2O among those mantle minerals should be important, however there are few data except for the result in the system MgO-SiO_2-H_2O (Bolfan-Casanova et al., 2000). We have determined the partitioning of H_2O between Wd, Rw, perovskite (Pv) and majorite garnet (Mj) to clarify the distribution of H_2O in the mantle using the model mantle composition.

High-pressure experiments were conducted by MA-8 type (Kawai-type) high-pressure apparatus in Ehime University. We used pyrolite composition which was approximated with respect to five major components, CaO, MgO, FeO, Al_2O_3 and SiO_2. Two starting H_2O contents, 2.9 and 8.3 wt% were selected. The experimental P-T conditions were 18-23 GPa and 1200-1700 degree C. The recovered samples were polished and then the chemical compositions were determined by EPMA in Ehime University and the water contents of minerals were measured by SIMS in Hokkaido University.

We succeeded to synthesize large (~30-50 micron) coexisting crystals of Wd, Rw, Pv and Mj to determine the H_2O partitioning between those phases. The H_2O content of Wd and Rw decreased with increasing temperature, which is consistent with Ohtani et al. (2000). However the H_2O content of Mj did not change so much with increasing temperature. As the results, the partition coefficients between Wd and Mj, and between Rw and Mj decreased with increasing temperature. Further details will be presented.