Partitioning of H2O on postspinel phase transformation of olivine

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H2O is one of most abundant volatile components in the Earth, and it has been supplied to the Earth's interiors by subducted slab. Water influences the physical properties and melting behavior of minerals. It has been clarified that the high-pressure polymorph of olivine, wadsleyite and ringwoodite, can contain ~3 wt% of H2O, and perovskite can contain ~0.2 wt% of H2O in their crystal structures. However, the partitioning of H2O among those minerals has not been clarified yet. In this study, we determined the partition coefficient of H2O between ringwoodite and perovskite to clarify the distribution of water between the mantle transition zone and lower mantle.

Starting materials have the compositions of (Mg0.8Fe0.2)2SiO4 and (Mg0.8Fe0.2)2SiO4 + H2O (15.8wt%), and were mixed using regent powder of MgO, Mg(OH)2, SiO2 and Fe2SiO4 in the appropriate proportion. High pressure experiments were conducted at pressures of 23.0 ~ 23.1GPa and temperature of 1873K by an MA-8 type (Kawai-type) high pressure apparatus in Ehime University. The recovered samples were examined by micro-Raman spectroscopy and EPMA for identification and the chemical composition of phases. The H2O contents of phases were measured by SIMS at Tokyo Institute of Technology.

We could succeed to synthesize the large (~30-100 micron in diameter) coexisting crystals of ringwoodite and perovskite. The measured partition coefficient between ringwoodite and perovskite is ~10 or more. Thus, mantle transition zone between 520 and 660 km is a potential water reservoir compared to the lower mantle.