Partitioning of H2O on high pressure phase transformation of olivine

Toru Inoue[1], Tomoyuki Wada[2], Rumi Sasaki[2], Tetsuo Irifune[2], Hisayoshi Yurimoto[3]

[1] GRC, Ehime Univ.,, [2] Dept. Earth Sci., Ehime Univ., [3] Earth & Planet. Sci., TiTech

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 is the most abundant mineral in the mantle, and it is clarified that the high-pressure polymorphs of olivine, wadsleyite and ringwoodite, can contain ~3wt% of H2O in their crystal structures. However, the partitioning of H2O among these minerals have not been clarified yet except for olivine-wadsleyite transformation (Chen et al., 2003). We have determined the partitioning of H2O between wadsleyite and ringwoodite and between ringwoodite and perovskite, and clarified the distribution of H2O among upper mantle, mantle transition zone and lower mantle.

High-pressure experiments were conducted by MA-8 type (Kawai-type) high-pressure apparatus in Ehime University, and the chemical compositions were determined by EPMA. The water contents of minerals were measured by SIMS in Tokyo Institute of Technology.

We succeeded to synthesize large (~50 micron) coexisting crystals of wadsleyite and ringwoodite, and of ringwoodite and perovskite, and we could clarify the partitioning of H2O between those coexisting minerals. The partition coefficients between wadsleyite and ringwoodite and between ringwoodite and perovskite were about 2 and about 10 or more, respectively. We (Chen et al., 2003) have already determined that the partition coefficients between wadsleyite and olivine is about 5, so the partitioning among upper mantle, 410-520km and 520-660km of mantle transition zone, and lower mantle are 4:20:10:1. Thus the mantle transition zone should be a strong water reservoir in the Earth's interiors.