Water solubility of Al-bearing bridgmanite at the lower mantle condition

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Introduction

Water is the most important volatile component on the Earth, because it has influences on the chemical and physical properties of mantle minerals (e.g. melting temperature, electrical conductivity). The nominally anhydrous minerals can contain a small amount of water. Wadsleyite and ringwoodite existing in the mantle transition zone can contain ~2-3 wt% water [1, 2]. On the other hand, the water solubility of the most abundant mineral in the lower mantle, bridgmanite is a matter of debate. Inoue et al. (in prep) reported that Al-bearing bridgmanite can contain ~0.8 wt% water with 4.7 wt% Al_2O_3. The substitution mechanism was suggested to $Si^{4+} \rightleftarrows Al^{3+} + H^+$.

In this presentation, we will report the pressure and temperature dependence of water solubility in Al-bearing bridgmanite.

Experimental Method

We conducted high pressure and temperature experiments using 2000 ton mult-anvil apparatus installed at the GRC, Ehime Univ. The oxide and hydroxide mixture with clinochlore composition was used as a starting material. The experiments were conducted at 24-32 GPa, 1400-2000 degree C. The chemical composition of the recovered samples was measured by FE-SEM-EDS.

Result

Bridgmanite coexisted with some hydrous phases. The water content was estimated by assumption that the following reactions occur ($Mg^{2+} + Si^{4+} \rightleftarrows 2Al^{3+}$, $Si^{4+} \rightleftarrows Al^{3+} + H^+$). In addition, the water contents were directly measured by SIMS at Hokkaido Univ. in some run products.

The water solubility in bridgmanite increased with increasing pressure up to 32 GPa.

The unit cell volume of Al-bearing hydrous bridgmanite was increased compared to the Al-bearing dry bridgmanite. So, hydrogen should be contained in the crystal structure.

[1] Inoue *et al*. (1995) *PEPI* **22**, 117-120. [2] Kohlstedt *et al*. (1996) *Contrib. Mineral. Petrol* **207**, 345-357.