The 430th Geodynamics Seminar

Equation of state of Al-bearing hydrous bridgmanite

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Abstract

Water is the most abundant volatile element in the Earth. The presence of water affects some physical properties (e.g. melting temperature, bulk modulus, and so on.). Experimental studies on water solubility in the mantle minerals suggest that the upper mantle is dry and the transition zone should be an important water reservoir, because wadsleyite and ringwoodite can contain ~2-3 wt% water in the structure. Actually hydrous ringwoodite (~1.5 wt% water) was discovered as the diamond inclusion recently (Pearson et al., 2014). On the other hand, water solubility in the bridgmanite is a matter of debate. Recently, our group succeeded to synthesize Al-bearing hydrous bridgmanite containing ~0.8 wt% H_2O by mainly coupling substitution: $Si^{4+} \rightleftarrows Al^{3+} + H^{+}$. Hydrogen position in Al-bearing hydrous bridgmanite was determined by single crystal X-ray and powder neutron diffraction analyses (Kuribayashi et al., in prep; Inoue et al., in prep). But the elastic behavior of Al-bearing hydrous bridgmanite at high pressure and temperature is unknown. So, we tried to determine equation of state of Al-bearing hydrous bridgmanite.

In situ X-ray high-pressure experiments were conducted at SPring-8, BL04B1 using multi anvil apparatus. Al-bearing hydrous and anhydrous bridgmanites were used as starting materials. Sintered diamond was used as 2nd stage anvil for generating high pressure up to 53 GPa. The X-ray diffraction was collected after annealing at 900 or 1500 K.

The unit cell volume of Al-bearing anhydrous bridgmanite is larger than Mg-endmember bridgmanite (Tange et al., 2012). This is consistent with the previous studies (e.g., Walter et al., 2004). On the other hand, the unit cell volume of Al-bearing hydrous bridgmanite abnormally decreased between ~25-40 GPa. This phenomenon may be caused by symmetrization of the hydrogen bond.

In this talk, the physical property (unit cell volume, density, bulk modulus and bulk sound velocity) and crystal chemistry of Al-bearing hydrous bridgmanite will be discussed in detail.

詳細は当センターホームページ：http://www.grc.ehime-u.ac.jp/ をご覧ください
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