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ブリッジマナイトのその場応力-歪同時測定のための予備的変形実験
Preliminary deformation experiments for in-situ stress-strain measurements of bridgmanite

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In order to discuss mantle dynamics in the Earth's interior, knowledge of viscosity of the Earth's lower mantle, which is the highest of the whole mantle, is important. Viscosity models of the Earth's lower mantle were reported by geophysical observations. However, observation values of viscosity have large variety (2˜3 order magnitude). Although determination of viscosity of lower mantle minerals by high pressure experiments is needed to understand mantle dynamics, stress-strain relationship for bridgmanite, which are principal minerals of the Earth's lower mantle, are not reported due to difficulty of high pressure deformation experiments. In this study, we tried in-situ stress-strain measurements of Mg-Pv at 27 GPa.

In-situ uniaxial deformation experiments were conducted using MADONNA, which is D-DIA apparatus, as Kawai-type apparatus at SPring-8 BL04B1. Experimental conditions are 27.3 GPa, 1473 K estimated by equation of state on bridgmanite (Katsura et al., 2009). WC anvils with slit or corn (5^o) to take tomography and 2D X-ray diffraction, was used along X-ray path. Two-dimensional X?ray diffraction patterns were taken for 300 s using CCD detector. To calculate the stress magnitude from the X?ray diffraction data, we used a model of stress-lattice strain relationship (Singh et al. 1998),

$d_{hkl}(\psi)= d_{0hkl}$ [1+(1-3cos2ψ) σ/6 G_{hkl}] (1)

where d_{hkl} is the d-spacing measured as a function of azimuth angle ψ, d_{0hkl} is the d-spacing under the hydrostatic pressure, G_{hkl} is the appropriate shear modulus for a given hkl, and σ is the uniaxial stress. Pressure and stress were estimated using bridgmanite (111) diffraction peak at deformation experiments. X?ray radiographies of the strain markers was taken using an imaging system composed of a YAG crystal and a CCD camera with an exposure time of 10 s.

Uniaxial tension stress and strain of Mg-Pv at 27.3 GPa, 1473 K were estimated as ˜1.3 GPa and ˜4 % during doformation by differential ram. We confirmed deformation experiments at the lower mantle pressure conditions can be conducted by WC anvils. We will perform additional deformation experiments with large strain.

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