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三軸変形川井型装置(KATD)を用いた下部マントル条件下での予備的実験

Preliminary experiments at the lower mantle condition using Kawai-type apparatus for triaxial deformation (KAT-D)

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Knowledge of rheological property of mantle constituent minerals is important for understanding of material behavior in the Earth's deep interior. The Earth's lower mantle consists of ~77 vol% Mg-rich perovskite, ~16 vol% ferropericlase and ~8 vol% Ca-rich perovskite in pyrolite mantle (e. g. Irifune et al., 1994). In spite of its small proportion (~16 vol%), there is a chance that ferropericlase dominates the lower mantle rheology because ferropericlase is significantly softer than Mg-perovskite (e.g. Yamazaki and Karato, 2001). The deformation induced microstructure is one of the most important factors which control viscosity of the rheologically heterogeneous aggregate. However, no experimental study has been conducted on the deformation microstructure of the lower mantle material due to difficulty in deformation experiments at high-pressure and high-temperature.
The Kawai-type apparatus for triaxial deformation (KATD) installed at Magma Factory, Tokyo Institute of Technology is a modification of cubic-type Kawai-type multi-anvil apparatus with top and bottom differential rams. Since achievable maximum pressure using Kawai-type apparatus (with WC anvils) is ~30 GPa, deformation experiments up to ~30 GPa is expected to be possible using KATD. In this study, we have successfully generated the lower mantle conditions using KATD apparatus and WC second stage anvils with truncation edge length of 2 mm. Generated pressure is calibrated at 1873 K using phase transition in Mg_2SiO_4(ringwoodite - Mg-perovskite + periclase). In our previous study (Nishihara, 2008), we have reported a deformation experiment of ferropericlase at 15 GPa and 1473 K up to shear strain of 1.8 using KATD. Thus the KATD is promising technique for the deformation experiments at the lower mantle condition.

キーワード:下部マントル,レオロジー,フェロペリクレース, Mg-ペロブスカイト

Keywords: lower mantle, rheology, ferropericlase, Mg-perovskite