【Science and engineering（Mathematical and physical science）】

Rheology of the high-pressure mantle minerals using giant single crystals and technology of high-pressure generation in large volumes

Tomoo KATSURA
(Okayama University, Institute for Study of the Earth's Interior, professor)

【Outline of survey】

Although the Earth's mantle mainly consists of solid minerals, it dynamically flows in geological time scales. The flow of the mantle materials, so called mantle convection, causes various kinds of geophysical phenomena observed on the surface. Therefore, quantitative understanding of mantle convection is one of the most important issues in solid-Earth geophysics. At present, however, we are not able to understand mantle convection quatitatively. One of the reasons is that we do not have sufficient knowledge on rheology of high-pressure mantle minerals because the sufficiently large size of single crystals of high-pressure mantle minerals were available. Fortunately, it is now possible to synthesize single crystals of high-pressure mantle minerals sufficiently large for rheological study. By using such giant single crystals and technology of pressure generation in large volumes, we will conduct the following experiments for high-pressure mantle minerals such as wadsleyite, ringwoodite majorite perovskite, and stishovite.

1) Measurement of silicon self-diffusion coefficient as a function of P and T.
2) Observation of dislocation creep mechanism as a function of P, T and $\dot{\varepsilon}$.
3) Measurement of mobility of dislocation as a function of P and T.
4)Determination of equilibrium grain size as function of P, T and $\dot{\varepsilon}$ by dynamic recrystallization experiment.

【Expected results】

Dislocation and diffusion creeps are two major mechanisms for deformation of minerals. The diffusion creep rate can be estimated from silicon self-diffusion coefficient and grain size. The P-T dependence of dislocation creep rate can be estimated from dislocation mobility and silicon self-diffusion coefficient. Such information will make it possible to quantitatively understand dynamics of the mantle. For example, we can examine the hypothesis that the stagnation of subducted slab above the 660-km discontinuity is because of the viscosity contrast between the upper and lower mantles.

【References by the principal investigator】

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- Yamazaki, D., Kato, T., Yurimoto, H., Ohtani, E., Toriumi, M., Silicon self-diffusion in $MgSiO_3$ perovskite at 25 GPa, *Physics of the Earth and Planetary Interiors* **119**, 299-309, 2000.

【Term of project】 FY2008－2012	**【Budget allocation】** **175,100,000 yen** (direct cost)

【Homepage address】 http://www.misasa.okayama-u.ac.jp/~hacto/