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遷移層から下部マントルに至る圧力での高圧鉱物の熱伝導測定
Measurement of thermal conduction of high-pressure minerals at pressures of the transition zone and to the lower mantle

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Knowledge of thermal diffusivity or thermal conductivity of the mantle is vital for study of the dynamics of the Earth. So far thermal diffusivity and thermal conductivity of mantle minerals were measured under high pressure using a pulse-heating method of one-dimensional heat flow. This method is a predominant one for study in deep Earth's materials under pressure because it requires comparatively small amount of samples. It is also applicable to materials with anisotropy in thermal conduction. In addition its measurement yields heat capacity data under pressure.

Thermal conductivity or thermal diffusivity of olivine and garnet increases 3-4 % per 1 GPa, and olivine still reveals anisotropy in thermal conduction under the conditions of the upper mantle. Antigorite, a high-temperature form of serpentine, has low thermal diffusivity and low thermal conductivity which are much lower than those of olivine, whereas talc has high thermal diffusivity and thermal conductivity comparable to those of olivine. All those data were obtained from the measurements at pressures up to 10 GPa and temperatures to 1100 K. An advanced cell assembly was needed to expand the pressure range of measurement.

A new pressure-cell assembly similar to our previous one is designed for a sample of 3 mm in diameter and 0.7 mm in thickness. This smaller cell was applied to pyroxene samples of which sizes were necessarily limited. The measurements were conducted using the Kawai-type apparatus at the Institute for study of the Earth's interior, Misasa. This cell enabled to make measurements of thermal properties at pressures exceeding 15 GPa, which will covers the condition in the mantle transition zone.

We made preliminary measurements by this cell for the garnet sample as a test material. The thermal diffusivity showed slightly lower value (5~10 %) and the thermal conductivity was slightly high (0~10 %) value compared with the previous results by the large cell. The precision of measurements should be improved by well-controlled machining of the cell assembly and by refining the data acquisition system. After that this cell will be used for measurements of wadsleyite, ringwoodite and majorite. A cell assembly of more reduced in size is planned. This cell will be used for measurements of MgSiO3 perovskite.

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