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遷移層から下部マントルに至る圧力でのマントル鉱物の熱伝導測定
Measurement of thermal conductiviy of mantle minarals at pressures of the transition zone 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 we have measured thermal diffusivity and thermal conductivity of upper mantle minerals, i.e. olivine and garnet and hydrous phases, i.e. serpentine and talc. All those data were obtained by the experiments at pressures up to 10 GPa and temperatures to 1100 K. The measurements were conducted by a pulse-heating method of one-dimensional heat flow using the Kawai-type apparatus at the Institute for study of the Earth's interior, Misasa. This current method is a predominant one for study in deep Earth's materials under pressure. It has some advantages as follows:(1) comparatively small amount of samples (2) applicable to materials with anisotropy in thermal conduction (3) simple cell assembly. Moreover, this method enables to obtain specific heat capacity under pressure.

In order to expand pressure range the cell assembly is needed to advance by reducing its dimensions. A new cell-assembly similar to our previous one is designed for a sample of 2.6 mm in diameter and 0.6 mm in thickness. This smaller cell is installed in a 14 mm edged octahedral pressure medium in 7 mm trancated anvils. This cell enables to make measurements of the thermal properties at pressures exceeding 15 GPa, which will covers the condition in the mantle transition zone. The cell will be also applied to pyroxene samples of which sizes are necessarily limited. Test measurements were made using garnet samples. The results agree well with those of the previous experiments using the larger (18-11 and 14-8) cell, and the extrapolations to zero-pressure coincide to values of other methods. Thus, the pulse heating method will be applied for thermal property measurements of wadsleyite, ringwoodite and majorite. Using large anvils ($>$46 mm), the method is probable to measure the thermal conductivity of $MgSiO_3$ perovskite (bridgmanite). However, measurements at high temperature still have somewhat problems in precision. Materials of impulse heater and external furnace should be re-considered. The precision of measurements should be improved by well-controlled machining of the cell assembly and by refining the data acquisition system.

キーワード: マントル鉱物, 熱拡散率, 熱伝導率, 高圧力, 川井型装置
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