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Experimental investigation of the thermal transport properties of omphacite under high pressure and high temperature

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Temperature is a key parameter controlling physical and chemical properties of earth. Knowledge of thermal transport properties (diffusivity, conductivity, and heat capacity) of mantle mineral is indispensable because of its important implications for mantle convection, subduction dynamics and the origin of deep earthquakes (e.g. Mosenfelder et al., 2001; van Keken, 2004; Marton et al., 2005). Pyroxene is an important mineral not only in the upper mantle but also the deep subduction zone (eclogite). Its thermal transport properties at mantle pressure and temperature conditions will provide key insights into these dynamic processes. However, we currently know little of such information.

Eclogite is the major rock in deep subduction zone and lowermost crust of thickened continental (e.g., Ringwood, 1982; Gubbins and Snieder, 1991; Peacock, 1996; Anderson, 2005). The thermal property of eclogite is key information to constrain thermal structure of continental crust and mantle convection. Dobson et al. (2010) measured the thermal diffusivity of eclogite at 3.5 GPa with changing temperature. Considering the stability fileld of eclogite (up to about 15 GPa), it is not sufficient to discuss eclogite properties regarding with subduction process. Thermal property of garnet, which is one of tow major component of eclogite, has already been measured by Osaka (2004). Therefore, we intend to study the thermal property of omphacite, which is also major component of eclogite, at pressures up to 15 GPa, above which pyroxene will dissolved into garnet to form majorite.

We have measured thermal properties of omphacite at pressures to 14 GPa, applying a pulse heating method for simultaneous thermal conductivity and thermal diffusivity measurement. The measurements were conducted using 14/8 cell assembly on a Kawai-type high-pressure apparatus at the ISEI, Misasa. The result shows that omphacite has lower (around 10 %) thermal conductivity than jadeite, and its pressure derivative is 5.1 % per 1GPa, which is higher than than that of jadeite (2.5%, Osako, unpublished data) and olivine (4.5%, Osako et al., 2004).

Keywords: Thermal tansfer, High pressure and high temperature, Omphacite