Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SCG004-07 Room: 302 Time: May 25 10:45-11:00

Low thermal conductivity of antigorite and a possible thermal insulating layer on the slab

Masahiro Osako[1*], Akira Yoneda[2], Mitsuhide Yonehara[2], Eiji Ito[2]

[1]National museum of nature and science, [2]Inst Study Earth Inter, Okayama Univ

Antigorite has been though to be distributed extensively in the mantle wedge, where dehydrated water from the slab can infiltrate into peridotite layer to produce serpentinite. The physical properties of antigorite have been widely studied in recent years, because it is a key material for understanding slab subduction, and for relating seismic and volcanic processes. Since the hydration and dehydration of the subducting zone is controlled with the temperature of the slab, the thermal conductivity of antigorite is an important factor in the temperature distribution and the dehydration sequence in the slab. We measured thermal diffusivity and thermal conductivity of antigorite up to 8.5 GPa and 800 K in the Kawai-type high-pressure apparatus at the Institute for Study of the Earth's Interior, Misasa. Antigorite has low thermal diffusivity of 0.95 x $10^{-6} m^2 s^{-1}$ and low thermal conductivity of 2.8 $Wm^{-1}K^{-1}$ at 5 GPa and 300 K. Moreover, the pressure derivatives of thermal diffusivity and thermal conductivity are significantly small. From the simultaneous measurement of both thermal conductivity and thermal diffusivity, the heat capacity of antigorite is determined to be ca. $1x10^6 Jkg^{-1}K^{-1}$, and increases to ca. $1.5x10^6 Jkg^{-1}K^{-1}$ at 800 K under high pressure. Antigorite has much lower thermal conductivity and thermal diffusivity (less than half) of the major dry mantle minerals such as olivine. Through a simple evaluation, the thermal conductivity difference between olivine and antigorite (ca. 3 $Wm^{-1}K^{-1}$) can yield a temperature gradient difference of ca. 20 K/km under the assumption of typical earth's heat flow. A seismological anisotropy study suggested ca. 20 km thickness of serpentines layer for the Ryukyu subduction zone. Thus maximum ca. 400 K temperature difference could be estimated for the thin layer if the constituting material is hydrated from peridotite to serpentinite. In the warm subduction zone, the serpentinite layer may act as an efficient thermal insulator for the subducting slab beneath it. Therefore, the temperature increase of the slab is likely to be efficiently suppressed by the existence of the thermal insulating layer of serpentine. Then the temperature in the layer is expected to be kept lower than the surrounding, and the unstable antigorite can intrude into the deeper part crossing the dehydration boundary owing to low kinetic due to low temperature. We measured thermal conductivity of talc as well, and obtained relatively higher thermal conductivity for talc compared with antigorite. It is well know that antigorite and talc are quite similar hydrous sheet minerals. Although talc has lower acoustic velocity than antigorite, thermal conductivity of talc is twice or three times larger than that of antigorite. Unlike antigorite, talc could not act as thermal insulator in or around subducting slabs.

Keywords: antigorite, thermal diffusivity, thermal conductivity, high-pressure, subduction zone