Lattice thermal conductivity of wadsleyite and ringwoodite at the mantle transition zone pressures

SEIJI KIMURA[1], KENJI OHTA[1], TAKAAKI KAWAZOE[2], KEI HIROSE[3], HIROYUKI KAGI[4], TAKASHI YAGI[5]

[1]Department of Earth and Planetary Sciences Tokyo Institute of Technology
[2]Department of Earth and Planetary Systems Science, Hiroshima University
[3]Earth-Life Science Institute, Tokyo Institute of Technology
[4]Geochemical Research Center, Graduate School of Science, University of Tokyo
[5]National Institute of Advanced Industrial Science and Technology

The lattice thermal conductivities of wadsleyite (Wd) and ringwoodite (Rw), which predominantly occupy the Earth's mantle transition zone, are important transport properties to understand the dynamics and thermal structure of the mantle. In particular, the temperature in the subducting slab is mainly controlled by the thermal conduction of Wd and Rw. Wd and Rw are both thought to preserve a large amount of hydrogen ions, thus should play an important role as the main water reservoir in the Earth. Furthermore, it has been reported that the hydration affects the physical properties of minerals including thermal conductivity, so it is necessary to measure the lattice thermal conductivity of Wd and Rw considering their water content. However, so far, the reported lattice thermal conductivities of Wd and Rw has not been considered their water content [1].

Here we measured the room temperature lattice thermal conductivity of $(Mg_{0.89}Fe_{0.11})_2SiO_4$ Wd and $(Mg_{0.91}Fe_{0.09})_2SiO_4$ Rw up to 22 GPa and 27 GPa, respectively, to clarify their hydration dependence using the pulsed light heating thermoreflectance technique in a diamond anvil cell. The obtained results show similar pressure dependence of the lattice thermal conductivity to the previous study [1]. However, the absolute values of the thermal conductivity are different; the lattice conductivities of hydrous Wd and Rd are ~52% and ~40% lower than the results of Xu et al. (2004), respectively. Our results suggest strong water content dependence of lattice thermal conductivities of Wd and Rw, implying that the water content in the mantle minerals is key factor for calculating the thermal structure in a subducting slab, mantle dynamics.

[1] Xu et al., (2004), *Physics of the Earth and Planetary Interiors*. 143, 321–336.