Lattice thermal conductivity of (Mg,Fe)O magnesiowustite

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The Earth has been cooling since it was born about 4.6 billion years ago. To decipher the thermal history of the Earth, thermophysical properties of the lower mantle materials that constitute more than half the volume of the Earth is of great importance. A number of research has suggested the possibility that (Mg,Fe)O ferropericlase, one of the main constituent minerals of the lower mantle, exists with very iron-rich chemical composition at the Earth’ s core-mantle boundary (CMB). Such iron-rich (Mg,Fe)O magnesiowustite at the CMB may cause regional variation of thermal conductivity of the lowermost mantle due to its distinct iron concentration, which potentially influences the mantle convection style, inner core age, inner core structure, geomagnetic field reversal frequency and so on [e.g. Olson, 2016]. However, there is no systematic study to examine the effect of iron on the thermal conductivity of (Mg,Fe)O solid solution under high pressure. In this study, we measured lattice thermal conductivity of (Mg,Fe)O magnesiowustite with various iron contents at high pressures, and evaluated its compositional dependence. Our results show much lower lattice conductivity of iron- rich magnesiowustite than that of MgO and FeO due to strong iron impurity phonon scattering, which would help to estimate the thermal conductivity of the expected iron- rich region in the lowermost mantle.

Reference: Olson, P. Mantle control of the geodynamo: Consequences of top-down regulation, *Geochem. Geophys. Geosys.* 17, 1935–1956, (2016).

Keywords: thermal conductivity, lower mantle, ferropericlase, magnesiowustite

