Electrical conductivity measurement of ilmenite and perovskite under lower mantle conditions.

Sho Yokoshi[1]; Tomoo Katsura[2]; Eiji Ito[3]

[1] Dept of Earth Sci, Okayama Univ; [2] ISEI, Okayama Univ.; [3] ISEI

Geophysical observations such as the MT method suggest that the electrical conductivity increases from 1 to 10 S/m from the top to the bottom of the lower mantle.

Measurement of electrical conductivity of silicate perovskite under lower mantle conditions is indispensable in order to explain the geophysical observations, because the lower mantle is believed to be mainly composed of silicate perovskite.

Electrical conductivity measurements at high pressures and temperatures have been conducted by using diamond anvil cells (DAC) and multi-anvil apparatus (MAA). However, the reliability of electrical conductivity measured with DAC is low because it is difficult to generate a steady and uniform pressure - temperature conditions in DAC.

Xu et al. (1998) measured electrical conductivity of silicate perovskite at 25GPa and 1400-1600C by using MAA. Because of use of WC anvils, their pressure condition is limited to 25GPa, and therefore, pressure dependence of electrical conductivity of silicate perovskite was not determined by their measurement.

In This study, we use MAA with sintered diamond (SD) anvils, so that we could measure the electrical conductivity of silicate minerals at much higher pressure conditions, enabling us to determined the pressure dependence of electrical conductivity of silicate minerals

We firstly measured electrical conductivity of (Mg0.93Fe0.07) SiO3 ilmenite at pressures of 25, 35 and40GPa and temperatures of 300 to 1200 K. We have obtained activation energy and volume of 0.69+-0.04 eV and -0.91+- 0.10 cm3/mol, respectively. And it became clear that electrical conductivity of ilmenite had big pressure dependence. Thus, the pressure dependence of electrical conductivity of ilmenite is very large.

Next, we have conducted measurement for (Mg0.93Fe0.07) SiO3 perovskite at pressures of 35 and 40 GPa and temperature of 300 to 1400 K showing activation energy and volume of 0.39+-0.04 eV, and -0.06+- 0.04 cm3/mol, respectively. In contrast with ilmenite, electrical conductivity of perovskite is has very small pressure dependence.

These results render it possible to calculate the electrical conductivity of the model lower mantle suggesting that it increases from 2.7 to 4.75 S/m from the top to the bottom of the model lower mantle. The increasing rate is much smaller than that indicated by the geophysical observation