Electrical conductivity of diaspore, δ-AlOOH and ε-FeOOH

*Ran Wang[1]

1. Institute for Planetary Materials, Okayama University

FeOOH and AlOOH are dominant hydrous phases in sedimentary rocks deposited in the sea or lake basins which were considered to be possibly related to the deep water cycle by slab subduction. Therefore, understanding of the electrical conductivity behaviors of these phases are essential to explore the nature and dynamic process of the Earth's interior. In this study, electrical conductivity of diaspore (α-AlOOH), δ-AlOOH and ε-FeOOH was measured by impedance spectroscopy with a frequency range from 10^{-1} to 10^{6} Hz at pressures up to 15, 20 and 12 GPa and temperatures of 1200, 1200 and 1000 K well below the dehydration temperatures of these phases under the relevant pressures. For diaspore at 8, 10, and 12 GPa, the relationship between electrical conductivity and reciprocal temperature could be well fitted by the Arrhenius formula: $\sigma = \sigma_0 \exp[-(\Delta E+P\Delta V)/kT]$ and shows the pre-exponential factor (σ_0), activation energy (ΔE) and activation volume (ΔV) of 55.94 ±1.16 S/m, 0.547 ±0.016 eV and 1.683 ±0.123 cm^3/mol, respectively. However, data of diaspore obtained below 6 GPa could not be fitted by the Arrhenius formula, which was thought to be due to the remnant of free water in the sample caused by heating to insufficient temperature to proceed dehydration of interstitial water. Thus, it is quite difficult to measure the electrical conductivity of diaspore at low pressures. The electrical conductivity of diaspore increased with pressures ranging from 8 to 12 GPa by half order of magnitude and then the conductivity change with pressures from 12 to 15 GPa became negligibly small. The dominant conduction mechanism of diaspore is regarded as proton conduction. δ-AlOOH and ε-FeOOH show one and two orders of magnitude higher electrical conductivity than diaspore. Due to isostructural $CaCl_2$-type hydroxide structure, δ-AlOOH and ε-FeOOH display the nearly identical activation enthalpy (0.384 ±0.007 eV, 0.330 ±0.048 eV) which is relatively lower than that of diaspore.

Keywords: Electrical conductivity, Diaspore, δ-AlOOH, ε-FeOOH

©2019. Japan Geoscience Union. All Right Reserved.