Electrical conductivity of serpentinites

Tohru Watanabe[1]; Hisanori Oguri[2]

[1] Dept. Earth Sciences, Toyama Univ.; [2] Grad. School. Sci. Eng., Toyama Univ.

Serpentinites play important roles in circulation of water in subduction zones. Mapping their distributions is essential to good understanding of subduction zone processes: earthquakes, volcanism, etc. The electrical conductivity is one of observable physical properties, which provides us information on materials in the Earth's interior.

Stesky and Brace (1973) reported that some serpentinites have high conductivity of 1e-2 S/m even at the room temperature, and that other serpentinites have low conductivity of 1e-5 S/m. Microstructural observation suggested that the measured high conductivity was caused by the connection of magnetite grains, which are produced during serpentinization.

We have conducted conductivity measurements on antigorite-bearing serpentinites, which were collected in Hida outer-belt (Toyama, Niigata and Nagano prefectures). Our objectives are (1) to clarify the connectivity of magnetite grains and (2) to clarify the temperature dependence of the conductivity. Measurements were performed under the atmospheric pressure and at the temperature below 550C. The conductivity measurement was also done with a peridotite (Hokkaido, Horoman) as a reference. Most of serpentinite speciments show conductivities similar to the peridotite. Some serpentinite specimens have higher conductivities than the peridotite by 4-6 orders. In terms of the electrical conductivity, serpentinites are very heterogeneous. The conductivity of specimens (2-3 mm) cut from the same rock sample varies by orders. We have investigated the scale dependence of the connectiveness of magnetite grains by measuring the conductance between two points with different distance. Higher conductance was observed only within 10 mm. It suggests that the connectiveness of magnetite grains is limited within 10 mm.

The activation energy of the electrical conductivity is 16 kJ/mol and 46 kJ/mol for the high-conductivity serpentinite group and the low-conductivity group, respectively. The activation energy of the low-conductivity group is similar to that of the peridotite. The high-conductivity serpentinites shows stronger temperature dependence than magnetite single crystal (e.g., Miles et al., 1957). We are now studying the electrical conductivity of magnetite single crystals and synthetic polycrystalline aggregates. We will report these results, and discuss the temperature dependence of the conductivity. The distribution of magnetite grains in serpentinites will be presented in a poster.