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Electrical conductivity of mudstone (before and after dehydration at high *P-T*) and a test of high conductivity layers in the crust

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Abstract

The electrical conductivity of mudstone before and after dehydration was measured using complex impedance spectroscopy in the frequency range of 10^{-1} to 10^{6} Hz, and the experiments were carried out at 0.5–2.5 GPa and 623–973 K. Before and after dehydration, the electrical conductivity of mudstone and temperature followed an Arrhenius relation. The influence of pressure on electrical conductivity was weaker than that of temperature. The conductivity slightly increased with increasing pressure. Dehydration at 760–800 K dramatically enhanced the electrical conductivity of mudstone; the dehydration temperature decreased slightly with increasing pressure. Hydrogen-related lattice defects (e.g., H'_M or $H^\bullet$) are proposed to be the main charge carriers in the mudstone sample before dehydration, whereas H^+ and OH^- are suggested to be the main charge carriers in the dehydration product of mudstone. Finally, the electrical conductivity of the dehydration product of mudstone can be used to interpret high-conductivity layers (HCLs) associated with the Hope and Porters Pass fault zones in Marlborough, New Zealand.

Keywords: Electrical conductivity, mudstone, high pressure, dehydration, conduction mechanism, high-conductivity layer