Change in electrical conductivity in a brine-saturated granite under uni-axial compression

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Geophysical observations have shown that fluids exist pervasively within the crust. Fluids fill intergrain cracks (open grain boundaries) and intra-grain cracks at the upper and middle crust conditions. Since the opening of cracks strongly depends on the stress state, electrical conductivity should be anisotropic under a stress state. We have conducted uni-axial compression tests on brine-saturated granitic rocks and studied the change in electrical conductivity in the directions parallel and perpendicular to the compression.
The loading system is composed of a hand press (Maximum load: 20 kN), a load cell and stainless steel end-pieces. A fine grained (100-500 mm) biotite granite (Aji, Kagawa Pref., Japan) was selected as a rock sample for its small grain size and textural uniformity. A cube sample with the edge length of 25 mm was filled with 0.1 M KCl aqueous solution and loaded up to 20 MPa. Electrical impedance was continuously monitored during a compression test with two-electrode method (Ag-AgCl electrodes).
Electrical conductivity decreased with increasing axial stress in the directions parallel and perpendicular to the compression. Electrical conductivity decreased in both directions with increasing axial stress, and the conductivity change was almost reversible. No significant difference in the magnitude of conductivity change was observed between two directions. The decrease in conductivity must be caused by the closure of cracks, which were perpendicular or subperpendicular to the compression. The fluid path for the electrical conduction in the axial direction must be composed of cracks parallel and perpendicular to the axial stress. Electrical conductivity does not become anisotropic, while elastic wave velocity does.

Keywords: differential stress, electrical conductivity, anisotropy

