Electrical conductivity of NaCl-H_2O fluid at elevated pressure and temperature

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Estimating the volume and distribution of aqueous fluids in the Earth's crust is important for understanding the mechanism of earthquakes. Electrical conductivity of aqueous fluid should be a best property to be investigated in the crust, because the conductivity of aqueous fluid is much higher than that of dry rocks and minerals at ambient conditions. The conductivity of aqueous fluid, however, has not been revealed at elevated pressures (>0.3 GPa) in the crustal conditions; therefore, it was difficult to explain the observed highly conductive zones by the presence of aqueous fluid.

In this study, we conducted molecular dynamics (MD) simulations of NaCl-H_2O fluid [1-3] as shown in figure 1. Our MD simulations cover 673 to 2000 K, 0.2 to 2.0 GPa, and 0.1 to 1.8 mol/kg NaCl concentration. The conductivity higher than 673 K shows a greater degree of pressure and temperature dependences. The conductivity increases with increasing pressure and decreasing temperature. This behavior can be intepreted by the change of density and permittivity of solvent H_2O. The permittivity of H_2O is critical on the number of ion pairs in the fluid.

Calculated conductivity is used for interpreting the highly conductive zones by the presence of NaCl-H_2O fluid in the crust, arc, and subduction zone.

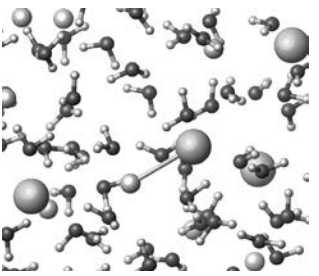

Figure 1: Snapshot of a MD simulation. Na-Cl ion pairs can be recognized in the snapshot.

[1] Sakuma *et al*. (2013) *J. Chem. Phys*. **138**, 134506. [2] Sakuma & Ichiki (2016) *Geofluids* **15**, 89-102. [3] Sakuma & Ichiki (2016) *J Geophys. Res. Solid Earth* **121**, doi: 10.1002/2015JB012219.