Electrical conductivity of crustal rocks and hydrous mineral

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The laboratory measurements of electrical conductivity for rocks and hydrous minerals help us to interpret results from Electro-Magnetic (EM) soundings. We have preformed electrical conductivity measurements on sintered sample, raw rocks and hydrous mineral from well-known geological sites. A granulite, gneiss and amphibolite were obtained from the metamorphic belt in Japan. A single crystal brucite collected from Zimbabwe. These rocks and mineral were selected as being representative of mid- to lower crust. Pressures for conductivity measurement are 0.5 - 1 GPa and which represent that of the mid- to lower crust while the temperature range is up to about 1000 K.

Self potential modeling of infiltration experiments in unsaturated sand

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Streaming currents that are associated with two-phase flow can potentially be used to study vadose zone dynamics, to monitor petroleum production, and they act as a significant error source in self-potential monitoring of volcanological activity when associated with the percolation of rain water. Unfortunately, the generation of streaming currents is poorly understood under two-phase flow conditions in porous materials. We report on controlled infiltration experiments in a tank where 80 self potential electrodes and 18 micro-tensiometers were used during the experiment. The experiment was also modeled with a flow- and transport simulator that allows us to calculate, at any time, the water saturation, hydraulic pressure and the associated self-potential signal under different assumptions about how the self-potential coupling term and the electrical conductivity depends on water saturation. The first objective of these experiments was to investigate whether we could simulate the resulting self potential signals from existing theory, and if not, if we could develop new theory to do so. The second objective was to study a set of inverse problems in order to retrieve hydraulic properties of the well-calibrated sand and thereby evaluate the usefulness of the self-potential method to monitor vadose zone dynamics.

Combined effective medium modelling for electrical and seismic properties of clastic formations

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Despite much progress in geophysical effective medium modelling methods, it is still common practice when relating the electrical resistivity of porous sedimentary formations to their electrical resistivity to fall back on empirical relationships (for example Archie's Law). We present a new, combined effective medium modelling method based on consistent physical and geometrical parameters which models both the bulk electrical and elastic properties of a two-phase medium consisting of conductive fluid and resistive grains. The solution for resistivity is grain size independent, and can simulate both isotropic and anisotropic structures. Results compare well with laboratory measurements on artificial sediment samples. We expect in future work to further develop this approach and enable its application to three-phase media.