Geophysical Research Abstracts
Vol. 14, EGU2012-5613, 2012
EGU General Assembly 2012

Induced polarization of clay-sand mixtures. Experiments and modelling.

G. Okay (1,2) and P. Leroy (3)

(1) UMR 7619 Sisyphe, Université de Pierre et Marie Curie, Paris, France, (2) French Institute of Radioprotection and Nuclear Safety, Fontenay-aux-Roses, France, (3) French Geological Survey, BRGM, Orléans, France

The complex conductivity of saturated unconsolidated sand-clay mixtures was experimentally investigated using two types of clay minerals, kaolinite and smectite (mainly Na-Montmorillonite) in the frequency range 1.4 mHz - 12 kHz. The experiments were performed with various clay contents (1, 5, 20, and 100 % in volume of the sand-clay mixture) and salinities (distilled water, 0.1 g/L, 1 g/L, and 10 g/L NaCl solution). Induced polarization measurements were performed with a cylindrical four-electrode sample-holder associated with a SIP-Fuchs II impedance meter and non-polarizing Cu/CuSO4 electrodes. The results illustrate the strong impact of the CEC of the clay minerals upon the complex conductivity. The quadrature conductivity increases steadily with the clay content. We observe that the dependence on frequency of the quadrature conductivity of sand-kaolinite mixtures is more important than for sand-bentonite mixtures. For both types of clay, the quadrature conductivity seems to be fairly independent on the pore fluid salinity except at very low clay contents. The experimental data show good agreement with predicted values given by our SIP model. This complex conductivity model considers the electrochemical polarization of the Stern layer coating the clay particles and the Maxwell-Wagner polarization. We use the differential effective medium theory to calculate the complex conductivity of the porous medium constituted of the grains and the electrolyte. The SIP model includes also the effect of the grain size distribution upon the complex conductivity spectra.