Geophysical Research Abstracts
Vol. 14, EGU2012-6934, 2012
EGU General Assembly 2012

Spectral induced polarization of disseminated electronic conductors: laboratory data obtained through time domain measurements

G. Gurin, Yu. Ilyin, A. Tarasov, and K. Titov
Faculty of Geology, St. Petersburg State University, St. Petersburg, Russian Federation

With a time domain (TD) technique, we measured Spectral Induced Polarization responses of 19 models of ore. The models were mixtures of calibrated sand (0.2 - 0.3 mm) with calibrated electron-conductive grains (average radii: 0.045, 0.055, 0.13, 0.20, 0.38 and 0.50 mm). The grains represent a mixture of pyrrhotite (30 %), pyrite (30 %), magnetite (30 %) and chalcopyrite (10 %). In the models the grain concentration varied from 0.6 to 30 % by volume.

We measured IP decay with a conventional TD measuring setup and a lab low-current transmitter in the time range from 0.3 ms to 64 s. The IP decays obtained with various current wavelength forms were inverted on the basis of the Debye decomposition, which allowed obtaining the relaxation time distribution.

The following results were obtained:

1. The total chargeability, m, was found to be independent of the grain size; it is related to the grain fraction, χ, according to the power law, m=6.28$\cdot 10^{-2} \cdot \chi^{0.78}$($m$ is dimensionless, and χ is in per cents; R^2=0.98);
2. The grain size, r, was found to be closely related to the mean IP relaxation time, τ, according to the square law, r^2=10$^{-5} \cdot \tau$ (r is in meters, and τ is in seconds; R^2=0.74); the square law corresponds to the diffusion kinetics, but contains the unrealistically large value of the diffusion coefficient;
3. The maximum values of the relaxation time distributions, Z_{max}, was found to be closely related to the specific surface of the grains, S_v, according to the power law, Z_{max}=1.82 10^{-2} $S_v^{0.65}$ (Z_{max} is dimensionless, and S_v is in cm^{-1}; R^2=0.94);
4. The relaxation time distribution for disseminated ores can be safely recovered on the basis of TD measurements with relatively short pulse lengths (or using frequency domain measurements with relatively high frequency values).