Geophysical Research Abstracts,
Vol. 11, EGU2009-5065, 2009
EGU General Assembly 2009

Implication of rock heterogeneities on the optical scanning of thermal conductivity

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We want to find out (1) how sensitive are measurements of thermal conductivity to heterogeneities in rocks? (2) How can we localize heterogeneities? Most methods for measuring thermal conductivity do not allow detecting the variation of thermal conductivity which results from heterogeneities. Yuri Popov and others conceived and developed a high-resolution optical scanning method that yields a conductivity profile along a scanning line. We use this method to study the effects of heterogeneities due to microfractures, layering, changing mineral composition and rock structure on thermal conductivity.

We studied two samples, a claystone rich in carbonate and a sample composed of conglomerate, carbonate and claystone. At first, we scanned the samples in dry condition and in two different directions. The measurements were performed with a resolution of 1 mm and spacing between profiles of 5 mm. These measurements permit to localize the inclusions of carbonate in the claystone and to identify the individual layers in the second sample.

Thereafter, we saturated the second sample prior to measurement and calculated the difference between the saturated and dry measurements. This allowed to quantify the distribution of water in the samples. The result agrees well with a porosity profile obtained from gamma-density measurements. It appears that our approach is useful to quantify the effect of rock heterogeneity on the variation of thermal conductivity on a small scale.