Geophysical Research Abstracts, Vol. 7, 06864, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06864

Measurements of seismo-electromagnetic conversions in a cylindrical sand sample.

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In fluid-filled saturated porous media, the seismic wave propagation induces seismo-electromagnetic conversions due to relative fluid-pore motions that can be measured with electric dipoles. In a homogeneous medium, the seismo-electric conversions are due to alternating compressions and dilatations of the porous medium and the resulting electrical signals reproduce the main characteristics of seismic P-waves. Under favourable circumstances, contrasts of physico-chemical generate electromagnetic waves with a dipolar radiation pattern that can be analyzed to estimate fluid and rock properties not accessible with classical geophysical investigation methods.

Seismo-electromagnetic phenomena have been recently revisited via field and laboratory measurements. In the steady state regime, the measurement of the zeta potential for many different rocks allows one to estimate the coupling coefficient for seismo-electric conversions. Nevertheless, the mechanisms of these conversions are still poorly understood. In order to quantify them in some favourable environment, we have designed a laboratory experiment within the ultra-shielded chamber of the Low Noise Underground Laboratory (LSBB) of Rustrel, France.

The experimental apparatus is located in the Faraday cage of LSBB. It consists of a 1 m high and 8 cm diameter vertical Plexiglas cylinder filled with Fontainebleau sand, possibly including one thin clay layer (kaolin). The seismic source consists of a brass tube containing a piston driven by compressed air. The seismic excitation results from the impact of a little ruby ball on a small granite slab. The transient electric potentials are measured with ten silver electrodes spaced 10 cm apart along the column generatrix simultaneously with the seismic response recorded by eight high frequency accelerometers. The experiment is remotely controlled from outside the Faraday cage.

In this presentation, we will concentrate on the seismo-electric conversions generated in a homogeneous and stratified media. Our ultimate goal is to compare the seismic and seismo-electric fields with the seismo-magnetic signals recorded with two induction magnetometers.