



Acoustic experiments in the Strengbach catchment in Alsace (France)

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The Strengbach catchment is located in the Vosges mountains. The rocks are granite and gneiss. Five boreholes with depths of 20 m, 50 m and 120 m were drilled for scientific measurements. We performed three types of acoustic measurements: Sonic logging, vertical seismic profiling and surface seismics. The measurements aim to provide information for the hydrological modeling of this catchment area (ANR Hydrocriszto project).

We used a full-waveform sonic logging sonde with one piezo-ceramic transducer and two receivers to record P and S head waves in the hard rock with a high source frequency of 30 kHz. We developed a data processing method which is based on correlation of waveforms to determine the wave propagation velocities with high precision. Seismic measurements in a nearby mine at Saint-Marie-aux-Mines in the rock basement have shown higher velocities which means that the granite in the catchment area is highly fractured. An effective medium theory is used to convert the wave propagation velocities into crack density and water saturation. When we use the logging sonde with a low frequency 1000 Hz source signal the wave field is then dominated by the tube wave and we observe diffractions which indicate fluid flow paths in the granite through larger fractures.

Zero-offset and walk-away vertical seismic profiling experiments (VSP) were performed with a sledgehammer as source and an Oyo Geospace hydrophone as receiver. The dominant source frequency is 200 Hz. The seismic velocities are smaller than the logging velocities and the amplitudes of the P waves decay much faster than caused by geometrical spreading. We interpret this result in the following way: The seismic waves with the large wavelengths propagate in an effective medium with more cracks than the waves in the logging experiment.

The surface seismic experiments can be used to extrapolate borehole VSP and logging results to larger parts of the catchment area.