Experimental Long-term Investigations on Geothermal Reservoir Rock Properties at Simulated In-situ Conditions

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Sustainable energy production from geothermal reservoirs requires an exact knowledge of the hydrological aquifer rock properties as well as the processes that could potentially alter its productivity. The latter comprise both mechanical (e.g. fines migration) and chemical (fluid-rock interactions) effects. To perform controlled long-term investigations on the evolution of sedimentary rock transport properties at conditions pertinent to deep geothermal reservoirs two new permeameters have been set up at the GFZ-Potsdam.

The apparatuses allow for a variety of continuous petrophysical measurements at a maximum temperature, lithostatic- and pore pressure of 200 °C, 140 and 50 MPa, respectively. The permeability, ultra-sonic p- and s-wave velocities and the specific electric conductivity of the rock can be determined. In particular, the use of corrosion-resistant parts allows for experiments with highly saline formation pore fluids that can be sampled under pressure for further chemical analysis. The typical duration of an individual test is four to twelve weeks. Experiments are comparatively performed on two types of sandstones: a Lower Permian (Rotliegend) reservoir rock from Eberswalde, Germany and a pure Quartzite from Fontainebleau, France. In addition, two kinds of pore fluids are used: a low salinity brine (0.1 mol NaCl) and a synthetic Ca-Na-Cl formation fluid with a TDS-content of 250 g/l.

In a first series the former fluid was used to petrophysically characterize both rocks as a function of temperature and effective pressure within the relevant range of up to 150 °C and 75 MPa, respectively. In addition, in a continuous flow experiment the permeability and the specific electric conductivity of the reservoir sandstone were monitored as a function of time during six weeks at constant p-T-conditions. In an ongoing series similar continuous flow experiments are performed using the second, highly saline reservoir fluid. These tests are also complemented by pH and redox potential measurements of the pore fluid that is sampled in regular time intervals.