Experiments on sandstone-brine interaction with various solutions under geothermal conditions

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Enhanced geothermal systems create fresh rock surfaces which consequently contact with generally high saline brines. In order to better understand the geochemical-mineralogical changes of fault systems in geothermal sandstone reservoirs, we conducted batch-type experiments in time series with varying fluid composition under reservoir conditions.

Arkosic sandstone samples with a fresh sample surface, representing fault surfaces, have been used as solid sample. Two molal Na-Cl, Na-Ca-Cl and Ca-Cl solutions have been prepared for the experiments. Experiment temperatures were 200 °C and ~16 bar. The experiments were conducted in stainless steel vessels with a teflon liner (90 ml). In every run one sandstone cylinder (25 mm diameter, 10 mm height) and 60 ml solution were used. Solid samples were investigated before and after the experiments by SEM (with EDX) for morphological changes, occurrence of mineral phases and their (qualitative) chemical composition. Identification of mineral phases in the initial and post-experimental samples were done by XRD measurements. Fluid analyses were conducted by ICP-OES, ICP-MS and IC.

First results show, the mineral assemblage changed on the sample surface after all experiments. Independent on the fluid composition all solid samples show dissolution of quartz; the cementation phases were removed from the sandstone surfaces. Initially pure K-feldspar incorporates detectable amounts of Na in experiments with Na-bearing solutions.

Depending on the fluid composition a bunch of Na-, Na-Ca- and Ca-zeolites precipitates from solution during the experiments. They show euhedral crystal habits with phyllosilicates nearby after the experiments.

Preliminary evaluation of the fluid data from the experiment series show a distinct dissolution behaviour of several dissolved elements depending on the initial fluid composition.

Our results show changes in the initial mineral assemblage depending on the solution composition. The mineral-solution interaction changes the primary mineral assemblage on the fault surfaces with an impact on fault permeability and thus the lifetime of geothermal installations.