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Reactive Reservoir Systems - Crystallization and Filter Processes of Barite in Geothermal Systems

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During geothermal energy generation, the change of temperature and pressure conditions can lead to supersaturation of the extracted fluids and therefore to the precipitation of crystalline phases. Well-documented crystalline deposits on the inner walls of pipes are the consequences. In addition, turbulence-induced inhomogeneities and mechanical disturbances also lead to the spontaneous formation of free-floating crystal nuclei. A significant part of them are carried along and reinjected into the reservoir. There, the crystal nuclei are possible centers for crystallization and cementations processes or can accumulate by filter effects. Both processes contribute to scaling effects which limit the permeability of the geothermal reservoir and therefore the profitability of a geothermal power plant. So far, such effects have been barely considered in previous studies.

Our investigations focus on a better understanding of the formation and growth of crystal nuclei in saturated geothermal solutions during thermal and pressure relaxation, and their role in decreasing permeability of fractured geothermal reservoirs. For this purpose, a high-pressure-high-temperature apparatus is built and used which is based on the working principle of a geothermal cycle. Circulating flow-through experiments with fractured reservoir rocks, i.e., two sandstones, and barite-supersaturated fluids are conducted under geothermal conditions with the option to simulate heat extraction and injection of colder crystal-contaminated fluids. Furthermore, the size and morphology of precipitated barite crystals are studied as important factors influencing the potential filter processes in fractures. First results show substantial change in barite morphology with different sodium chloride concentrations in solution. To minimize the scaling effects, the goal is to develop approaches to control crystal nucleation.

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