Injection-triggered occlusion of flow pathways in sedimentary basins

Dr. Maren Brehme, Co-Autoren: Abel Marko, Kerstin Nowak, Sigitas Petrauskas, Siklosi Istvan, Axel Sanden, Guido Blöcher, Ernst Huenges
GFZ Potsdam, Geothermische Energiesysteme

Keywords: injectivity decline, soft stimulation, fines migration, precipitation, biofilm, corrosion, EU

Reasons for injectivity decline were investigated at different geothermal sites located in sedimentary aquifers. The study sites are investigated within the DESTRESS project, which demonstrates different stimulation techniques in geothermal reservoirs. Due to low injectivities, production rates have to be reduced and the sites face negative commercial implications. Investigated study sites are located in Lithuania, Hungary and the Netherlands. Additionally to historical operation data, fluid and rock samples were sampled on-site and further investigated in the laboratory. Analysis results and experiments focus on physical, chemical and biological processes and their interaction. Results show four main processes being responsible for injection-triggered occlusion of flow pathways: fines migration, precipitation, biofilm and corrosion. Fines migration is caused by washouts in loosely cemented rocks, from where fines sand or clay particles are transported and injected into lower aquifer layers. At our sites, precipitation of minerals is caused by cooling (Lithuania) or oxygen exposure (Hungary, Netherlands). Biofilm is a result of sulfate-reducing bacteria being present at injection depth. Biofilm and physicochemical conditions also cause corrosion in pipelines and wells. Especially at the Lithuanian and Hungarian site, these four processes interact in a loop including countermeasures. Precipitation is removed by acidization, which in turn released fines particles especially from inappropriately completed well sections. Since then, precipitation has been successfully avoided using phosphonate inhibitor in Lithuania. The organic based inhibitor, however, fostered microbial activity. Microbial activity again is the main cause for corrosion at this site. Conclusions from this study are the basis for stimulation design plans, which will take place in the frame of the DESTRESS project. Stimulations will include chemical, mechanical or hydraulic treatments aiming for sustainable injectivity enhancement.