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Scaling and reservoir clogging potential in the DeepStor High Temperature Aquifer Energy Storage (HT-ATES)

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Heat for industrial processes and housing accounts for 50% of the primary energy demand in Germany. A sustainable and emission free heat supply is therefore one of the key tasks of the energy change. Installed capacities for heat generation are typically largely over-dimensioned due to strongly differing demands from winter to summer. Therefore, heat storage is of increasing importance. In this context, the reuse of abandoned oil reservoirs as aquifer thermal energy storage systems is getting increasing attention. Their widespread distribution and the often already existing data the future reservoir is very advantageous. Numerous aquifer thermal storage systems in the low- to mid-temperature range (25°C < T < 90°C) are currently under operations worldwide. More efficient high temperature systems (T > 100°C) are lacking completely. Large temperature differences between storage- and injection temperatures increase the interference of the hydro-geochemical system, leading to an increased scaling potential in the surface installations as well as in the reservoir. To study these processes real-scale the KIT is planning the implementation of the storage demonstrator DeepStor in an abandoned oil reservoir below its campus with a foreseen half-yearly cyclic energy storage and reproduction scheme.

By using hydro-geochemical modelling techniques, this study pre-assesses the hydro-geochemical processes induced by the foreseen operation scheme. It is based on wellhead fluid data from nearby previous oil production from the target formation. After determination the undisturbed reservoir temperature, an important reference value for specifying the chemical systems equilibrium, the rather poor quality data is corrected using a geochemical equilibrium approach. Finally, the scaling formation is modelled both. It is shown, that the major scaling phases are iron oxides, calcite, celestite and barite. A combination of processes (e.g. decrease of pressure, decrease and increase of temperature, exposition to atmospheric oxygen, etc.) are drivers for the precipitation. Depending of the minerals' prograde or retrograde solubility, mineral precipitation or mineral dissolution tendencies can be observed at the production and reinjection well, respectively.