Mechanical effects of salt precipitation during gas injection in saline porous media: dynamic studies by X-ray tomography.

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Saline aquifers have a large capacity for gas storage, such as CO_2 or natural gas. This storage leads to perturbations of the underground environment, and might induce the precipitation of salts, natural constituents of brines present inside the host rock. When precipitation occurs inside the pores, the rock's permeability might decrease, and crystallization stresses build up which might eventually fracture the rock. As such, the injectivity can be highly impacted. It is therefore essential to understand the relationship between salinity, pore structure and the risk for pore clogging and fracture formation.

In this study, we investigate salt crystallization during gas injection using a model system composed of monodispersed glass beads saturated with a saline solution (NaCl). Dry gas was injected at a constant flow rate from the bottom of the sample and percolates upward due to buoyancy. The local desaturation in the pore space increases the salt concentration, leading up to crystallization.

Tests are conducted for different initial salt concentrations and with different bead sizes. X-ray tomographic scans performed at regular time intervals enable pinpointing the locations where crystals initiate. Furthermore, by tracking the motion of the barycenter of each individual glass bead, the crystallization-induced deformation can be quantified. Combined with knowledge on the elastic moduli of the model material, this yields an estimate of the exerted crystallization stress. Further work will focus on including CO_2 injection under pressure conditions and on using reservoir rocks.

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