

The role of mineral heterogeneity on the CO₂ storage capacity and injectivity under CO₂ supercritical conditions

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The reactivity of two fractured reservoir rocks (limestone composed of 100% calcite and sandstone composed of 65.7% calcite, 27.8% quartz and 6.5% microcline) in contact with a CO₂-rich sulfate solution was examined.

Flow-through percolation experiments were performed using artificially fractured limestone and sandstone cores and injecting a CO₂-rich sulfate solution under constant volumetric flow rate at $P = 150$ bar and $T = 60$ °C. Measurements of the pressure difference between the inlet and the outlet of the samples and of the aqueous chemistry enabled the determination of fracture permeability changes and net reaction rates. Additionally, X-ray computed microtomography (XCMT) was used to characterize changes in fracture volume induced by dissolution and precipitation processes.

Results and discussion

In all reacted cores an increase in fracture permeability and in fracture volume was always produced even when gypsum precipitation occurred. The presence of inert silicate grains in sandstone samples favored the occurrence of largely distributed dissolution structures in contrast to localized dissolution in limestone samples, and it promoted greater dissolution and smaller precipitation in sandstone than in limestone experiments.

As a result, in sandstone reservoirs, the larger increase in fracture volume as well as the more extended distribution of the created volume would favor the CO₂ storage capacity. The different distribution of created volume between limestone and sandstone experiments led to a different variation in fracture permeability. The progressive stepped permeability increase for sandstone would be preferred to the sharp permeability increase for limestone to minimize risks related to CO₂ injection, favor capillary trapping and reduce energetic storage costs.