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Feedback between reactive transport and convective flow during CO_2 migration in a saline aquifer

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A configuration of denser CO_2-enriched brine overlying a lighter water leads to convective flow and the formation of gravity fingers of dense fluid sinking into the resident brine. This process has been acknowledged as an enhancer of supercritical CO_2(g) dissolution in saline aquifers. Given the non-linear feedback between reactive transport (dissolution/precipitation), porosity and permeability changes and density driven flow, chemical reactions may affect fingering and convection patterns.

In this work, we use a numerical framework to analyze the interaction between flow and reactive transport processes associated with the dissolution of CO_2 in brine in a carbonated aquifer. Fingering of acidic CO_2-rich brine leads to non uniform calcite dissolution patterns that result in preferential flow paths that control flow dynamics in later times. The numerical simulations have been performed with a java interface that couples the high performance code COMSOL Multiphysics with the reactive transport code PHREEQC.