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Fluid-solid reactions in multiphase flows

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Coupling of multiphase flows and fluid-solid reactions, including rock dissolution and mineral precipitation, takes place in environmental (unsaturated zone of karst areas) and apply energy (geothermal energy production, CO_2 sequestration, acidization in oil recovery) contexts. However, a deep understating of the coupling of these two processes is missing. To achieve this objective, we designed a geo-material microfluidic cell using limestone as substrate. Single flow, injecting supercritical (sc) CO_2 dissolved in brine, and multiphase flow, injecting CO_2-saturated brine and scCO_2 simultaneously, experiments were performed in the same controlled etched geometry. Dissolution and precipitation rates for single and multiphase flows were deduced from high-precision 3D measurements, and changes in permeability from pressure measurements. We also simulated the flow through the pore space for both experimental cases to quantify changes in flow dynamics due changes in geometry. We showed the coupling of single and multiphase flow and fluid-solid reactions, demonstrating the impact of multiphase flows on the latter.