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A microfluidic approach to understanding coupled dissolution-precipitation during CO_2 storage in fractured systems

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Until recently, efforts to understand the fluid dynamics processes occurring in flowing fractures have generally excluded chemical reactions or only explored one reaction: dissolution or precipitation. This has hindered our progress in predicting the CO_2 storage potential in a given system because it has limited our understanding of *in situ* carbon mineralization. Identifying the influence of fluid flow in fractures on geochemical reactions is particularly important for CO_2 mineralization in low-permeability rocks, such as ultramafic rocks (e.g. peridotite), which will rely on fractures to act as primary conduits for CO_2 distribution and mineralization. We are working towards bridging this knowledge gap by conducting experiments using an advanced high-P, high-T microfluidics setup that permits real-time visualization of carbon mineralization in a coupled dissolution-precipitation regime under flowing conditions.

In order to understand fundamental regimes of coupled dissolution and precipitation relevant to mineral carbonation, experiments have been conducted in an analog setup where the dissolution of gypsum ($CaSO_4$) by a carbonate solution is coupled to the precipitation of calcite ($CaCO_3$). The fracture model used in the experiments included a primary channel and dead ends, which define advection and diffusion-dominated zones. We conducted experiments under different flow conditions, and the results revealed key factors that affect optimal carbonation. The amount, morphology, and geochemistry of carbonate mineralized was strongly influenced by the fluid flow rate. These results suggest that the rate of CO_2 injection could be an important parameter to consider during *in situ* carbon mineralization operations.