Multiphase, multicomponent simulations and experiments of reactive flow, relevant for combining geologic CO$_2$ sequestration with geothermal energy capture
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Understanding the fluid dynamics of supercritical carbon dioxide (CO$_2$) in brine-filled porous media is important for predictions of CO$_2$ flow and brine displacement during geologic CO$_2$ sequestration and during geothermal energy capture using sequestered CO$_2$ as the subsurface heat extraction fluid. We investigate multiphase fluid flow in porous media employing particle image velocimetry experiments and lattice-Boltzmann fluid flow simulations at the pore scale. In particular, we are interested in the motion of a drop (representing a CO$_2$ bubble) through an orifice in a plate, representing a simplified porous medium. In addition, we study single-phase/multicomponent reactive transport experimentally by injecting water with dissolved CO$_2$ into rocks/sediments typically considered for CO$_2$ sequestration to investigate how resultant fluid-mineral reactions modify permeability fields. Finally, we investigate numerically subsurface CO$_2$ and heat transport at the geologic formation scale.