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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.