Permeability Hysteresis Effects in Geologic CO_2Sequestration

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Abstract

Relative permeability depends on wettabitlity properties of the fluids, the displacement process, and the displacement history. Hysteresis in relative permeability has a strong influence on the ability of injected and resident fluids to flow. We construct a mathematical model to accommodate the drainage, imbibition and scanning cycles measured in laboratory experiments of two-phase CO_2/brine flow.

The system of partial differential equations for this model is fully nonlinear. Ignoring the diffusive effects of capillary pressure, we solve the associated Riemann problem analytically and with state-of-the-art numerical methods. The analytic solution of the Riemann problem is used to verify the numerical simulations.

The Riemann solutions generically display stationary discontinuities, which might constitute an additional mechanism for CO_2trapping.

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