CONVECTIVE MIXING AT LATE TIMES: SIMULATIONS AND EXPERIMENTS

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Convective mixing is a key CO2-trapping mechanism during geologic sequestration. While this mechanism has been shown to dramatically increase the CO2 dissolution rate at short times after onset, it has not been studied at late times when the CO2-rich fingers interact with the bottom of the aquifer. In this work, we study the late-time behavior in a simple system: a linear, homogeneous aquifer in which the CO2-brine interface spans a finite region along the top of the aquifer (Figs. A,B). To model this system, we solve the equations for pressure and concentration under the Boussinesq approximation. We discretize the equations using finite volumes, including limiters for the concentration equation. We solve the pressure equation using a fast Poisson solver. To evaluate the model, we compare the numerical results (Figs. A1-A3) with experiments that involve dissolving CO2 into a Hele-Shaw cell filled with water and a pH indicator (Fig. B). We quantify how the CO2 dissolution rate decreases in time, which will be helpful for calculating the timescale over which a volume of injected CO2 will completely dissolve.