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How convective mixing slows down MICHAEL SZULCZEWSKI, RUBEN JUANES, Massachusetts Institute of Technology — Convective mixing is a key CO2-trapping mechanism during geologic sequestration. While this mechanism has been shown to 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. Here, 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. We perform high-resolution simulations and experiments that involve dissolving CO2 in a Hele-Shaw cell filled with water and a pH indicator. We show that the late-time dissolution rate decreases after the fingers reach the bottom due to two mechanisms: (1) fill up, in which the CO2-rich fingers accumulate beneath the free-phase CO2, decreasing the density difference that drives convective mixing; and (2) shielding, in which the accumulation of CO2-rich fluid forms a wedge that blocks water without CO2 from reaching the entire CO2-brine interface. We further show that the dissolution rate decreases according to a power law in time. These results will be helpful for calculating the timescale over which a volume of injected CO2 will completely dissolve.

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