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Experiments and High-resolution Simulations of Density and Viscosity Feedbacks on Convective Mixing[1] JUAN J. HIDALGO, MIT, Cambridge, MA, USA, JAIME FE, University of A Coruña, A Coruña, Spain, CHRISTOPHER W. MACMINN, LUIS CUETO-FELGUEROSO, RUBEN JUANES, MIT, Cambridge, MA, USA — Dissolution by convective mixing is one of the main trapping mechanisms during CO_2 sequestration in saline aquifers. Initially, the buoyant CO_2 dissolves into the underlying brine by diffusion. The CO_2-brine mixture is denser than the two initial fluids, leading to a Rayleigh-Bénard-type instability known as convective mixing, which greatly accelerates CO_2 dissolution. Although this is a well-known process, it remains unclear how convective mixing scales with the governing parameters of the system and its impact on the actual mixing of CO_2 and brine. We explore the dependence of the CO_2 dissolution flux on the nonlinearity of the density and viscosity of the fluid mixture by means of high-resolution numerical simulations and laboratory experiments with an analogue fluid system (water and propylene glycol). We find that the value of the concentration for which the density of the mixture is maximum, and the viscosity contrast between the fluids, both exert a powerful control on the convective flux. From the experimental and simulation results, we obtain the scaling behavior of convective mixing, and clarify the role of nonlinear density and viscosity feedbacks.

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