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Non-Boussinesq Dissolution-Driven Convection in Two- and Three-Dimensional Porous Media at Partially-Saturated Condition MOHAMMAD AMIN AMOOIE, MOHAMMAD REZA SOLTANIAN, JOACHIM MOORTGAT, The Ohio State University — Sequestrated carbon dioxide (CO2) into saline aquifers, increases brine density through dissolution, and leads to gravitational instability and convective mixing. Traditionally, only the underlying brine-saturated subdomain is studied to avoid two-phase systems while replacing the gas cap atop with a constant, fully-saturated boundary condition. This violates the interface movement, neglects the capillary transition zone across original phases, and imposes constant density at top boundary insensitive to convective downwelling flow. Moreover, dissolution causes volume swelling, reflected as pressure build-up in absence of interface (movement), which further increases the fluid density –not captured under Boussinesq approximation. Here we accurately model the nonlinear phase behavior of brine-CO2 mixture, altered by dissolution and compressibility. We inject CO2 at a sufficiently low injection rate to maintain the single, partially-saturated phase, with no constraint on pressure and composition, so that density at top is free to change against the rate at which dissolved CO2 migrates downwards. We discover new flow regimes and present quantitative scaling relations for their temporal evolution in both two- and three-dimensional porous media.

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