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Pattern formation study of dissolution-driven convection NOUFE ALJAHDALY, King Abdulaziz University, LAYACHI HADJI, The University of Alabama — A three-dimensional pattern formation analysis is performed to investigate the dissolution-driven convection induced by the sequestration of carbon dioxide. We model this situation by considering a Rayleigh-Taylor like base state consisting of carbon-rich heavy brine overlying a carbon-free layer and seek, through a linear stability analysis, the instability threshold conditions as function of the thickness of the CO_2-rich brine layer. Our model accounts for carbon diffusion anisotropy, permeability dependence on depth and the presence of a first order chemical reaction between the carbon-rich brine and host mineralogy. A small amplitude nonlinear stability analysis is performed to isolate the preferred regular pattern and solute flux conditions at the interface. The latter are used to derive equations for the time and space evolution of the interface as it migrates upward. We quantify the terminal time when the interface reaches the top boundary as function of the type of solute boundary conditions at the top boundary thereby also quantifying the beginning of the shutdown regime. The analysis will also shed light on the development of the three-dimensional fingering pattern that is observed when the constant flux regime is attained.

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