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Modeling the convective stability of CO_2 sequestration by a discontinuous and unstably stratified density profile TABER WANSTALL, LAYACHI HADJI, The University of Alabama — The convective stability associated with carbon sequestration is modeled by adopting an unstably stratified basic profile having a step function density with top heavy carbon saturated layer overlying a lighter carbon free layer. The model takes into account the anisotropy in both permeability and carbon dioxide diffusion, and chemical reactions between the CO_2 rich brine and host mineralogy. We carry out a linear stability analysis to derive the instability threshold parameters for a variety of CO_2 boundary conditions. We solve for the minimum thickness of the carbon-rich layer at which convection sets in and quantify how its value is influenced by diffusion, anisotropy, permeability, reaction and type of boundary conditions. The discontinuity leads to convective concentration contours that have the shape of an asymmetric lens which we quantify by deriving and making use of the CO_2 flux expressions at the interface. The linear problem is extended to the nonlinear regime, the analysis of which leads to the determination of a uniformly valid super critical steady solution.

Layachi Hadji
The University of Alabama

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