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The Effect of Geochemical Reaction on Convective Mixing in a Gravitationally Unstable Diffusive Boundary Layer in Porous Media: Geological Storage of CO_2 in Saline Aquifers KARIM GHESMAT, HASSAN HASSANZADEH, JALAL ABEDI, University of Calgary — The storage of carbon dioxide and acid gases in deep geological formations is considered a promising option for mitigation of greenhouse gas emissions. Understanding of the primary mechanisms, such as convective mixing and geochemistry that affect the long-term geostorage process in deep saline aquifers is of prime importance. First, a linear stability analysis of an unstable diffusive boundary layer in porous media is presented, where the instability occurs due to a density difference between the carbon dioxide saturated brine and the resident brine. The linear stability results have revealed that geochemistry stabilizes the boundary layer. A detailed physical discussion is also presented with an examination of vorticity and concentration eigenfunctions and streamlines' contours to reveal how the geochemical reaction may affect these physical terms. Second, nonlinear direct numerical simulations are presented, in which the evolution of density-driven instabilities for different reaction rates are discussed. The results indicate that the boundary layer will be more stable for systems with a higher rate of reaction. However, the quantitative analyses show that more carbon dioxide may be removed from the supercritical free phase as the flux at the boundary is higher for flow systems coupled with stronger geochemical reactions.

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