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The effect of mixed convection and hydrodynamic dispersion on CO2 dissolution in saline aquifers

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One of the most important trapping mechanisms in CO2 geologic storage is convective dissolution. When CO2 is dissolved, it slightly increases the brine density, resulting in natural convection in the form of dense fingers. In most previous studies, natural groundwater flow and the associated hydrodynamic dispersion were neglected. In this work, we study the effect of hydrodynamic dispersion and natural and forced convection (mixed convection) on CO2 dissolution.

We use laboratory-scale analog experiments and numerical simulations to study the influence of horizontal flow and hydrodynamic dispersion on the fingers morphology and dissolution flux. The results indicate that background flow and dispersion significantly reduce the fingers wavenumber and velocity. Yet, the effect on the dissolution rate is complex and non-monotonic. Based on the simulated results, new scaling laws that predict the dissolution rate and wavenumber in the presence of dispersion and background flow were developed. These new laws show that the available predictions in the literature overestimate the dissolution rates in potential storage sites.

Participation

In-Person

References

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