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Spreading and dissolution of CO₂ in horizontal aquifers: theory and experiments CHRISTOPHER MACMINN, Massachusetts Institute of Technology, JEROME NEUFELD, Cambridge University, MARC HESSE, University of Texas at Austin, HERBERT HUPPERT, Cambridge University — Injection of carbon dioxide into saline aquifers is widely regarded as a promising tool for reducing atmospheric CO₂ emissions. While an accurate assessment of the post-injection spreading and migration of the CO₂ is essential for estimates of storage security, many of the physical processes controlling CO₂ migration are poorly understood. CO₂ is buoyant relative to groundwater at reservoir conditions. This is undesirable because the presence of a pre-existing well or fracture, or the activation of a fault, could lead to leakage. It is well known, however, that the dissolution of CO₂ increases the density of the groundwater, resulting in convective currents that dramatically enhance CO₂ dissolution. Once dissolved, the CO₂ is considered to be securely stored within the subsurface. Recent numerical and experimental work has led to a greatly improved understanding of the resulting rate of CO₂ dissolution into groundwater. Here, we use analog experiments and simple theoretical models to study dissolution from a plume of CO₂ as it spreads upward against the caprock in an aquifer of finite thickness. We show that the interaction between spreading, dissolution, and the finite thickness of the aquifer has a strong influence on the ultimate distribution of the CO₂.

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