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Plume dynamics in heterogeneous porous media JEROME A. NEUFELD, HERBERT E. HUPPERT, Institute of Theoretical Geophysics, Department of Applied Mathematics and Theoretical Physics, University of Cambridge — Buoyancy driven flows in layered porous media are present in many geological settings and play an important role in the mixing of fluids, from the dispersal of pollutants in underground aquifers to enhanced oil recovery techniques and, of more recent importance, the sequestration of carbon dioxide (CO_2). Seismic images of the rise of a buoyant CO_2 plume at Sleipner in the North Sea indicate that these plumes are greatly influenced by a vertical array of thin lenses of relatively low permeability material. We model propagation of CO_2 at each layer as a gravity current in a porous medium which propagates along, and drains through, a thin, low permeability seal. Drainage, driven both by hydrostatic pressure and the body force on the draining fluid, leads to an initial rapid advance followed by a gradual retreat of the current to a steady-state. By incorporating a vertical array of these single layer models we are able to capture the rise of the buoyant plume in layered reservoirs. We find that the plume is characterized by a broad head with a tail given by the steady state extent.

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