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Buoyant convective plumes in a layered heterogeneous porous medium DUNCAN HEWITT, University of Cambridge — Convection in porous media, driven by either an isolated source of buoyancy or a distributed source along one boundary, can be encountered in a variety of geophysical settings, and has been widely studied in recent years because of its relevance to the long-term security of geologically sequestered CO_2 in saline aquifers. Such aquifers generally have a heterogeneous permeability structure, which is often dominated by thin, roughly horizontal layers of much lower permeability rock than the bulk rock. In this talk, we present simulations and theory of buoyant plumes spreading in the presence of such layers. The relative permeability and depth scale of the layer combine to give an effective impedance Ω of each layer, which, together with an effective Rayleigh number for the plume, govern its spread. If Ω is low, the plume is almost unaffected by the layer and spreads according to Wooding's [JFM;1962527-544] similarity solution. For increasingly large values, the plume spreads as a 'leaking' gravity current along the layer, which for sufficiently large values of Ω leaks only by diffusion across the layer. These regimes are explored in detail. The effect of a series of layers is explored, as is the extension to a line source buoyancy.

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