Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

The competition between buoyancy and flow focussing in a two layer porous media flow HERBERT HUPPERT, JEROME NEUFELD, ITG, DAMTP, University of Cambridge — Flow of relatively dense gravity currents in saturated porous media with two distinct layers has been pursued theoretically and experimentally and will be demonstrated by a table-top experiment. In such systems, where fluid flow is driven by buoyancy, there exists a competition between gravity acting on the heavy fluid and flow focusing driven by ease of flow within the high permeability layer. When these two effects act together – the lower layer is more permeable – the current extends more rapidly than in a uniform medium of equivalent permeability. When gravity and the permeability structure act in opposition there is a critical flux $Q_C = (g' k_L H/\nu) f(k_U/k_L)$, where $f(x) = 0.9(x-1)^{-1/3}$, beyond which the upper layer attracts the current sufficiently to overrun the lighter interstitial fluid in the lower layer (k_U and k_L are the permeabilities of the upper and lower layers and H is the lower layer depth). When the system is at an angle to the horizontal, flow is driven by the component of gravity down the incline, rather than by the slope of the upper surface of the current, with the critical flux dependent on the angle. The studies have applications to sequestering supercritical carbon dioxide in saline aquifers 1 to 2 km beneath the surface of the Earth.

Herbert Huppert
ITG, DAMTP, University of Cambridge

Date submitted: 01 Aug 2008 Electronic form version 1.4