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Injection and leakage of fluids in confined porous media SAM PEGLER, HERBERT HUPPERT, JEROME NEUFELD, Univ of Cambridge — We present a theoretical and experimental study of viscous gravity currents injected into porous media confined vertically by horizontal impermeable boundaries and saturated by a fluid of different density and viscosity. With two-dimensional flow injected at a constant volumetric rate, the pressure gradient introduced by the injection shapes the interface towards a concave similarity solution in which gravity is negligible and the interface grows in proportion to time. Data from a new series of laboratory experiments confirm our theoretical predictions over a range of viscosity ratios. We proceed to consider situations in which the current can leak through a localized "fracture," at a rate which depends both on the gravitational head of the current below the fracture and the pressure introduced by injection. Confinement constrains the vertical growth of the current and implies a maximum possible rate of leakage. Consequently, two different flow regimes can arise, depending on whether the injection rate exceeds that maximum. If it does, then the proportion of injected fluid retained in the medium can be orders of magnitude greater than has been proposed previously from studies of unconfined aquifers with otherwise identical flow properties.

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