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Capillary pinning of immiscible gravity currents in porous media BENZHONG ZHAO, Massachusetts Institute of Technology, CHRISTOPHER MACMINN, Yale University, HERBERT HUPPERT, University of Cambridge, RUBEN JUANES, Massachusetts Institute of Technology — Gravity currents in porous media have attracted interest recently in the context of geological carbon dioxide (CO_2) storage. Capillarity can be important in the spreading and migration of the buoyant CO_2 after injection because the typical pore size is very small, but the impact of capillarity on these flows is not well understood. Here, we study the impact of capillarity on the buoyant spreading of a finite gravity current of non-wetting fluid into a dense, wetting fluid in a vertically confined, horizontal aquifer. We show via simple, table-top experiments using glass bead packs that capillary pressure hysteresis pins a portion of the fluid-fluid interface. The horizontal extent of the pinned portion of the interface grows over time and this is responsible for ultimately stopping the spreading of the buoyant current after a finite distance. In addition, capillarity blunts the leading edge of the buoyant current. We demonstrate through micromodel experiments that the characteristic height of the nose of the current is controlled by the pore throat size distribution and the balance between capillarity and gravity. We develop a theoretical model that captures the evolution of immiscible gravity currents and predicts the maximum migration distance.

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