Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Capillary pinning of immiscible gravity currents in porous media BENZHONG ZHAO, Massachusetts Institute of Technology, CHRISTOPHER MACMINN, Yale University, MICHAEL SZULCZEWSKI, Massachusetts Institute of Technology, HERBERT HUPPERT, University of Cambridge, RUBEN JUANES, Massachusetts Institute of Technology — Gravity currents in porous media have attracted much interest recently in the context of geological carbon dioxide (CO2) storage, where supercritical CO2 is injected underground into deep saline aquifers. Capillary effects can be very important in the spreading and migration of the buoyant CO2 after injection because the typical pore size is very small ($\sim$10-100 μm), but the impact of capillarity on these flows is not well understood. Here, we study the impact of capillarity on a finite-release gravity current of a buoyant non-wetting fluid. Via simple, table-top experiments, we show that capillary pressure hysteresis causes pinning of a portion of the initial interface, which ultimately stops the spreading of the buoyant current at a finite distance. In addition, capillarity causes blunting at the leading edge of the draining buoyant current. We demonstrate through micromodel experiments that the height of the nose of the current is controlled by the pore geometry as well as the balance between capillarity and gravity. Our analysis suggests that capillary pinning and capillary blunting exert a fundamental control on the interface evolution of immiscible finite-release gravity currents in the context of CO2 sequestration in deep saline aquifers.

Benzhong Zhao
Massachusetts Institute of Technology

Date submitted: 09 Aug 2012 Electronic form version 1.4