Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Density-Driven Convection with an Inclined Boundary PEICHUN TSAI, TALAL AL-HOUSSEINY, ZHONG ZHENG, HOWARD STONE, Department of Mechanical and Aerospace Engineering, Princeton University — We experimentally investigate convective instability and transport in a Hele-Shaw geometry and in a porous medium with inclined boundaries. The initial fluid configuration is buoyantly stable: a lighter liquid is placed above a dense one. The convection is generated by the dissolution of the two liquids which results in a heavier fluid layer at the interface, advecting into the underlaid, lighter fluid. Phenomenologically, in a vertical cell, heavier, mushroom-like plumes mostly travel downward and then partially merge. In contrast, in an inclined cell, the dense fingerings initially transport vertically downward and subsequently tilt and move laterally due to the inclined boundaries. We examine the width, wavelength, and dynamics of the dense plumes. We find that the tilting angle of the inclined boundary profoundly affects the dynamics of the density-driven plumes. In addition, the permeability of the porous media strongly changes the convective rate. These findings show key implications for geological carbon dioxide (CO2) storage in a silane aquifer when the dissolved CO2 into brine produces a heavier mixture with an enhancement of the mass transfer by convection.

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Date submitted: 12 Aug 2011 Electronic form version 1.4