Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Uncertainty characterization of solubility trapping of CO2 in saline aquifers AMIR RIAZ, University of Maryland, MARC HESSE, University of Texax Austin, HAMDI TCHELEPI, Stanford University — Buoyancy driven unstable convection of CO2 saturated plumes in brine aquifers that results from the Rayleigh-Benard hydrodynamic instability in a porous medium is one of the principle mechanisms of CO2 sequestration by solubility trapping. The finite time of the onset of instability has been analyzed in detail by many authors previously but an agreement as to its precise value as a function of the Rayleigh number has not yet emerged. Rather, the onset time obtained from various analyses is known to vary by an order of magnitude. In an attempt to resolve this discrepancy we carry out high accuracy numerical simulations and measure the critical time. We find that the critical time and the closely related time-to-initiate-convection are fundamentally dependent on the magnitude and realization of the field of initial random perturbations employed to induce instability and are hence not deterministic. We therefore provide a probabilistic description of the processes of initialization of instability and convection and formulate correlations with late time events such as the total amount of CO2 dissolved to provide a reliable characterization of the process of CO2 solubility trapping in brine aquifers.

Amir Riaz
University of Maryland

Date submitted: 07 Aug 2009 Electronic form version 1.4