Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Effect of dispersion on convective mixing in porous media[1] BAOLE WEN, MARC HESSE, University of Texas at Austin, GEOLOGICAL POROUS MEDIA GROUP TEAM — We investigate the effect of dispersion on convection in porous media by performing direct numerical simulations (DNS) in a 2D Rayleigh-Darcy domain. Scaling analysis of the governing equations shows that the dynamics of this system is not only controlled by the classical Rayleigh-Darcy number based on molecular diffusion, Ra_m, and the domain aspect ratio, but also controlled by two other dimensionless parameters: the dispersive Rayleigh number $Ra_d = H/\alpha_t$ and the dispersivity ratio $r = \alpha_l/\alpha_t$, where H is the domain height, α_t and α_l are the transverse and longitudinal dispersivities, respectively. For $Ra_m \ll Ra_d$, the effect of dispersion on convection is negligible; for $Ra_m \gg Ra_d$, however, the flow pattern is determined by Ra_d while the mass transport flux $F \sim Ra_m$ at high-Ra_m regime. Our DNS results also show that the increase of the mechanical dispersion (i.e. decreasing Ra_d) will broaden the plume spacing and coarsen the convective pattern. Moreover, for $r \gg 1$ the anisotropy of dispersion destroys the slender columnar structure of the primary plumes at large Ra_m and therefore reduces the mass transport rate.

[1]This work was supported by the Center for Frontiers of Subsurface Energy Security, an Energy Frontier Research Center funded by the U.S. Department of Energy, Office of Science, Basic Energy Sciences under Award number DE-SC0001114.

Baole Wen
University of Texas at Austin

Date submitted: 26 Jul 2017 Electronic form version 1.4