# Abstract

Saline aquifers are chosen for geological storage of greenhouse gas $CO_2$ because of their storage potential. In almost all cases of practical interest, $CO_2$ is present on top of the liquid and $CO_2$ dissolution leads to a small increase in the density of the aqueous phase. This situation results in the creation of negative buoyancy force for downward density-driven natural convection and consequently enhances $CO_2$ sequestration. In order to study $CO_2$ injection at pore-level, an isothermal Lattice Boltzmann Model (LBM) with two distribution functions is adopted to simulate density-driven natural convection in porous media with irregular geometry obtained by image treatment. The present analysis showed that after the onset of natural convection instability, the brine with a high $CO_2$ concentration infringed into the underlying unaffected brine, in favor of the migration of $CO_2$ into the pore structure. With low Rayleigh numbers, the instantaneous mass flux and total dissolved $CO_2$ mass are very close to that derived from penetration theory (diffusion only), but the fluxes are significantly enhanced with high Ra number. The simulated results show that as the time increases, some chaotic and recirculation zones in the flow appear obviously, which promotes the renewal of interfacial liquid, and hence enhances dissolution of $CO_2$ into brine. This study is focused on the scale of a few pores, but shows implications in enhanced oil/gas recovery with $CO_2$ sequestration in aquifers