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Relative contributions of permeability heterogeneity and viscosity contrast on scalar mixing

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Solute transport in porous media is affected by several factors. The heterogeneous structure of the permeability field is a key factor controlling the spreading and mixing behaviors of a solute cloud. On the other hand, other factors such as the viscosity contrast between the dissolved solute and the ambient fluid can also play an important role. Although both these mixing mechanisms (field heterogeneity and viscosity contrast) had been acknowledged and studied, further investigation is needed in order to better characterize the effect of the variation of both the degree of viscous fingering and the level of disorder of the porous medium. This work aims to explore the impact of field heterogeneity and viscosity contrast on the transport behavior of an inert solute in a two-dimensional flow field. To achieve this, we performed high-resolution numerical simulations to solve coupled flow and transport equations for a given range of viscosity contrast and log-permeability variance. We analyze the degree and rate of mixing, contour length of the scalar cloud, spatial statistics of the concentration field and arrival times at a control plane to characterize spreading and mixing in the domain. We provide a quantitative separation of the impacts of fingering and heterogeneity and we parameterize the concentration probability distribution function. We find that the interplay between viscous fingering, high-permeability channeling, and low-permeability stagnation at small scales create important features in the spreading and mixing characteristics.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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Primary authors: BONAZZI, Alessandra (University of Southern California); MORVILLO, Maria (University of Southern California); IM, Jinwoo (University of Southern California); Prof. JHA, Birendra (University of Southern California); Dr DE BARROS, Felipe P. J. (University of Southern California)

Presenter: BONAZZI, Alessandra (University of Southern California)

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