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A pore-scale investigation of dispersion in two-phase flow with varied viscosity contrast in porous media

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Dispersion in partially saturated porous media has many applications in scientific and engineering fields. For example, in carbon dioxide capture and storage (CCS), dispersion increases the mass transfer rate and accelerates the dissolution process in large background velocity field (Tsinober, 2022). In this study, we create a steady-state system that mimics a depleted oil field where salty water and oil co-exist. A tracer cloud is injected into a cylindrical container where sands are densely packed, representing a supercritical CO2 cloud that can mix with the surrounding water in a porous media. The impact of oil viscosity on dispersion behaviors was investigated in a large range of viscosity contrast of non-wetting phase and wetting phase from 0.65 to 500.

The results inform dispersion scale was drastically extended with the increase of viscosity contrast. An increase in viscosity contrast yields more heterogeneities of the local velocity field generated by trapped oil with a wide variation of its volumes. The local heterogeneity causes surface distortions and increases the interfacial area of the tracer cloud and surrounding brine water. The dispersion coefficients vary with time and exhibit abnormal behaviors, especially when the oil viscosity is large.

These results can be attributed to the fact that the oil phase becomes disconnected, and the volume of trapped oil decreases as the oil viscosity increases (Suwandi et al., 2022). An oil film is observed, where oil is sandwiched by sand and water and narrows pore spaces. The velocity of the water phase exhibits an extensive range of fluctuation, which may contribute to the enhanced dispersion and mixing state, even with the low connectivity of the water phase.

This study provides insights into dispersion in porous media where oil and water co-exist with varied oil viscosities at both the large and pore scales, which may provide an insight into the storage condition of CO2 in partially saturated porous media (Li, 2022).

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References

Li, Y. et al. (2022). In-Situ Imaging of CO2 Trapping and Oil Recovery in Three-Phase Systems: Dependence on Pore Geometry and Wettability. SPE Journal, 1–15. Suwandi, N., Jiang, F., & Tsuji, T. (2022). Relative Permeability Variation Depending on Viscosity Ratio and Capillary Number. Water Resources Research, 58(6). https://doi.org/10.1029/2021WR031501 Tsinober, Avihai, Ravid Rosenzweig, Holger Class, Rainer Helmig, and U. S. (2022). The Role of Mixed Convection and Hydrodynamic Dispersion During CO2 Dissolution in Saline Aquifers: A Numerical Study. Water Resources Research, 58(3), e2021WR030494. https://doi.org/10.1029/2021WR030494

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