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Temperature Dependency of Steady-State Relative Permeability Curves: Aquistore CO2 Storage Site, Canada

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Large-scale subsurface CO2 storage has been recognized as a promising technology to mitigate carbon emissions in the atmosphere. Relative permeability with phase saturation is an essential flow parameter for quantifying and modelling injectivity, gas storage capacity, and containment of geological formations for CO2 storage. The drastic impact of temperature fluctuations, due to CO2 injection cycles in deep (hot) saline aquifers (e.g., Aquistore CO2 storage site, Canada), on hydro-mechanical properties of rock has been well-established. However, experimental studies on temperature-dependent relative permeability have reported conflicting results regarding the consistency of shifts in end-point saturations and mobility. We implemented a series of core-flooding experiments on the deadwood sandstone (Aquistore) using the modified Hassler method in which two fluids are simultaneously injected into the core at declining brine fractional flow rates. Using this method, we present steady-state isothermal drainage relative permeability at three temperatures (20, 45, and 70^{o}C) and 30 MPa effective confining stress. We find a systematic rightward shift in relative permeability curves in response to an increase in temperature. We further find a 10% and 48% increase in irreducible brine saturation and end-pint gas mobility, respectively, increasing temperature from 20^{o}C to 70^{o}C. Intuitively, these results indicate an increment in rock's affinity to the brine (i.e., increase in hydrophilicity) with temperature. These experimental observations underscore the significant effect of temperature on multiphase fluid flow in porous media, leading to a more accurate characterization of fluid-fluid displacement mechanisms for CO2 injection in deep saline aquifers.

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References

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Participation

Unsure

Primary author: Dr HAGHI, Amir (University of Alberta)

Co-author: Dr CHALATURNYK, Richard (University of Alberta)

Presenter: Dr HAGHI, Amir (University of Alberta)

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