Contribution ID: **695** Type: **Poster (+) Presentation**

Magnetic Resonance Imaging of Fluid Compositions in CO2 Displacement of Decane in Berea Sandstone

Thursday, 3 June 2021 14:40 (1 hour)

Volume changes on mixing can significantly affect the flow of non-ideal mixtures in porous materials. In the case of a significant excess volume, the law of conservation of volume, instead of mass, governs flow equations. Such profound thermodynamic effects affect the modeling of many multicomponent fluid flow processes in porous materials. Despite theoretical advancements in this regard, in-situ experimental data is still very limited, especially in systems in which the effect of dispersion is significant. The carbon dioxide/decane mixture is a simple two-component system that can form miscible and immiscible phases and model such complex behavior.
We utilized magnetic resonance methods to study the flow of carbon dioxide/decane mixtures in Berea sandstone at conditions where dispersion and thermodynamics effects are significant. Conventional magnetic resonance instruments and methods cannot image fluids at high-pressures and quantitatively –without significant losses of short-lifetime signal components. We employed a high-pressure controlled-temperature environmental metallic sample holder with an integrated radiofrequency probe that permits experiments at up to 35 MPa and 80℃. MRI methods, including Centric Scan Single-Point Ramped Imaging with T1-Enhancement (SPRITE), T2-Mapping Spin-Echo Single Point Imaging (SE-SPI), and π Echo-Planar Imaging (πEPI), in addition to free induction decay and CPMG methods continuously monitored the flow process.
MRI methods imaged fluid compositions of the carbon dioxide/decane mixture during CO2 injection into decane-saturated Berea sandstone core plugs. MRI methods and parameters employed in this work were precise enough to permit accurate evaluation of partial derivatives of composition with respect to time and position in miscible, 9 MPa, and immiscible, 6 MPa, conditions –both at 40℃. Temporal and spatial derivatives of composition were acquired with a smoothing spline interpolation and processed to compute compositional wave velocity, dispersion coefficient, and the advection-dispersion kernel. The correlation of wave velocity with composition revealed the movement of leading and trailing shocks in agreement with fluid displacement theories and thermodynamics of carbon dioxide/decane mixtures. Local minima of wave velocity coincided with the extremum of mixture's excess volume. Magnetic resonance relaxation provided information about the composition of fluids in close proximity of the rock surface, complementary to compositions acquired by MRI.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

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