Contribution ID: **444** Type: **Poster (+) Presentation**

Experimental Investigation of Capillary Number's Control on Stress-Dependent Shifts in Irreducible Saturation in Deformable Porous Media

Monday, 31 May 2021 19:35 (1 hour)

Characterization of irreducible saturation of the wetting phase during multiphase fluid flow in porous media is essential for an accurate estimation of CO2 storage capacity and hydrocarbon recovery of the geological formations. Despite pore deformation has been shown to significantly control single-phase and multiphase fluid flow in porous media, the interactive controls of capillary number and mechanical pore deformation on irreducible saturation during multiphase fluid flow in geo-materials is not yet fully explored. In this study, the stress-dependent shifts of irreducible water saturation (Swir) of a Berea sandstone and an Indiana limestone specimen are investigated through series of two-phase (water-N2) core-flooding experiments (i.e., drainage) under increasing effective stress from 10 MPa to 30 MPa and isothermal (40°C) conditions. We used X-ray computed micro-tomography to quantify changes in the topology of the pore-space with effective stress. The controls of the capillary number on the stress-dependent shifts of Swir is studied through experiments under constant injection rate and constant injection pressure conditions, independently. We find a 22% and 52% decrease in Swir of Berea sandstone and Indiana limestone, respectively, in response to an increase in effective stress under constant injection rate (i.e., increasing capillary number) condition. We further find a 27% increase in Swir of Indiana limestone with the same increase in effective stress under constant injection pressure (i.e., decreasing capillary number) condition. We reveal that the deformation of the pore throats, due to an excess effective confining stress, and changes in the driving energy for the gas phase to invade smaller channels, due to an increase/decrease in capillary number, leads to a decrease/increase in Swir of both specimens. These micro-scale and macro-scale observations underscore the remarkable control of capillary number on deformation-dependent fluid-fluid displacement in porous media, which pave the way for relevant research in geoscience and engineering.

Time Block Preference

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

References

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