Contribution ID: **387** Type: **Oral Presentation**

Understanding the influence of pore-scale structural heterogeneity in CO2 geo-sequestration

Tuesday, 31 May 2022 12:15 (15 minutes)

1. Introduction
   Of the viable strategies outlined by the Intergovernmental Panel on Climate Change (IPCC) for atmospheric emission reduction strategies and technologies, geological storage of CO2 holds an enormous promise with the potentials to have significant impacts on emission and atmospheric CO2 reduction. Predicting the behavior of CO2-brine in the complex heterogeneous porous structure of reservoir rocks as well as the interaction between these fluids with minerals in rocks are important for designing and managing CO2 storage sites in CCS technology. To increase the effectiveness of the underground CO2 sequestration, the multiphase-flow and its relevant mechanisms that change the distribution and concentration of the underground CO2 must be assessed. To date, CO2 geo-sequestration as a complex multiphase fluid flow in heterogeneous rock systems has not yet been given enough attention due to various reasons including lack of high quality experimental data, coupled fluid-fluid-rock interaction that is made even more complex due to rock heterogeneity, difficulty of in-situ experimentation and acquisition of usable data etc.
2. Materials and Methods
   The focus of this research is directed towards understanding the role of rock heterogeneity on the safety and capacity of CO2 geo-sequestration at the pore and core scales. We will present a pore-scale tomographic and experimental study of CO2 trapping mechanisms in homogeneous and heterogeneous sandstones. The in-situ experiments consist of multiple sets of drainage and imbibition experiments on three sandstone rocks with different types of heterogeneities. The working fluids in the experiments were super-critical CO2 (scCO2)and Potassium Iodide (KI) brine. High resolution X-ray micro Computed Tomography (XCT) scans were acquired to resolve pore scale features and fluid distribution in the system. The experimental setup [1] is composed of a high pressure/temperature triaxial flow cell for in-situ flow experiments.
3. Results and Conclusion
   Rock heterogeneity at the pore scale can be mapped in 3D and we have correlated rock morphology with multi-phase fluid distribution. Our results show larger amounts of trapped scCO2 in heterogeneous rock compare with the homogeneous ones at a high rate. Residual scCO2 are mostly trapped in pores with larger radii with high aspect ratios. Moving toward pores with smaller radius and aspect ratio decreases the amount of scCO2 in the pores. We have also conducted in-situ cyclic brine-CO2 flooding experiments, and our results show that residual CO2 accumulates in layers parallel to the low-perm lamination layers, and primarily below the layers present in the rock. Further, we observe that scCO2 saturation profiles below the low-perm layers align after drainage. These results agree with the conceptual model that the cyclic fluid injection creates a preferential high-flow pathway below the low-perm layer [2]. We observe that at low flow rates; the capillary trapped CO2 increases in volume as the number of injection cycle increases, however, at high flow rates, lower residual trapping of CO2 is observed.

Acceptance of the Terms & Conditions

Click here to agree

MDPI Energies Student Poster Award

Yes, I would like to submit this presentation into the student poster award.

Country

Australia

References

[1] P.E. Øren et al. https://dx.doi.org/10.2139/ssrn.3366008
[2] A. L. Herring, et al. https://doi.org/10.1029/2021WR030891

Time Block Preference

Time Block A (09:00-12:00 CET)

Participation

Unsure

Primary author: DARAEI GHADIKOLAEI, Farshad (Mr.)

Co-authors: HERRING, Anna (The Australian National University); KNACKSTEDT, Mark (Prof); SAADATFAR, Mohammad (Australian National University (ANU))

Presenter: DARAEI GHADIKOLAEI, Farshad (Mr.)

Session Classification: MS01

Track Classification: (MS01) Porous Media for a Green World: Energy & Climate