Contribution ID: **62** Type: **Oral Presentation**

Brine drying and salt precipitation in porous media: microfluidics quantification of pore heterogeneity and wettability impact

Wednesday, 24 May 2023 12:45 (15 minutes)

Deep saline aquifers are promising CO2 geological sequestration sites with wide distribution and large storage capacity. Pilot projects have shown that the injection of CO2 into saline aquifers can lead to brine drying and salt precipitation, and eventually injectivity reduction. The interplay between gas injection, brine drying and salt precipitation determines the distribution of resulted salt crystals thus the impact on injectivity reduction. This dynamic process is influenced by rock properties (e.g., pore heterogeneity, surface wettability), initial salt concentration, gas injection rate, drying condition, etc. Laboratory experiments lead to inconsistent conclusions about these controlling factors, which indicates the lack of understanding of the mechanisms involved and hinders our prediction capability. Particularly, the pore heterogeneity and wettability of natural rock samples vary largely from site to site, and their impact on this dynamics process requires more detailed investigations. This study implements microfluidics to characterize pore-scale dynamics of brine drying and salt precipitation. We fabricate radial flow microfluidic chips with varying pore-space heterogeneity and surface wettability. A digital microscope records air invasion, brine drying and salt precipitation processes, while a pressure sensor monitors the injection pressure. We adopt a deep learning algorithm to automatically segment different phases, i.e., air, brine and salt crystals, in pore channels, which enables quantifying drying and precipitation rates and the evolution of brine clusters and salt crystals. Preliminary results indicate that pore heterogeneity determines the distribution of residual brine, i.e., increasing pore heterogeneity leads to more residual brine and salt precipitation. Also, the capillary backflow in hydrophobic chips significantly increases the accumulation of ions and salt precipitation near the drying front. In contrast, capillary backflow is absent after gas breakthrough in the hydrophobic chip, which results in the least amount of salt precipitation at the drying front. The quantitative results enable further statistical analyses on the evolution of brine cluster and salt crystals and their dependence on pore heterogeneity and surface wettability.

Participation

In-Person

References

MDPI Energies Student Poster Award

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

Country

Ireland

Acceptance of the Terms & Conditions

Click here to agree

Energy Transition Focused Abstracts

This abstract is related to Energy Transition

Primary authors: Mr ZHANG, Hui (School of Civil Engineering, University College Dublin, Dublin, Ireland); Dr SUN, Zhonghao (School of Human Settlements and Civil Engineering, Xi'an Jiaotong University, Xi'an, China); Dr ZHANG, Nan (School of Mechanical and Materials Engineering, University College Dublin, Dublin, Ireland); Dr ZHAO, Budi (School of Civil Engineering, University College Dublin, Dublin, Ireland)

Presenter: Mr ZHANG, Hui (School of Civil Engineering, University College Dublin, Dublin, Ireland)

Session Classification: MS11

Track Classification: (MS11) Microfluidics and nanofluidics in porous systems