Contribution ID: **465** Type: **Oral Presentation**

Stability of two-phase flow with interfacial flux in CO2 mineralization: Theory for complex system evolution

Thursday, 22 May 2025 12:35 (15 minutes)

The primary objective of Carbon Capture and Storage (CCS) applications in porous media is to achieve a stable and planar CO2 displacement front, thereby suppressing viscous fingering. Particularly, a stable front can ensure uniform and exhaustive carbonation throughout a reactive medium. Drawing inspiration from experimental observations of CO2 flooding into cores of portland cement-based materials, we examine the stability of such systems. Focusing on the early injection time allows us to reduce the complex problem, typically involving thermo-hydro-mechanical-chemical interactions, into a two-phase flow scenario of immiscible displacement with an interfacial flux (from the invading CO2 phase into the resident water solution). This simplification is then justified a posteriori.

The formulated equations with the interfacial flux term are used to investigate the development of a saturation profile and define a base-state solution for linear stability analysis. Assuming negligible capillary forces and a step-profile allows us to derive a closed-form stability criterion. Findings show that the interfacial flux can either suppress or promote perturbations depending on the saturation profiles, typically leading to stability enhancement. Implications are then briefly drawn. Finally, this research demonstrates the important role of theory in simplifying complex multi-physical and scale processes and inferring the ultimate state of subsurface systems.

Country

United States

Acceptance of the Terms & Conditions

Click here to agree

Student Awards

Water & Porous Media Focused Abstracts

References

Roded, R., & Dalton, L. E. (2024). Stability of two-phase flow with interfacial flux in porous media: CO2 mineralization. Physics of Fluids, 36(11). https://doi.org/10.1063/5.0237389.

Primary authors: Dr DALTON, Laura (Duke University); RODED, Roi (The Hebrew University)

Presenter: Dr DALTON, Laura (Duke University)

Session Classification: MS25

Track Classification: (MS25) Advances in Carbon Mineralization: Unveiling Multiscale Geo-processes and Coupled Mechanisms