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# Dynamic imaging of the impacts of flow instabilities and rock heterogeneity on CO2 plume migration

*Thursday, 3 June 2021 10:15 (15 minutes)*

Flow instabilities such as gravity override and viscous fingering, as well as rock heterogeneity could impact the CO2 plume migration during storage operations in underground formations. This consequently impacts the CO2 storage capacity of formations. Although over the past decade a significant amount of work has been conducted on the topic of CO2 storage in underground formations, the interplay between flow instabilities and rock heterogeneity and how much each could control the plume migration are not fully resolved. Current limitations in understanding are mostly due to the small dimensional size (1.5") of the samples in the majority of reported laboratory experiments. This undermines the impact of flow instabilities on the gas front and can not fully capture large-scale rock heterogeneity.

To address this gap of knowledge, we conducted a series of fluid-flow experiments in meter-long 4"Bentheimer and Boise sandstone outcrop cores using a high-pressure core flooding rig equipped with a medical X-Ray CT scanner. The cores were initially saturated with a synthetic brine where the cores'heterogeneity structures were identified by 3D image processing of the medical CT data. Brine-saturated cores were horizontally flooded with nitrogen, and their dynamic 3D flow patterns and fluid distributions were studied by analyzing captured 3D volume data sets. The results show that for the case of the Bentheimer core, which is much less heterogeneous compared to Boise, the plume migration is mostly controlled by buoyancy forces with heterogeneity-induced gas channeling occurring at the bottom side of the core. On the other hand, for the case of Boise, the rock structural heterogeneities led to stronger gas channeling which consequently reduced the vertical plume migration driven by buoyancy forces and improved the storage potential of the gas compared to homogenous cases. The results show that depending on the rock heterogeneity and heterogeneity direction, gas channeling could occur which could hinder the vertical CO2 plume migration driven by buoyancy forces and improve the storage capacity of the storage site.

## Time Block Preference

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

## References

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