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The Impact of Capillary Heterogeneity on CO2 Plume Migration at the Endurance CCS Target Site in the UK –A Core To Field Scale Study

Tuesday, 23 May 2023 12:00 (15 minutes)

The characterisation of multiphase flow properties is key to predict large-scale fluid behaviour in the subsurface, such as the migration of a carbon dioxide (CO2) plume at a Carbon Capture and Storage (CCS) site. Many CCS sites have displayed unexpected fluid flow behaviour, where the CO2, once injected, migrated away from injection wells at significantly higher rates and in different orientations to what had been predicted with reservoir simulations. Recent studies have demonstrated that conventional reservoir models are not incorporating the impact of small-scale heterogeneities in multiphase flow properties, such as capillary heterogeneity. In this work, we combine experimental and numerical methods to model the impact of capillary heterogeneity on CO2 plume migration at the proposed Endurance storage site. The site supports the Northern Endurance Partnership (NEP) serving the Zero Carbon Humber and Net Zero Teesside projects in the UK. We build small-domain, fine-scale models, populated with well and experimental data from the Endurance site. These models are used to infer the impact of heterogeneity on CO2 flow in 3D with the full physics represented. Our results show that capillary heterogeneity can lead to a 3-fold increase in the relative CO2 migration speed, underscoring the importance of characterising and incorporating it within reservoir models. Using the results, we then build a full field-scale 3D model of the Endurance site. We apply a novel upscaling scheme, originating in the work of Jackson & Krevor (2020), to model the impact of heterogeneity, buoyancy and structure on CO2 migration. Our results emphasize the prevalent impact of small-scale capillary heterogeneities on CO2 plume migration.

Participation

In-Person

References

Jackson, S. J., & Krevor, S. (2020). Small-scale capillary heterogeneity linked to rapid plume migration during CO2 storage. Geophysical Research Letters, 47, e2020GL088616. https://doi.org/10.1029/2020GL088616

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