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# Trapping, Hysteresis and Ostwald Ripening in Hydrogen Storage: A Pore-Scale Imaging Study

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Gas injection and withdrawal in the subsurface can be considered as a long-term energy storage solution. Green gas can be produced from the excess electricity during peak production and can subsequently be injected into the surface reservoir and withdrawn during times of high demand. Repeated injection and withdrawal of gas causes capillary pressure hysteresis –in this work we use X-ray tomography to understand the hysteresis phenomenon, which can be applied in operating underground hydrogen storage processes. Two experiments were performed at an unsteady state to investigate gas and water distribution in different pore space geometries during drainage and imbition cycles. Gas phase was injected into 6 cm long samples of Bentheimer sandstone and Estaillades carbonate at ambient temperature and a pore pressure of 1 MPa, followed by water flooding in three cycles. The gas flow rates decreased from 2 ml/min to 0.08 ml/min while the brine injection rate was keeping constant during the three cycles. We observe and quantify several interesting phenomena including (I) capillary pressure hysteresis, and (ii) hydrogen migration by Ostwald ripening through diffusion of gas dissolved in the brine. We characterise these phenomena by analysing interfacial curvature and area, along with wettability and pore occupancy analysis. This work provides pore-scale insights into hydrogen storage and withdrawal and uses image-based analysis to quantify multiphase flow properties for input into the reservoir-scale simulation.

## Participation

In-Person

## References

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