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Impact of hydrogen trapping in underground porous formations on recovery efficiencies during interseasonal storage injection and withdrawal cycles

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To meet the global commitments for net zero carbon emissions our energy mix must transition away from fossil fuels. Hydrogen is gaining increasing recognition as a low carbon energy option to support this energy transition, tackling the hard to abate sectors such as decarbonising domestic and industrial heat, power generation and heavy-duty transport. It can also promote increased renewable energy uptake by acting as an energy store to balance supply and demand. For hydrogen to be deployed at the scales required for net zero, we will need access to large-scale geological storage. Depleted porous gas fields provide both the required TWh storage capacity and production rates that can be delivered over many months. Interseasonal hydrogen storage in underground porous formations involves complex displacement and trapping mechanisms that can influence recovery efficiencies over time and as such the economic feasibility of any underground porous formation hydrogen storage operation.

The talk will present the findings from our ongoing research into hydrogen displacement and trapping in porous media during multiple drainage and imbibition cycles, undertaken using x-ray computed micro-CT, micromodels and conventional core flooding experimental equipment. Our results indicate that hydrogen behaves as a non-wetting fluid filling the centre of the pores, with residual brine in the pore corners and throats. During multiple injection and withdrawal cycles we demonstrate that hydrogen trapping occurs via snap-off of hydrogen ganglia. Our work also demonstrates that the magnitude of the trapping depends on flow rate, pore fluid pressure and pore size distribution. This suggests that appropriate site selection and management of hydrogen injection and withdrawal rates can create the opportunity to minimise hydrogen trapping, optimising recovery efficiencies and the economic feasibility of underground porous formation hydrogen storage operations.

Participation

In-Person

References

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