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Pore-scale observations of hydrogen trapping and migration in porous rock

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We use high-resolution three-dimensional X-ray imaging to study hydrogen injection and withdrawal in the pore space of Bentheimer sandstone. The results are compared with a replicate experiment using nitrogen. We observe less trapping with hydrogen because the initial saturation after drainage is lower due to channelling. Remarkably we observe that after imbibition, if the sample is imaged again after 12 hours, there is a significant rearrangement of the trapped hydrogen. Many smaller ganglia disappear while the larger ganglia swell, with no detectable change in overall gas volume. For nitrogen, the fluid arrangement seems largely unchanged. We suggest that this rearrangement is facilitated by concentration gradients in the aqueous phase –Ostwald ripening –and provide an estimate of the time-scales for the effect to be significant, which are consistent with the experimental observations. The work implies that there is less capillary pressure hysteresis in hydrogen storage, promoting hydrogen withdrawal efficiency.

Participation

In-Person

References

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