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Analysis of CO2 trapping potential by combining morphology-based digital rock simulations and pore-scale flooding experiments

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In the eye of climate change, Carbon Capture and Storage (CCS) gained importance as a large-scale option to permanently sequester CO2. To ensure storage safety, it is crucial to understand trapping mechanisms and the trapping potential. To do so in a time-efficient way, the application of Digital Rock Physics Simulation has become a major tool. The presentation will focus on capillary trapping by re-imbibition simulated by means of the morphological approach and benchmarked by pore-scale flooding experiments.

Using the data of flooding experiments with in-situ pore scale imaging, fluid configurations in digital twins of various sandstone samples were simulated and compared to experimental results. To compute the trapping potentials of those rocks, simulations of primary drainage and subsequent imbibition processes were performed based on the morphological method. From the results, land trapping model constants were calculated depending on the initial and residual CO2 saturations of the imbibition processes. For obtaining realistic results, we make use of recent developments in the frame of the morphological approach in digital rock physics by Arnold et al. Prior to that, only spontaneous imbibition processes could be simulated, now extended to the whole imbibition branch including forced imbibition. Also, the effect of wettability and contact angle variation is considered in a stochastic and deterministic way. Simulations of multiple scenarios with varying input parameters were performed to benchmark against experimental results and as first step towards stochastic input for reservoir modeling.

Participation

In-Person

References

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