
DTU

In Situ Imaging of Dynamic Processes in Chalk

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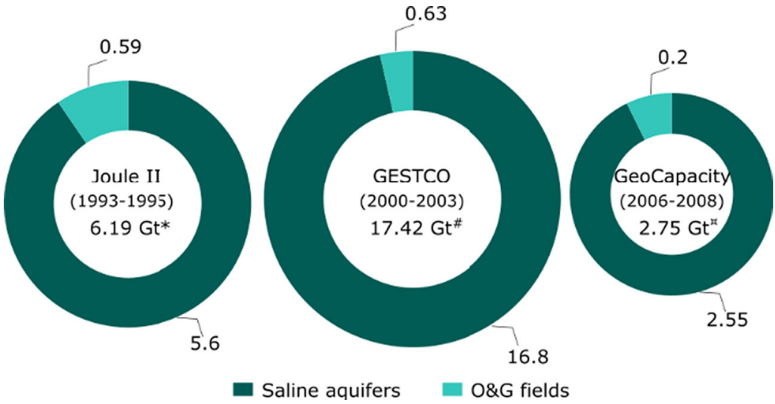
Motivation



Danish carbon storage capacity (Bonto et al., 2021).

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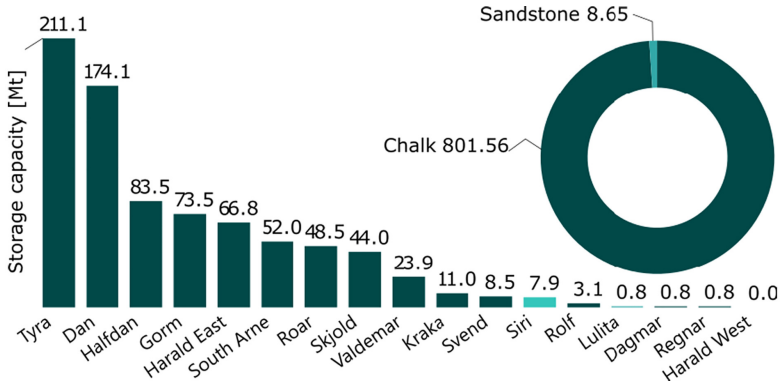
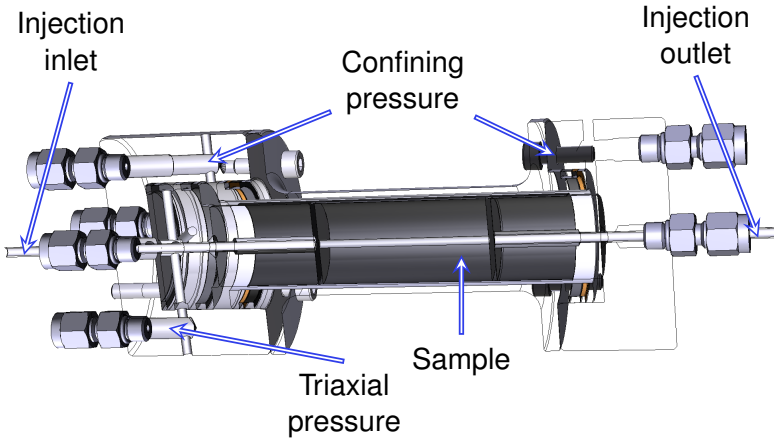
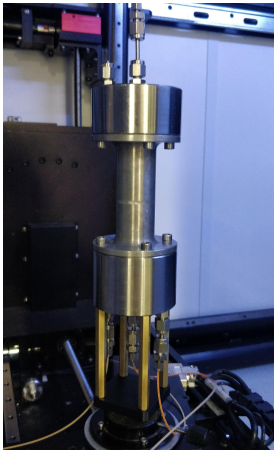


Danish North Sea carbon storage capacity (Bonto et al., 2021).

Triaxial Flow Cell



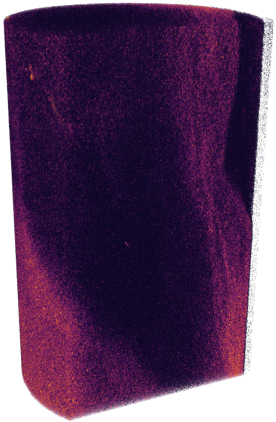
Experimental Setup



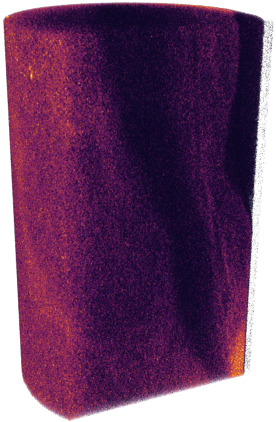
(a) Flow Cell Inside a CT Scanner.

(b) Chalk Sample outside of Cell.

Tracer Studies



(a) Tracer front after 1 PVs of injection.



(b) Tracer front after 1.7 PVs of injection.

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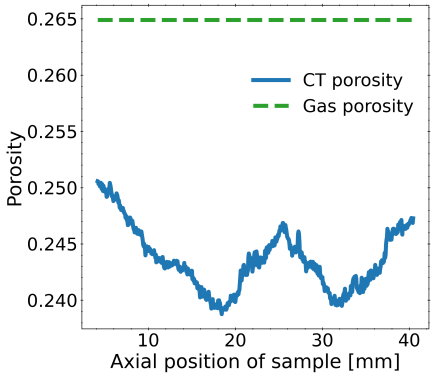
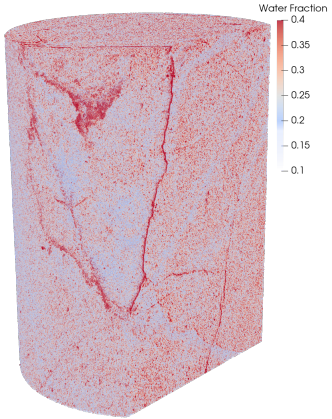
- We want to examine the impact of injecting CO_2 on the porosity of chalk.
- The spatial porosity of a chalk sample can be calculated using

$$p = \frac{CT_{wet} - CT_{dry}}{\mu_{water} - \mu_{air}}$$

Spatial Porosity – Case 1

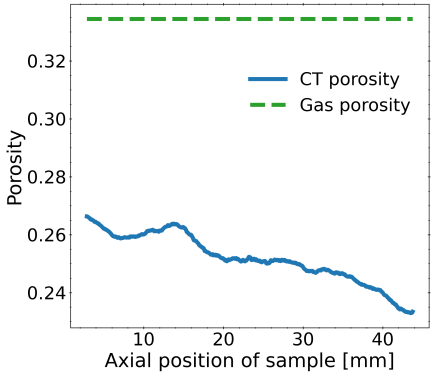


(a) Axial porosity of sample.



(b) 3D image of porosity distribution.

Spatial Porosity – Case 2



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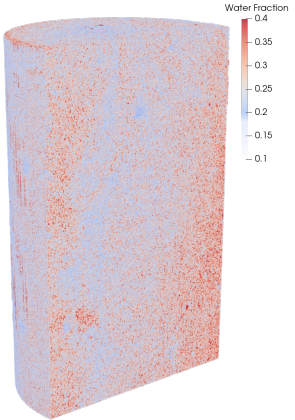

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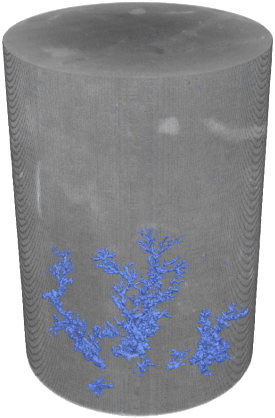
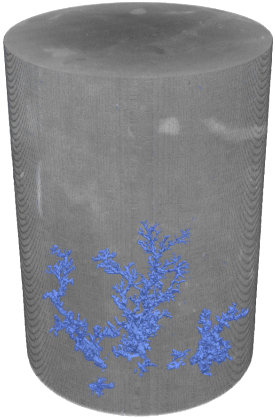
- We wanted to see how the injection affected porosity.
- We explicitly wanted to test the dynamic capabilities of our setup and therefore used a concentrated acid (0.005 mol/L or 2.3 pH) to promote fast dissolution.
- We calculated the Péclet and Damköhler numbers to be 1.32×10^{-2} and 4.7 (Gray et al., 2018).

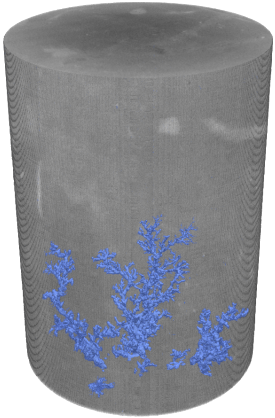
Dissolution of Sample #2



(a) Chalk sample after 89.95 PVs of injection.



(b) Chalk sample after 91.45 PVs of injection.



(c) Chalk sample after 92.98 PVs of injection.

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  - We have sufficient temporal resolution to capture dynamic behaviour.
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  - Calculating the porosity after dissolution.
  - Injecting CO_2.

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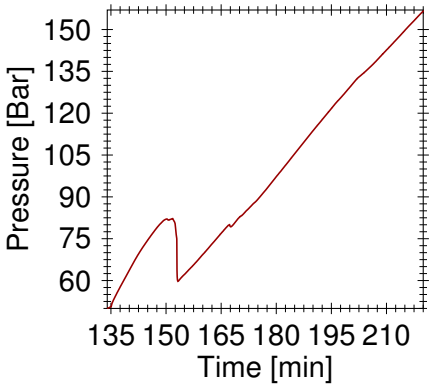
References

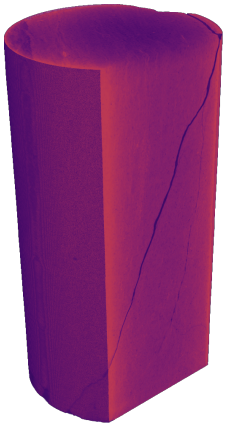
- Bonto, M. et al. (2021). “Challenges and enablers for large-scale CO2 storage in chalk formations”. In: *Earth-Science Reviews* 222, p. 103826. ISSN: 0012-8252. DOI: https://doi.org/10.1016/j.earscirev.2021.103826. URL: https://www.sciencedirect.com/science/article/pii/S0012825221003275.
- Gray, F. et al. (2018). “Chemical mechanisms of dissolution of calcite by HCl in porous media: Simulations and experiment”. In: *Advances in Water Resources* 121, pp. 369–387. ISSN: 0309-1708. DOI: https://doi.org/10.1016/j.advwatres.2018.09.007.

Bonus Slides

Compaction Experiment



(a) Axial pressure on sample.



(b) 3D image of fractured core.