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Contribution ID: **431** Type: **Poster (+) Presentation**

Strain evolution, faulting, and slow slip in Draupne shales

Tuesday, 1 June 2021 20:00 (1 hour)

New developments in carbon capture and storage (CCS) technology are under constant demand, and current initiatives focus on evaluating the possibility to store carbon dioxide (CO2)below the seabed in the North Sea 1. The Draupne Formation is a promising candidate and acts as a caprock for deeper reservoirs [2]. Injection of CO2 in such formations could cause changes in the in-situ stresses, resulting in fault reactivation or the creation of microfractures, and thus alter the performance of the caprock. The ability of shale caprock seals to prevent CO2 leakage is a major concern for the geological storage of anthropogenic CO2 emissions, however, the micromechanisms of the crack formation are not well understood.
Time-lapse synchrotron-based micro computed tomography (μCT) imaging has made it possible to study non-destructively the mechanical behaviour of rocks. By using an advanced rock deformation apparatus, the HADES triaxial rig [3-5] (Fig. 1a), conditions similar to those found in the natural environments at kilometer depths below the seabed can be reproduced during dynamic μCT experiments.
Here, we combine μCT and digital volume correlation (DVC) analysis [4] to measure the mechanical properties of a Draupne shale sample when loaded under reservoir conditions. In the sample, brittle failure occurred and slip accumulated on the newly created fault [6]. Detailed quantitative analysis of the data using DVC reveals complex temporal three-dimensional (3D) patterns of the evolving strain. Interestingly, changes in the linear region of stress-strain are found to be irreversible. Intermittent bursts of deformations at apparently random locations are observed, and they gradually converge to a localized major fracture plane developing across the sample (Fig. 1c). Localization of the strains before the formation of the macroscopic fault can be quantified. Creep on the major fracture was observed which shows that slow deformation in shales can be related to the slip-on faults and not only to bulk creep. Visualizations and calculations of the volumetric and von Mises strains help quantifying the evolving strain within the sample (Fig. 1d).
Time-resolved μCT in combination with DVC reveals the local mechanics in Draupne shale, and is a promising method to understand the microstructural geomechanics of these rocks for the application of CO2 sequestration.

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Time Block Preference

Time Block B (14:00-17:00 CET)

References

References
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