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Contribution ID: **461** Type: **Oral Presentation**

In-Situ Micro-CT Studies to Understand the Role of Salt Precipitation during CO_2 Storage in Saline Aquifers

Monday, 31 May 2021 15:10 (15 minutes)

CO_2 injection into underground geological formations, particularly saline aquifers, causes the removal of water by evaporation into the CO_2-rich phase. This process triggers salt nucleation and precipitation inside the pores, and therefore, alters the petrophysical properties of the formation rock.
In the context of CO_2 storage, several experimental studies have been conducted at pore and core scales to investigate salt precipitation. While micromodel experiments have provided a 2D insight into salt precipitates at the pore scale [1, 2], core flooding tests have been extensively employed to mimic this process in natural porous media. These core-scale experiments have mostly been used to monitor the petrophysical alterations due to salt precipitation during CO_2 injection and have reported porosity and absolute permeability reductions [3, 4]. The advent of X-ray microtomography (micro-CT) has facilitated the rapid, non-destructive, in-situ 3D imaging of rock-fluid systems. This technique provides a comprehensive pore-scale characterisation of rock samples down to microns, as well as the distribution, morphologies, and characteristics of the occupying fluids. However, using micro-CT scanning for monitoring such a flow process is challenging due to high-pressure/high-temperature (HPHT) subsurface conditions, which need to be replicated because of the dramatic impact of such conditions on fluid properties and fluid/rock interactions.
In this work, we aim to investigate salt precipitation induced by CO_2 injection in natural porous media by providing direct, 3D pore-scale evidence using in-situ HPHT micro-CT imaging. Although this technique has been extensively used to study many CO_2 storage related topics, it has rarely been utilised for imaging the potential petrophysical alterations due to salt precipitation during storage operations. Accordingly, we have designed and developed a unique HPHT micro-CT core flooding system, which is an excellent tool for providing valuable 3D information of flow processes at realistic subsurface conditions. The system consists mainly of two parts: (1) the micro-CT instrument itself capable of performing high-resolution scans down to a nominal pixel size of 3 microns; and (2) the HPHT flooding system, the main part of which is an X-ray transparent flow cell, capable of withstanding elevated pressures and temperatures to provide the conditions of typical deep saline aquifers.
Despite the numerous experimental studies published in this area, the impact of salt precipitation on the flow paths of the injected CO_2 and the potential alteration of its effective permeability is still a subject of discussion. Hence, the main objective here is to investigate the nucleation, precipitation, and dry-out mechanisms, as well as the extent of injectivity reduction at the pore scale. Accordingly, micro-CT scanning of the drying process of a brine-saturated rock sample (diameter $\approx$ 5 mm) by dry gas injection is conducted. The analysis of the CT images taken before and after the experiments quantifies the precipitate particle sizes, the extent of pore size alterations, and the pattern of precipitation. Moreover, this presentation explores different injection conditions mimic the potential of salt precipitation at different distances from the injection well and analyses the resulting patterns of such a process.

Time Block Preference

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

References

[1] M. Kim, A. Sell, D. Sinton, Aquifer-on-a-Chip: understanding pore-scale salt precipitation dynamics during CO2 sequestration, Lab on a Chip, 13 (2013) 2508-2518.
[2] R. Miri, R. van Noort, P. Aagaard, H. Hellevang, New insights on the physics of salt precipitation during injection of CO2 into saline aquifers, International Journal of Greenhouse Gas Control, 43 (2015) 10-21.
[3] N. Muller, R. Qi, E. Mackie, K. Pruess, M.J. Blunt, CO2 injection impairment due to halite precipitation, Energy procedia, 1 (2009) 3507-3514.
[4] G. Bacci, A. Korre, S. Durucan, Experimental investigation into salt precipitation during CO2 injection in saline aquifers, Energy Procedia, 4 (2011) 4450-4456.

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