Salt precipitation in carbonate and sandstone core samples following complete diffusive evaporation under various boundary conditions: Homogeneity of the deposits and impact on the flow properties.

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Regarded as a technological pathway to regulate climate change, geological storage of CO_2 is being deeply studied in several countries. Since 2005, the French Research Agency (ANR) has funded several projects on this crucial topic. Storage in deep saline aquifers has several advantages and the first projects dealt with site selection, reservoir injectivity, cap rock integrity, and surface monitoring. A large amount of experimental results was collected and many questions found an answer. But also several more specific questions arose.

Among those questions was the risk of permeability alteration in the near wellbore region due to salt precipitation because of the drying induced by the large volume of dry CO_2 injected. The injected gas is not in thermodynamic equilibrium with the surrounding water and then water evaporation occurs, followed by salt precipitation.

In this work, salt precipitation experiments were conducted on carbonate and sandstone core samples under two different controled drying procedures in order to quantify the impact of salt precipitation on the intrinsic permeability and inertial coefficient and also the impact of boundary conditions.

The first group of core samples (3 sandstone and 3 carbonate samples for each of the 6 KCl concentration levels investigated) was dryed under constant temperature in a ventilated oven while only the two faces of the core were exposed to evaporation. The drying procedure of the samples involved several cycles to try to get homogeneous salt deposition. Each cycle consisted in exposing the samples to an oven temperature of 40°C during one hour and then to room temperature during three hours in order to reach equilibrium conditions for the dissolved salt saturation.

The impact of salt deposition was evaluated on both the intrinsic permeability and the inertia coefficient of each sample. Those properties where measured before and after exposure to salt deposition. For all samples, results show a permeability reduction related to an increase of the inertia coefficient. Sandstone samples were less impacted than carbonate samples. Spatial distribution of the salt deposits in the samples has been analysed by means of a X-ray tomographic investigation.

The second group of core samples has been dryed under constant drying conditions at 60°C in a ventilated oven. 5 samples of sandstone, initially fully saturated with KCl at different concentrations are exposed to drying with only one face and this time in one cycle. Spatial distribution is also analysed with X-ray tomography. Strong permeability reduction is observed linked to strongly heterogeneous salt deposit.

We show in this work the strong impact of boundary conditions and initial salt concentration on salt deposit and permeability alteration.

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