

## Changes in sealing performance of artificial caprocks caused by carbonate reactions

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Geological CO<sub>2</sub> storage assumes that a caprock retains injected CO<sub>2</sub> stably within a reservoir. However, there is little knowledge whether the caprock geochemically-reacted over a long time keep equal sealing performance. This study aims to quantify the change of the rock' s sealing performance caused by geochemical reactions.

To understand the rock reaction and the resultant changes in pore structure, it is reasonable to perform experiments under the system with clear reaction process and of controlled pore structures. I used sintered compacts comprising of differently packed uniform silica beads, whose particle size were respectively 0.5, 1 and 10  $\mu\text{m}$ . Here, attention was focused on reactions of carbonate minerals because carbonates have the highest reactivity of usual aquifer minerals. Therefore, products were immersed into the calcium acetate solution and heated up to 700°C, which resulted in the precipitation of carbonates within their pore space. In the current experiment, samples were reacted in a supercritical CO<sub>2</sub>-water system at 10 MPa and 40°C, which corresponds to the condition of 1000 m depth. The reaction was performed separately setting the reaction time to 1, 2, and 4 weeks. Each sample after reactions was made available for the measurement of permeability  $k$ .

It is generally expected that the dissolution of carbonates in rock' s pore space causes an increase in  $k$ , whereas that the precipitation of carbonates results in a decrease in  $k$ . Applying this presumption to experimental results, the  $k$  change caused by carbonate reactions was considered. On high density samples, carbonates dissolve from the sample surface by the CO<sub>2</sub>-dissolved water, but once the surrounding water reaches a concentration saturated to carbonates, no more dissolution occurs. In addition, even if the water does not reach a saturating concentration, most of leaching components have no way out. Therefore, they are concentrated and re-precipitated in the central part of a sample. This scenario expects that the permeability is initially increased and then maintained constant or decreased to a prior level. In contrast, low density samples dissolve more carbonates because of the penetration of CO<sub>2</sub>-dissolved water deep into a sample and of active material transport between surface and interior. This results in an increase in  $k$ . Hereafter, we should quantify the leakage risk through a caprock based on both penetration rate within a rock and the carbonates content.

Keywords: Geological CO<sub>2</sub> storage, Sealing performance, Geochemical reactions, Caprock, Carbonate minerals