Preliminary evaluation on geochemical impacts to rock's sealing performance

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Geologic CO_2 storage supposes that a caprock prevents the leakage of CO_2 to the ground surface. The sealing performance of caprocks is controlled by permeability *k* and threshold pressure P_c^{th}. Many efforts have been undertaken to measure these parameters for rocks obtained from actual storage sites. However, a caprock would be exposed to acidified circumstances over a long period of time. Our knowledge related to the sealing performance of such reacted rock is restricted. Therefore, this study aims to assess quantitatively the change of the sealing performance caused by geochemical reactions.

Six different kinds of rocks, i.e., three mudstones from Namihana Formation, Ohara Formation, and Ichishi Group, and the marlite from Itsukaichi-machi group, and two sandstones of Otomari foraminiferal sandstone and the coquinite from Haizume Formation, were collected from various outcrops located in Japan. These rocks were formed into a cylinder solid, with respective diameter and height of about 14 and 10 mm. Batch-type reaction experiments were done at 40˚C in deionized, distilled water using a supercritical CO_2-water reaction system. A constant CO_2 pressure of 10 MPa was maintained for four weeks at a maximum. After 1, 2, and 4 weeks, the system was opened to extract rock samples. Then, *k* and P_c^{th} of each sample were measured using a capillary pressure measurement system.

Results revealed that the degree of geochemical impacts strongly depends on rock types. Hydrological properties of Namihana and Ohara mudstones, and Haizume coquinite, were unchanged during 4 weeks. In contrast, other three rocks reduced their sealing performance by increasing permeability and decreasing threshold pressure. In fact, Ichishi mudstone and Itsukaichi-machi marlite produced numerous cracks after reactions. Therefore, their hydraulic changes were not caused by geochemical reactions. Consequently, geochemical reactions did damage solely to Otomari foraminiferal sandstone. Here, it is generally expected that rocks containing carbonate minerals would produce leakage paths of CO_2 because carbonates' dissolution rate is generally high. However, results showed no correlation between carbonate amount and hydrological changes. This means that mineral reaction is restricted by rock's internal structure on a microscale. In the presentation, the relationship between geochemical reactions and hydraulic properties will be discussed along with the information about chemical compositions of leached components and pore throat size distributions.

Keywords: Geologic CO2 storage, Sealing performance, Geochemical reaction, Carbonate minerals, Caprock, Threshold pressure

