[JJ] Evening Poster | H (Human Geosciences) | H-SC Social Earth Sciences & Civil/Urban System Sciences

[H-SC05]CCUS (Carbon Dioxide Capture, Utilization, and Storage) for Climate Mitigation

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The prevention of the global warming, which is the urgent challenge facing the world, requires the full-out efforts of science and technology. This session focuses on the CCUS (Carbon Dioxide Capture, Utilization, and Storage) as one of the useful countermeasures for the CO2 emission reduction. It not only targets various scientific phenomenon caused by the capture and storage of CO2, CO2 utilization, and CO2-EOR/EGR, but also discusses the latest R&D developments of each method for the environmental impact assessment, safety assessment, the measuring, monitoring and verification (MMV), and public acceptance.
The main theme is the recognition of key issues toward the practical use of CCUS, in addition to the deepening of our knowledge about the CO2 behavior on the underground.

[HSC05-P07]Evaluation of caprock’s sealing performance over the long term focusing on changes in pore structures and rock’s surface conditions

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To evaluate the sealing performance of a caprock over the long term on geologic CO_2 storage, the effects of geochemical reactions on rock’s hydraulic properties were examined. Among expected reactions, the dissolution of carbonates, whose dissolution rate is fastest in major minerals, is most important because that would have a potential to reduce caprock’s sealing ability. The parameter controlling the sealing performance includes the pore throat size within a rock (i.e., pore structure) and the contact angle (i.e., interfacial state). Therefore, different approaches were adopted for each parameter.

Regarding the change of pore structure, six different types of sedimentary rocks were reacted in CO_2-containing spring waters, which can be regarded as a natural analogue of geologic CO_2 storage, and their hydraulic properties were analyzed. It is generally expected that the growth of carbonates within the pore space of a rock would reduce the permeability and increase the threshold pressure, whereas the dissolution of carbonates would work in reverse. In this study, three of five types of altered rocks fitted with this trend. However, the rest two indicated the inverse correlation. As this reason, it is possible that the dissolved carbonate was re-precipitated.

The artificial silica sintered compact, whose pore space was filled with carbonates, was also used to clarify the relationship between the carbonate content within a rock and the change of rock’s hydraulic properties. The result showed the distinct particle size dependency on the hydraulic property changes. The samples composed of large size silica particles increased their permeability because of the carbonate dissolution, whereas those of smaller-size particles decreased their permeability probably due to the carbonate re-precipitation. In fact, although the re-precipitation might have occurred even on large particle samples, this effect stopped short of filling up the pore space. In contrast, the sample’s permeability under the supersaturated condition with respect to the carbonate was almost constant or decreased slightly. Also in this case, smaller particle samples showed more significant drop of permeability. This means that smaller pore space would be easily influenced by the carbonate reaction. However, such a trend was not necessarily consistent with that of sedimentary rocks. This is probably due to the difference of the carbonate content.

Another purpose in this study is to quantify the changes in rocks’ surface condition using the contact angle. However, its measured value generally has a large margin of error. For this problem, we developed new approach, where the contact angle is estimated from the threshold pressure of the target sample, whose pore throat size is known. The microfabricated rock samples with a pore less than 10 μm were prepared, and its threshold pressure was measured. In the presentation, the applicability of this methodology, along with the measurement limit when the sample permeability is too small, will be discussed.