

The influence of measurement methods on evaluation of threshold pressures

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In site selection process for the geological sequestration of greenhouse gas, threshold pressures should be evaluated as sealing efficiency of a seal layer. Threshold pressure means the minimum gas injection pressure over which constant gas flow will occur through a sealing layer. For evaluating threshold pressure, strictly conditioned tests to reproduce in-situ stress, fluid pressure, temperature and type of injected gas will sometimes be planned. On the contrary, easy evaluation by simple method will sometimes be planned by estimating capillary pressure curves from pore size distributions and surface tensions. The former will provide more strict evaluations of threshold pressures but this process will be limited by using a particular test apparatus. So, researches for comparing the test results from some methods to verify the accuracy of each test have been studied. In the research on CO₂ geological sequestration, three methods are usually used; i.e. (1) threshold pressure test using supercritical CO₂, (2) threshold pressure test using N₂ gas, (3) threshold pressure estimation from a mercury intrusion test result. In abroad, some researcher report that the results from different methods are consistent considering the surface tensions of relevant fluid system, but others say that the results are inconsistent because of the sample preparation process or anisotropy of samples. Also, there are only few studies in Japan. The authors conducted three kinds of tests using domestic and foreign sedimentary samples (mudstones and sandstones) and examined the consistencies of their results.

Comparing the results using supercritical CO₂ and N₂ gas, the threshold pressures might be consistent considering the surface tensions in relevant fluid systems. However, there are some inconsistencies with the anisotropic young sediments which could not be reused because of their low solidification. On the other hand, the threshold pressures from mercury intrusion tests with estimation are almost equal to or a little lower than those from N₂ threshold pressure tests. This discrepancy may be caused by the anisotropy or shrinkage during drying process.

In Japan, the candidate of seal formation will be thought as not only massive mudstones but also alternated layers of mudstones and sandstones. In latter case, a limit number of strictly conditioned tests should be compensated by sufficient number of lower quality test results. So, the approach in this study will be important in future site selection process.

Keywords: threshold pressure, seal layer, sealing efficiency