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Numerical Simulation of the Effects of Sandstone channels Properties on the Seal Integrity in Geological Storage of CO2

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Geological storage of CO_2 is one of the methods to mitigate the global warming. Several kinds of reservoir are suggested including depleted oil/gas fields, unminable coal seams, and deep saline aquifers, test and demonstration projects for which are underway. In Japan, saline aquifers without structural trapping are known to keep water soluble methane gas and are considered to be the targets of geological storage of CO_2.

If the seal capacity and the continuity of the layer located immediately above the reservoir are sufficient, all injected CO_2 is expected to be stored within the reservoir. However, even if the global permeability of mudstone seal seems low enough, the presence of intra-layer sandstone would significantly degrade the seal integrity. The past work by the authors indicated that the presence of those sandstone channels have large effects on the long-term fluid behavior by numerical simulations adopting the double porosity model to the seal layers.

In this study, we will present the results of numerical simulations to indicate the effects of the presence and properties of sandstone channels such as the volume fraction, spacing and permeability (or permeability ratio to the mudstone seal) on the seal integrity. The results include the behavior of CO_2 injected into a deep saline aquifer at a depth of 1000 m, dissolution and residual gas trapping, and pressure buildup and propagation. The global permeability of seal layers is set to be low enough to keep CO_2 below if they are homogeneous porous media. Calculations are carried out using the ”STAR” general-purpose reservoir simulation code with the ”SQSCO2” equation of state.

Keywords: Geological storage of CO2, saline aquifer, double porosity model, numerical simulation