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Simulation of the Effects of Seal Properties on the Long-term Behavior of CO2 Injected Into a Deep Saline Aquifer

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Geological storage of CO2 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 CO2.

If the seal capacity and the continuity of the layer located immediately above the reservoir are sufficient, all injected CO2 is expected to be stored within the reservoir. On the other hand, if they are not sufficient, CO2 gradually migrates upward through the layers during shut-in period. In this case, CO2 will be trapped by multi-layers due to dissolution and residual gas mechanism. We have conducted the sensitivity analysis on the long-term behavior of CO2 injected into a deep saline aquifer, and found that mulit-layers can trap CO2 before reaching the shallow depth even if the seal capacity of single layer is not sufficient.

We treated these seal layers as porous media which have moderate permeabilites in the previous study. However, they are more likely to be composed of mudstone layers with insufficient horizontal continuity. So, to reproduce this situation more appropriately, we adopt the double porosity model to represent the seal layers. If CO2 flows into narrow paths composed of high permeability sandstone (i.e. ”fracture region” in the double porosity model), total fluid behavior is thought to be significantly different from that of using the porous medium representation for the entire seal layers. We will present the results of numerical simulations on the long-term behavior of CO2 injected into a deep saline aquifer, using the double porosity model for the moderate permeability seal layers. Numerical simulations are carried out using the ”STAR” general-purpose reservoir simulation code with the ”SQSCO2” equation of state.

Keywords: Geological storage of CO2, Saline aquifer, alternating layers, double porosity model, numerical simulation