Numerical study on leakage suppression of CO_2 stored in sub-seabed strata by gas hydrate formation

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The Paris Agreement in 2015 stated that the issue was to keep the temperature rise below 1.5 ℃ after pre-industrial average temperature and IPCC (Intergovernmental Panel on Climate Change) presented a scenario in which the future temperature will change depending on the choices that we will tackle in the future. So, we need to solve global warming issue as soon as possible. But, the transition of capital investment against the global warming takes a long time. Therefore, we need to capture the CO2 and store it in deep underground as countermeasure for the CO2 emitted that time. For that reason, CCS(Carbon dioxide Capture and Storage)is spreading around the world.

In the storage under the seafloor, it is conceivable the stable storage becomes possible by forming gas hydrate under the conditions of high pressure and low temperature.

Hydrate storage leads to further expansion of storage potential. This study aims to visualize the behavior of CO2 in the stratum, using numerical simulation.

As a previous study, Yu et al. (2016) proposed a new model of hydrate formation was developed depending on the microscopic position. The hydrate formation simulation on the reservoir scale was performed with coupling the hydrate formation model with GETFLOWS (General purpose Terrestrial fluid-FLOW Simulator). We carried out the simulations using the physical conditions of Sleipner, Snøhvit, and Tomakomai, which are typical seafloor storages, such as seafloor depth, seafloor temperature, geothermal gradient, injection rate, and permeability.

As a result, it was found that the diffusion of the hydrate formation heat made it difficult to form hydrate around the area where hydrate had already been formed, and that the hydrate might leak to the seafloor. Whether it is possible to classify cases that can be stored and cases that lead to leakage depends on the conditions.

Keywords: CO2 hydrate blocking, CCS, Leakage suppression, Reservoir-scale simulation