Development of numerical models for the dispersion of CO_2 in the sea corresponding to some leakage scenarios

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In order to store CO_2 under the seabed in Japan, it is required by law to assess the impacts of unexpected leakage on the marine environmental before injection and to monitor the marine environment to detect unexpected leakage after injection. These are essential not only to comply with the law but also to gain public acceptance.

The assessment of the impacts on the marine environment is conducted with the simulations of CO_2 leakage. We have been developing and constructing numerical models for the simulations. CO_2 migration from the reservoir to the surface of the seabed is projected by numerically examining hypothetical cases in which potential leakage pathways are defined reasonably. Their model parameters are determined through the review of papers reporting faults/fractures in Japan. A set of parameters are chosen to construct a fault/fracture model which leads to the worst seepage cases. The results of the calculations with the model are utilized in the simulations of CO_2 dispersion in seawater and the development of the monitoring plans for seawater quality. In the simulation, since leaked CO_2 is dispersed mainly by ocean flows, it is important to represent realistic flows in the model. In this talk, we will outline the models for both geological formations and ocean that RITE have developed and constructed.

In the marine monitoring after injection, there is a significant question to be solved: how we judge whether CO_2 leaks or not. Even with detecting a high concentration of CO_2, it is not always adequate to judge there is a leakage because the natural variability of CO_2 concentration is large in the ocean. The main factors for the variation of CO_2 concentration include photosynthesis; and respiration and decomposition. The former produces O_2 and consumes CO_2 and the latter conversely produces CO_2 and consumes O_2. There can be the correlation between the concentration of CO_2 and that of O_2. We will explain to you our proposal of a new method where the concentration of O_2 as well as that of CO_2 is used to judge the measured high concentration of CO_2 is due to natural variability or a leakage of the stored CO_2.