A reactive transport modelling at the Nagaoka pilot-scale CO_2 injection site

SAEKO MITO*[,1], ZIQIU XUE[1]

[1] Research Institute of Innovative Technology for the Earth (RITE); 9-2, Kizugawadai, Kizugawa, Kyoto, 619-0292, Japan; *Corresponding author: mito@rite.or.jp

CO_2 geological storage is one of the options for reducing CO_2 emission from the large-scale point source such as the thermal power plant. Once CO_2 is injected into a deep underground, it is trapped in the pore space of the reservoir (gas trapping) and partly dissolved in the brine (solubility trapping). Then, CO_2 will precipitate as a carbonate (mineral trapping) and be fixed in the reservoir. To predict these trapping processes, a reactive transport modelling is necessary. In this study we present a case study using field data from the Nagaoka pilot-scale CO_2 injection site.

Target reservoir of the Nagaoka site is a saline aquifer of the Pleistocene Haizume Formation with 60m-thick while CO_2 injection layer is about 12m-thick in the reservoir. The Haizume Formation is composed of siltstone beds including sandstone, conglomerate and tuff. Thin layers of mudstone are interbedded within sandstone layers because of deposition on the margin of a wave-dominated delta system. One injection well (IW-1) and three observation wells (OB-2, -3 and -4) were drilled on the east side of an anticline, dipping at 15° to east-southeast with strike N100°. The CO_2 injection was conducted at a depth of about 1,100 m from July 2003 to January 2005 with total amount of 10,400 tonnes.

We developed small area (about 1 km by 1 km) and coarse grid 3D model for a reactive transport modelling [1]. To increase accuracy of the simulation result, we used (1) changes of the water composition obtained from the batch experiments using actual core and water sample from the injection layer, and (2) two fluid composition data sets obtained from OB-2 during the post-injection period.

Batch experimental results were helpful to select the effective minerals in the CO_2 mineral trapping process and to determine the reactive surface area of the minerals by a one-box model. When the adjusted geochemical input was applied to the 3D model, the simulated concentrations of HCO_3^- and Ca were matched with the field sampling results at the same order of the magnitude. Mineral trapping as $CaCO_3$ will increase from 20 years after the cessation of CO_2 injection and account for 6% of the injected CO_2 in 100 years.

[1] Mito *et al*. (2013) *Applied Geochemistry* **30**, 33-40