

## 実験的手法に基づく鉱物トラッピング進行速度の定量的評価 Evaluation of CO<sub>2</sub> Mineral Trapping Rates in Aquifers based on experimental studies

高谷 雄太郎<sup>1\*</sup>, 中村 謙太郎<sup>2</sup>, 加藤 泰浩<sup>1</sup>

TAKAYA, Yutaro<sup>1\*</sup>, NAKAMURA, Kentaro<sup>2</sup>, KATO, Yasuhiro<sup>1</sup>

<sup>1</sup> 東大・工・システム創成, <sup>2</sup> 海洋研究開発機構

<sup>1</sup>Sys. Innovation, Univ. of Tokyo, <sup>2</sup>PEL, JAMSTEC

In this study, experiments on CO<sub>2</sub>-water-rock interaction have been conducted to elucidate the rock dissolution rate and to investigate long-term dissolution and precipitation phenomena in CO<sub>2</sub> reservoirs. The dissolution experiments are conducted by using semi-open experimental system constructed for this study. As the rock samples, in addition to the basalt which is considered as a suitable candidate rock formation for geochemical trapping of CO<sub>2</sub>, tuffaceous sandstone (Hayama group: Kanagawa Prefecture) and three green tuff rocks (Tsugawa formation: Niigata Prefecture, Ushikiri formation: Shimane Prefecture, Daijima formation: Akita prefecture) from the Quaternary igneous rocks widely distributed in Japan were used.

From the eight-month-period of experiments, the facts found were that the composition of formation water will converge at the point where the rock dissolution and precipitation of secondary mineral are balanced and CO<sub>2</sub>-water-rock interaction proceeds under a certain formation water composition. For this reason, the determination of rock dissolution rate (element release rate) under a certain formation water composition inherent in each rock sample is indispensable in order to predict the long-term progress of the reaction within CO<sub>2</sub> reservoirs.

Si release rate under a certain formation water composition that indicates the dissolution of silicate minerals from each rock sample is  $29.8 \times 10^{-2}$  mmol/kg-rock/day for basalt,  $7.77 \times 10^{-2}$  mmol/kg-rock/day for Tsugawa green tuff,  $5.44 \times 10^{-2}$  mmol/kg-rock/day for Ushikiri green tuff and  $33.1 \times 10^{-2}$  mmol/kg-rock/day for Daijima green tuff at the temperature of 50°C.

The simulations on long-term CO<sub>2</sub> fixation efficiency (mineral trapping) in the CO<sub>2</sub> reservoir by using Ca, Mg and Fe release rates calculated from experiments were conducted. On the assumption that 1: CO<sub>2</sub> injection rate to be 2,000 ton/day 2: injection time period to be 50 years (total amount of injected CO<sub>2</sub> is 36,500,000 t) 3: target aquifer porosity 20% 4: CO<sub>2</sub> density 500 kg/m<sup>3</sup> 5: injected CO<sub>2</sub> to groundwater volume ratio 1:2, the time required for mineral fixation of 36,500,000 tons of CO<sub>2</sub> is simulated to be about 180 years for basalt, about 5,100,000 tons of CO<sub>2</sub> fixed as a carbonate mineral in 200 years for Tsugawa green tuff, about 22,000,000 tons of CO<sub>2</sub> fixed in 200 years for Ushikiri green tuff and 3,900,000 tons of CO<sub>2</sub> fixed in 200 years for Daijima green tuff. at the temperature of 50°C.

These results indicate that the mineral trapping rate in CO<sub>2</sub> reservoir is much faster than the results of previous studies and that geochemical trapping (mineral trapping) is an important mechanism not only for long-term (10<sup>3</sup> - 10<sup>4</sup> years) security but also for shorter-term (- 10<sup>2</sup> years) security of CO<sub>2</sub> aquifer storage and is a significant indicator for the selection of potential storage candidate site.

キーワード: CCS, 二酸化炭素地中貯留, 水 岩石反応, グリーンタフ, 玄武岩

Keywords: CCS, CO<sub>2</sub> geological storage, water-rock interaction, Green-Tuff, Basalt