

Carbonate kinetics in the CO₂-injected hot spring water

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Reaction Experiments at Hot Spring

Regarding geochemical processes associated with geological CO₂ storage (GCS), both precipitation and dissolution of carbonate minerals are important from each perspective of storage potentials and leakage risks. However, there have remained many uncertainties on their kinetics under conditions of GCS. In this study, to obtain reliable dataset on carbonate kinetics, we performed reaction experiments of carbonate minerals over a period up to 24 hours at bicarbonated springs, which can be regarded as a natural analogue of GCS. Present experiments focused specifically on the effects of injecting CO₂ and MgCl₂ into the water. Cleaved samples of various carbonate species were dipped into the spring water, and then taken out one by one at predetermined time. Reaction rate was estimated from measurements of the height level difference between original and reacted surfaces by using a phase-shift interferometer and a laser microscope.

Results and Discussion

An input of CO₂ gas and/or Mg ions into spring waters highlighted the effects of these chemical species on reaction rates and precipitating phase of carbonate minerals. The result showed that both growth and dissolution rates of carbonate minerals depend on water compositions and carbonate species. Specifically, the measured growth rate of calcite was much lower than that calculated from the empirical equation, which was compiled based on laboratory experiments. This is possibly because the equation includes no inhibitor effect of dissolved ions (mainly magnesium ions) and uses unrealistic function form with respect to the saturation-state dependency. We also found that dolomite is unlikely to form under the GCS condition in spite of its highest degree of supersaturation.

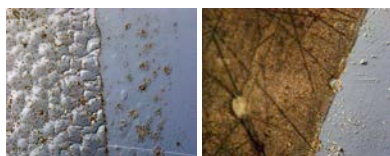


Figure 1: Crystal surfaces after reaction in the spring water: a) calcite, and b) aragonite.