

Geochemical study of shore subsurface groundwater with observation of dissolution rates of calcite/dolomite by a phase shift interferometer

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High saline groundwater is commonly observed near shore subsurface in sedimentary basins. Most of them at shallow depth are mixtures of fresh sea water and local meteoric water. In contrast, the deep groundwater changed the chemistry during interaction with surrounding rocks. Thus, the alteration degree depends on the reaction time and rock/water ratios. The chemistry of the deep groundwater in a certain sedimentary basin in Japan has been studied geochemically by an isotopic approach and calculation in equilibrium and kinetic reaction models. The major chemical compositions (Na,K,Ca,Mg) in the groundwater can be explained by considering an ion exchange and calcite/dolomite-water equilibrium. In the rocks studied, no dolomite can be observed. On the basis of the model that Mg in the calcite can behave as dolomite end member, we measured the dissolution rates of both calcite and dolomite to discuss whether dolomite component in the calcite can contributed to the reaction to change the water chemistry.

Calcite and dolomite dissolution phenomena have been studied by a newly designed analytical system and a reaction cell with a laser to a phase-shift interferometer with a white-light (Ueda et al., 2005). The calcite/dolomite crystal is partly coated with thin gold as a reference surface and then set in the reaction vessel. It reacts with saline water with flow rate of 0.05 ml/min. The surface (0.3×0.3mm in the area) is monitored through a CCD camera during the reaction. The heights of each point on the mineral and gold surfaces are simultaneously measured as the digital data (680×512 pixels). After the reaction, the change of the thickness of the mineral sample compared to that of the gold one is calculated. The dissolution rates of the calcite and dolomite are calculated to be $2 \sim 3 \times 10^{-10}$ and $3 \sim 4 \times 10^{-12}$ mol/cm²/sec, respectively. These results support the view that dolomite component in the calcite acts to control the Mg concentration in the saline water.