Pilot-scale experiment to investigate CO_2 migration characteristics for geological sequestration

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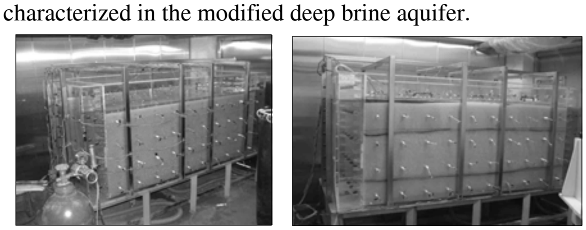
The pilot scale box experiment for CO_2 geological sequestration process was performed to characterize CO_2 migration in the deep aquifer. An acryl box (1 m x 1 m x 2 m) was filled with homogeneous glass beads (1 mm in diameter) to physically modify the deep brine aquifer. The tap water was injected from the left of the box at a constant velocity (300 ml/min) to maintain the hydrauric gradient of 7.3 cm/hr in the box. The injection well was installed on the left of the box and the distilled water dissolved CO_2 was injected through the injection well at a constant velocity (1 ml/min). For the experiment of CO_2 gas phase monitoring, the injection well connected with the air sparging device was installed in the center of the box. CO_2 gas was injected at a constant velocity (300 ml/min) by using the air flow meter. To characterize the supercritical CO_2 phase in the deep brain aquifer, a mineral oil (KF-50) representing a supercritical CO_2 liquid was injected at a constant velocity (20 ml/min) into the box. The movement of the mineral oil or the CO_2 phases in the box was characterized 3-dimensionally at a 12 hour interval. The liquids were sampled from the 40 ports attached at the walls of the box and analyzed on GC/TCD for CO_2 and GC/FID for the mineral oil.

From the results of the box experiment, the migration of the dissolved CO_2 phase and the supercritical CO_2 phase was characterized in the modified deep brine aquifer.



(A) (B)

Figure 1: Pilot-scale experiment for CO_2 geological sequestration. (A) migration experiment of CO_2 dissolved phase and (B) migration experiment of mineral oil.

Ca isotope systematics of marine hydrothermal and cold seep carbonates

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Authigenic carbonates precipitate when gas-rich fluids are emitted on the seafloor in mid-ocean hydrothermal systems or at cold seeps on continental margins. Several studies have shown that carbonate precipitation in those extreme environments is closely related to microbial activity [1, 2]. However, the role played by microbes during carbonate biomineralization remains poorly known. Calcium isotopes are a new proxy for investigating biogeochemical processes [3]. The application of Ca isotope systematics to hydrothermal and cold seep carbonates has therefore a great potential for bringing new insights on fluid-mineral-microbial interactions in extreme oceanic environments.

Here, we present preliminary $\delta^{44/42}Ca$ data for an actively venting carbonate chimney recovered from the Lost City hydrothermal site (Mid-Atlantic ridge) during the Exomar cruise (2006). Ca isotope analyses were performed by MC-ICP-MS (Neptune) on a series of samples collected across a 20-cm wide chimney cross section. A large $\delta^{44/42}Ca_{SRM915a}$ variability occurs across the chimney from ~0.1 to 0.7‰. High-resolution mineralogical profiles show that the variations in $\delta^{44/42}Ca$ are closely related to changes in carbonate mineralogy (brucite vs. aragonite contents). The possible factors controlling Ca isotope fractionation in those extreme oceanic systems (i.e. carbonate mineralogy, temperature, fluid chemistry, microbial activity) will be discussed by comparing data obtained on other samples from various hydrothermal and cold seep settings.

[1] Aloisi *et al*. (2002) *EPSL* **203**, 195-203. [2] Schrenk *et al*. (2004) *Environ. Microbio*. **6(10),** 1086-1095. [3] Chu *et al*. (2006) *Appl. Geochem*. **21**, 1656-1667.