

## Self-sealing effect of CO<sub>2</sub>-hydrate in the sediment storage concept of CO<sub>2</sub>

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Based on the laboratory measurements of the induction time (formation time) of CO<sub>2</sub> hydrate, the time period of liquid CO<sub>2</sub> travelling in the pore space before clogging was estimated.

The simulated pore space passage in laboratory was devised with a pair of grated silica glass plates, which gives network paths with the size of 200 micrometer in width and 20 micrometer in depth. At 5 degree C, the continuous flow regime was observed for 3 hours with the experimental breakthrough pressure of 0.4 MPa.

As an evaluation of the dynamic self-sealing capability during the upward leakage of the stored liquid CO<sub>2</sub> within the sediment layers, the hydraulic model analysis was made whether or not the buoyant liquid CO<sub>2</sub> reaches to the seabed. The calculation results showed that the clogging within an overlying sediment layers with total thickness of 171 m and with the permeability of 1 darcy, will take place before the front of the injected CO<sub>2</sub> reaches to the seabed.

Inside the Exclusive Economic Zone of Japan, the sea area covered with the sediment layers thicker than 1000 m, and with a water depth greater than 500 m, and with a bottom seawater temperature lower than 5 degree C is estimated to be 150, 000 km<sup>2</sup>, which corresponds to the estimated sediment storage potential of 480 billion tonne of CO<sub>2</sub>, based on the assumption that the effective thickness of storage layers is 200 m, the effective porosity is 20 % and the effective sweep efficiency of the injected liquid CO<sub>2</sub> with the density of 800 kg/m<sup>3</sup> is 10%.

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## S and O isotopes to identify the source of sulfate in the Jialing River, a headwater tributary of the Yangtze

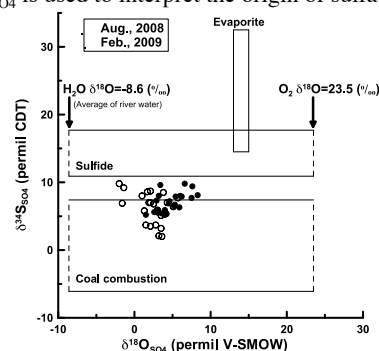
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This study analyzed the chemical (Ca<sup>2+</sup>, Mg<sup>2+</sup>, Na<sup>+</sup>, K<sup>+</sup>, HCO<sub>3</sub><sup>-</sup>, Cl<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>) and isotopic ( $\delta^{34}\text{S}_{\text{SO}_4}$  and  $\delta^{18}\text{O}_{\text{SO}_4}$ ) compositions of 23 samples uniformly distributed and collected along the Jialing River. The chemical composition of the river water is characterized by high concentrations of Ca<sup>2+</sup> and HCO<sub>3</sub><sup>-</sup>, followed by Mg<sup>2+</sup> and SO<sub>4</sub><sup>2-</sup>, which account for more than 90% of total ion concentration. Analyses of the stoichiometry of the river water show that the water chemistry is controlled by carbonate dissolution not only by carbonic but also by sulfuric acid, and indicate that sulfuric acid plays an important role in carbonate weathering. The river waters studied here are rich in sulfate ion. The co-variation of  $\delta^{34}\text{S}_{\text{SO}_4}$  and  $\delta^{18}\text{O}_{\text{SO}_4}$  is used to interpret the origin of sulfate (Figure 1).



**Figure 1:**  $\delta^{34}\text{S}_{\text{SO}_4}$  versus  $\delta^{18}\text{O}_{\text{SO}_4}$ , along with ranges for potential sources.

The sources of SO<sub>4</sub><sup>2-</sup> are considered to be most likely the high sulfur-content coal combustion and oxidation of sulfide minerals during weathering of coal containing strata in the Jialing River catchment.

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