

## Longtime behavior (<50 yr) of Groundwater Quality with Dissolution of a Ryukyu-limestone Aquifer in Okinawa Island

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Dissolution of a terrestrial limestone layer by chemical weathering is one of the most important factors affecting the carbon cycle and the transport of calcium from the land to the ocean. Residence times of sulfur hexafluoride (SF<sub>6</sub>) and chlorofluorocarbons (CFCs), as well as their chemical composition in the groundwater, were investigated to estimate the longtime behavior of field dissolution of the Ryukyu-limestone aquifer on Okinawa Island, Japan. The Ca, (HCO<sub>3</sub>+SO<sub>4</sub>) and Pco<sub>2</sub> increase with groundwater residence time. The field dissolution of Ca was estimated to be 0.090 mM(Ca)/L/yr, with groundwater Ca ranging from 1.75 to 4.0 mM/L. The increase observed in groundwater alkalinity and SO<sub>4</sub> over time (0.170 meq(HCO<sub>3</sub>+SO<sub>4</sub>)/L/yr; 16 to 34 yr) implies that the groundwater acts as a CO<sub>2</sub> sink through chemical weathering of the Ryukyu-limestone aquifer when groundwater CO<sub>2</sub> (gas) concentrations range from 1.0% to 4.5% (logPco<sub>2</sub>=-2 ~-1.35 atom). The (Ca + Mg) content of groundwater was also affected by groundwater alkalinity (HCO<sub>3</sub>), SO<sub>4</sub> and NO<sub>3</sub> derived from fertilizers used on Okinawa Island. These findings imply that the influence of fertilizer and the high partial pressure of groundwater CO<sub>2</sub> on the dissolution of Ryukyu-limestone aquifer may not be negligible. pH decreases with dissolution of the Ryukyu-limestone aquifer.

Keywords: Groundwater, Limestone, Dissolution, Residence time, Sulfur hexafluoride, Okinawa Island