

Sulfur system in anoxic confined aquifers in the northeastern Osaka Basin, Japan

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We used $\delta^{34}\text{S}$ values and chemical compositions of groundwater to investigate the influence of sulfate reduction and sulfide oxidation processes in a confined aquifer system in the northeastern Osaka Basin (NEOB), central Japan. Shallow confined groundwater (<100 m) in the basin is recharged mainly from mountainous areas to the north, and flows south and southwest through the aquifer system. Anion composition of the groundwater is dominated by HCO_3^- throughout the basin. However, concentrations of redox-sensitive species such as dissolved oxygen, NO_3^- , Fe^{2+} , and Mn^{2+} show that groundwater conditions become increasingly anoxic along the flowpaths. Moreover, $\text{SO}_4/(\text{SO}_4 + 2\text{HCO}_3)$ molar ratios decrease with increasing $\delta^{34}\text{S}$ along the flowpaths, which demonstrates that sulfate is reduced in the NEOB aquifer system. Groundwater with both high total dissolved solids and high SO_4 content was observed mainly in areas down-flow from faults. Because of the high SO_4 content, the anion composition of this groundwater cannot be adequately explained by a simple sulfate reduction process. A Rayleigh distillation model with $\varepsilon = -20\text{‰}$, which allows for sulfide oxidation within marine sediments in proximity to faults, explains the chemistry of all groundwater samples, including those with high SO_4 content. The model demonstrates that 76% of initial sulfate is reduced at maximum, and that reduced SO_4^{2-} content is up to 48.5 mg/L after sulfide oxidation in the NEOB aquifer system.