Hydrochemistry and quality of CO_2-rich springs in Gyeongsang sedimentary basin, South Korea, as a natural analogue of CO_2 leakage from geologic carbon storage sites

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Although geologic carbon storage is the most effective way to reduce anthropogenic CO_2 emissions, publics are still concerned about potential risks of CO_2 leakage from storage sites. Therefore, careful monitoring of the movement and leakage of CO_2 is highly needed. Natural CO_2-rich springs may provide useful insights on the groundwater quality impacts of CO_2 leakage as well as on efficient parameters to monitor the CO_2 leakage. For this concern, we conducted hydrochemical and isotopic analyses of a total of 18 naturally seeping, cold CO_2-rich springs in the Gyeongsang sedimentary basin, South Korea. CO_2-rich springs are characteristically high in alkalinity (average 2293±854 mg/L as $CaCO_3$) and total dissolved solids (average 2076±756 mg/L) but have near-neutral pH values (average 6.28±0.26). Carbon isotope compositions of dissolved carbonate are -3.2±1.6‰, suggesting that they formed through dissolution of CO_2 that did ascend from a deep magmatic source. The oxygen and hydrogen isotope compositions of CO_2-rich springs are lower than ambient alkaline groundwater. These data indicate that the supply of CO_2 from depths to groundwater accelerated the dissolution of silicate and carbonate minerals constituting an aquifer. Comparison of hydrochemistry data between CO_2-rich springs and ambient alkaline groundwater indicates that the following observations of groundwater can be useful to detect CO_2 leakage: 1) pH lowering and increases of the concentrations of a few solutes such as alkalinity, Ca and Mg and 2) the change of the carbon isotope compositions of dissolved inorganic carbon.