

## CO<sub>2</sub> uptake and trace element mobilization in Icelandic geothermal systems

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Hydrothermal systems serve as natural laboratories to investigate the fluid-rock interactions that modify magmatic CO<sub>2</sub> fluxes to the atmosphere and affect groundwater quality. Here we present interpretations on CO<sub>2</sub>-rich (> 4 mmol/kg ΣCO<sub>2(aq)</sub>) low-temperature (≤180 °C) basaltic geothermal areas in Iceland and new data on the metasomatic processes that mobilize trace elements to the fluid phase and sequester CO<sub>2</sub> through carbonate mineralization. Geothermal waters and gases from the Snæfellsnes Volcanic Zone, near the Torfajökull central volcano and within the South Iceland Seismic Zone contain up to ~80 mmol/kg ΣCO<sub>2(aq)</sub> and 7 bar P<sub>CO<sub>2</sub></sub>, which is up to 2 orders of magnitude greater than Icelandic geothermal systems of similar temperature. Based on stable isotope compositions (δD and δ<sup>18</sup>O) the fluids are of meteoric origin, and have experienced varying degrees of isotope exchange due to high temperature water-rock interaction. Gas phase carbon isotope (δ<sup>13</sup>C) values are consistent with a magmatic source for CO<sub>2</sub>. Dissolved cation concentrations indicate that the CO<sub>2</sub>-rich fluids enhance silicate mineral dissolution, but the concentrations of carbonate-forming divalent cations Ca<sup>2+</sup>, Mg<sup>2+</sup>, and Fe<sup>2+</sup> decrease with increasing temperature, potentially indicating removal by carbonate precipitation. The aqueous concentrations of metals and metalloids of environmental concern (e.g., As, Ni) are above the World Health Organization guideline for safe drinking water in several samples. A potential sink for the trace metal(loids) is the incorporation within or adsorption to Fe-rich calcite/aragonite travertine deposits or Fe(III) (oxy)hydroxides that precipitate at spring discharge sites. Such deposits contain more than 65 ppm As and 28 ppm Ni. Petrographic study of drill cuttings from wells in CO<sub>2</sub>-rich areas indicates that the sites have undergone initial high-temperature and subsequent low-temperature alteration, including calcite precipitation. Our results have implications for predicting the mineral products of low-temperature carbon capture and storage and the environmental effects of potential leakage scenarios.