

Natural analogue evaluation of the fate of hydrogen sulfide from a leaking carbon sequestration site

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The recognized relationship between increased atmospheric CO₂ concentrations and climate change, with its associated deleterious impacts, is motivating the development of technologies that minimize anthropogenic CO₂ emissions. Carbon Capture and Storage (CCS) is one such technology in which anthropogenic CO₂ produced by fossil fuels power plants is captured for long-term storage in geologic formations. However, power plant CO₂ streams often contain sulfur impurities that can impact the performance and cost of CCS systems. Wide-spread adoption of CCS requires demonstration that the CO₂ and co-disposed impurities remain safely stored in the geologic formations and that any leakage be detected and mitigated.

Here we report on a natural analogue site, Sulphur Springs, located near the community of Soda Springs, Idaho, USA. Sulphur Springs and surrounding natural seeps of CO₂ and H₂S are characterized by fault-controlled fluxes of CO₂ with trace H₂S into a Paleozoic carbonate hosted shallow groundwater system that have resulted in acidic waters and the precipitation of native sulfur and gypsum. Additionally the springs support communities of both sulfur oxidizing and sulfate reducing bacteria as indicated by elevated total cell counts (1,000x), and *soxB* (10,000x) and *dsrB* (30,000x) gene counts compared to other CO₂ rich but H₂S deficient features in the region. Oxygen and hydrogen isotope measurements for water and sulfur and oxygen isotope measurements for dissolved sulfate for Sulphur Springs are significantly lower than other CO₂ rich but H₂S deficient features. Geochemical modeling suggests that, depending on relative fluxes of O₂ and H₂S, H₂S is sequentially oxidized to native sulfur and then to SO₄²⁻ with subsequent re-reduction to H₂S.