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Structural and Geochemical Analysis of the Little Grand and Salt Wash Faults to Investigate the Leakage of CO2 from a Natural Reservoir

The Little Grand and Salt Wash faults, located in southeastern Utah in the Colorado Plateau, discharge significant amounts of CO2 gas and cut a series of sandstones, shales, and siltstones. They have and are impacting the regional (basin-wide) flow evidenced from travertine deposits, calcite/aragonite veins, springs, seeps, and geysers erupting from abandoned exploration wells that are localized along the fault zones. The structure of the fault zones show that fault movement and cementation have been active contemporaneously; namely, the fault rocks are cross-cut by thick veins, and travertine veins are cut by faults. Water chemistry of samples taken from the CO2-charged geysers and springs suggest that the CO2 is sourced from Paleozoic rocks 1.5 - 2 km deep. Analysis of 13/12C and 18/16O isotopes of the travertine terraces and veins likewise suggest a deeper, sub salt, Paleozoic source of the CO2. Our hypothesis for these faults is that the CO2 flows upward along the faults from near the Pennsylvanian Paradox Formation. The CO2 charges a shallower water system, which then flows to the surface. The CO2-rich discharging water is supersaturated with respect to calcite and aragonite and deposits travertine. Horizontal travertine veins are found along the fault trace. We infer that when fluids reached a lower lithostatic load and/or higher permeability stratigraphic interval, horizontal veins were formed. At various points in the fault history, fluid pressures were high enough to cause flow to occur across the fault zones, despite the presumably low permeability of the clay-rich faults.