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Hydrogeochemical Characterization of Leaking, CO_2-Charged, Low Net-to-Gross Fault Zones: The Little Grand and Salt Wash Fault Zones, Emery and Grand Counties, Utah

The Little Grand and Salt Wash faults consist of clay-rich fault gouge, and yet these faults leak fluids as evidenced by CO_2-charged springs and geysers, tufa and travertine deposits, and an oil seep which are localized along the trace of the faults. We examine the hydrogeochemistry of the system to determine the relationship of these failed fault seals with the emanating fluids. Hydrogen and oxygen isotopes of the waters indicate that they are meteoric in origin. Gas samples from six springs or geysers have CO_2-percent volumes of 96.45 to 99.41. The $\delta^{13}CCO_2$ data for these six samples have an average value of -6.60‰ with a standard deviation of 0.13‰. This shows that CO_2 gas is not generated alone by carbonate dissolution or soil zone gas. External gas sources may include the oxidation of organic matter, diagenetic reactions between carbonate and siliceous rocks, and the thermal degradation of carbonate material, all of which can occur at depths > 1 km. Carbon isotopic data are being collected for the dissolved carbonate and precipitated carbonate at the surface. Carbon isotopic data for the gas, liquid, and solid phases will indicate if the system is in isotopic equilibrium, and thus indicate whether a kinetic, CO_2-outgassing process is occurring. The waters are supersaturated with respect to aragonite, calcite, and dolomite. Our conceptual model is that a deeper gas charges the shallow aquifer. Geochemical modeling with PHREEQC is underway to ascertain what chemical reactions affecting porosity and permeability are taking place in the subsurface.