Geothermal springs in southwestern Colorado: Integrating water and gas chemistry, fault pathways, and CO_2 flux to understand mantle-to-surface connections

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This project investigates the role of faults as geothermal fluid conduits for rapid mantle-to-surface volatile transport. Variations in fault orientation, intersections, and reactivation by young magmatism may account for high mantle signature of geothermal fluids. The western San Juan Mountains of Colorado provide a field laboratory where the structural setting and hydrochemistry of carbonic springs can be studied. Rico Hot Springs has a helium isotope ratio of 5.88 Rc/Ra (73% mantle helium component), a dry gas CO_2 content of 99.7%, and is located above a low-velocity upper-mantle domain. This and nearby springs are associated with basement-penetrating faults of the Rico dome, and are near young igneous rocks such as the Calico Peak (4.7 Ma) and Priest Gulch (4.0 Ma) stocks. The near-MORB mantle helium value and high CO_2 content in several springs indicate that mantle volatiles are rapidly transmitted into the groundwater system. Three types of analyses were done. 1) New water and gas chemistry analyses indicate that each Rico area spring has unique major and trace element chemistry (Piper diagram) suggesting different mixing of geothermal with meteoric water. 2) Structural compilation of faults suggests E-W trending young normal faults. 3) CO_2 flux measurements were made using an EGM-5 flux meter; these data identify cryptic fault conduits and quantify CO_2 flux across structural features. Overall, results so far show strong localized controls on water geochemistry and the importance of faults (some cryptic) for transmitting mantle volatiles via geothermal fluids from depth.