Poster #21-28

2018 Geologic, Hydrologic, Borehole Geophysical, and Geochemical Data Collection in Redwell Basin, Colorado: Overview and Preliminary Results

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BER Program: SBR
Project: Berkeley Lab Watershed Function SFA
Project Website: https://www.usgs.gov/energy-and-minerals/mineral-resources- program/science/metal-transport-mineralized-mountain

A second round of drilling, sampling, and geophysical/geological data collection activities were performed during summer 2018 in Redwell Basin, an alpine tributary of the East River, Colorado. Redwell Basin contains sedimentary bedrock with extensive sulfide mineralization that produces both natural and mining-related acid-rock drainage. The central objective of our project is to characterize and quantify controls on the flux of water and metals in the basin's bedrock groundwater flow system. A second deep borehole, MW2.1, was drilled adjacent to Redwell Creek at mid-elevation (3267 m) to complement existing bedrock well MW1 located high in the watershed (3412 m). MW2.1 was drilled to a total depth of 46 m with nearly complete core recovery. High rates of artesian flow were encountered, preventing deeper drilling. Ten-meter interval open-hole packer tests were performed, indicating hydraulic conductivities of 10^{-7} to 10^{-6} m/s, and a multi-level monitoring well with three different screens was installed. A full suite of borehole geophysical logs were recorded using standard tools, plus acoustic and optical televiewer, full wave form sonic, spinner flow meter, and nuclear-magnetic resonance (NMR). A shallow (10 m) borehole was also drilled adjacent to MW1 and completed with six discrete sampling ports for vadose zone soil gas and shallow groundwater sampling.

Three additional shallow piezometers were installed in groundwater discharge zones to augment the existing network. Forty-five water samples were collected from wells, streams, and other sites, and analyzed for major ion and trace element chemistry and stable isotopes of water. A subset was also analyzed for Sr isotopes and age tracers (tritium, sulfur hexafluoride, and noble gas isotopes). Rock samples were collected from the MW2.1 drill core for permeability/porosity, petrophysical, petrographic, X-ray diffraction, and other chemical analyses. Finally, geological data collection included a second round of outcrop mapping of hydrothermal alteration and brittle structures, as well as comprehensive logging of stratigraphy, structures, and mineralogy in the MW2.1 core. Acquisition of analytical results, data interpretation, and merging of 2017 and 2018 data are ongoing, and preliminary results will be presented. One key initial finding based on available hydraulic head, water age, and water chemistry data is an apparent lack of hydraulic connection between the shallow active water-table aquifer and deeper (>30 m), much older groundwater in upper Redwell Basin.