

Chemical and isotopic dynamics of Spring water table rise at Rifle, CO

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The Rifle Site consists of a floodplain along the Colorado River that was remediated through the removal of surface material including U-V mill tailings. The Rifle Site provides an excellent field laboratory for the study of the fluxes of water and carbon from the vadose zone to groundwater (LBNL SFA 2.0). A network of monitoring wells, particularly a series of boreholes instrumented within the vadose zone, provide the opportunity to sample groundwater and vadose zone porewater both in space and time.

Previous and on-going work at Rifle has documented the existence of local naturally reduced zones within aquifer sediments (I). These zones can interact with seasonal variations in groundwater elevation to drive bio-mediated redox reactions that produce temporal changes in concentrations of nitrate, sulfate and other species in porewater that may play a role in maintaining high U concentrations in the Rifle aquifer. In this contribution we will present isotopic data for multiple elements in porewater from the vadose zone (sampled through depth-distributed lysimeters) and from groundwater in order to better understand the complex interplay of processes evident during the annual Spring-Summer rise and fall of the Rifle water table. Sr isotopes (⁸⁷Sr/⁸⁶Sr), $\delta^{18}\text{O}$ - δD of water, and ²³⁴U/²³⁸U activity ratios are potential tracers for source and sediment/water interaction, while $\delta^{238}\text{U}$, $\delta^{82}\text{Se}$ and $\delta^{34}\text{S}$ (of sulfate) can be useful proxies for redox reactions. Seasonal excursions in porewater and groundwater U concentrations of 100's of ppb are attributed to U dissolution/desorption followed by mixing to lower concentrations based upon observed variations in U and Sr isotope values and limited evidence of reduction-induced isotope fractionation.

[1] Campbell et al. (2012) *Appl. Geochem.* **27**(8), 1499-1511