Poster #162

A Last Line of Defense: Understanding Unique Coupled Abiotic/Biotic Processes at Upwelling Groundwater Interfaces

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Groundwater seeping from sediments into lakes, wetlands, and rivers generates approximately 70% of total surface water flow in the USA. However, groundwater can carry excess nutrients and other contaminants, and therefore threaten surface water quality. Fortunately, the shallow interface sediments that line surface water bodies can host beneficial bacteria that naturally remove contaminants from groundwater as it strains through pores on the way to the surface. When water that is low in dissolved oxygen reaches the oxygenated surface water, metal (typically Fe, Mn) oxides may be deposited in layers 10's of cm thick. These soupy deposits of iron (red) and manganese (black) metals are often observed around wetlands at groundwater seeps, or can coat solid grains in faster flowing systems such as the East River, CO. These deposits of metal oxides, which are also observed in abundance within mine-impacted watersheds, act as "contaminant sponges" that sorb toxic compounds. These toxins include arsenic and uranium, which threaten animal and human health. However, dissolved oxygen levels in surface and shallow groundwaters are highly dynamic, and if oxygen with shallow interface sediments is decreased, metal oxides may dissolve and their contaminants may be released as a toxic pulse.

The hydraulic pressures that affect oxygen exchange, and in turn, drive metal-oxide deposition and dissolution are complicated and currently not well defined. Further, there is emerging evidence that the metal-oxide deposits may act as strong conductors of heat and electricity, which likely affects sediment reaction rates including carbon cycling and the contaminant sequestration. We plan to extensively study metal oxides in the laboratory and within a mine-impacted watershed in Colorado to: (1) better understand how dissolved carbon and contaminants pass from groundwater to surface water, and (2) capitalize on the ability of natural systems to adsorb and sequester contaminants. This study will result in predictive, processes-based understanding of the paired stream and groundwater conditions that lead to metal-oxide deposition so our water resources can be better managed and used.