Poster #21-38

Subsurface Rock Records and Water Signatures of Metal and Nutrient Mobilization from Mancos Shale at East River

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It is increasingly appreciated that the biogeochemical weathering of rocks and minerals in the zone between topsoil and competent bedrock can provide an important source of nutrients and metals into groundwater. Studies at the East River watershed, and across the Upper Colorado Basin, have linked Mancos shale weathering to seasonal inputs of salinity, nutrients and metals including contaminants into floodplains and rivers. Knowledge is lacking, however, of the primary controls on the rates of shale weathering and the impacts of weathering products on biogeochemical cycles and river quality. In 2017 and 2018, complementary field and laboratory studies addressed the pathways and consequences of shale weathering at and around the PLM intensively monitored hillslope transect at East River. First, elemental, chemical and mineral analysis of drill cores, soil-to-bedrock pits and weathering fracture surfaces revealed shale weathering profiles at the 10-m and 10-mm length scales. Second, time series of vertically- resolved groundwater chemistry at instrumented wells, provided time-series data on the concentrations of inorganic and inorganic solutes derived from shale weathering. Third, batch and column incubations of unweathered shale isolated key geochemical and microbial processes that liberate and cycle metals and nutrients. The groundwater data show Mancos Shale to be an important source of nitrogen, sulfur, phosphorous, and metals that are preferentially mobilized in an actively weathering zone between base-flow water table and top soil. The laboratory studies establish the role of clay minerals in the release of ammonium and *in situ* microorganisms for rapid nitrification. Element and mineral patterns in the rock record show evidence for both export and accumulation of reactive minerals and metals with a strong dependence on groundwater and pore water pH and redox state. A shale weathering model is under development in CrunchFlow that will enable the prediction of nutrient and metal mobilization, retardation and export in response to changing hydrologic patterns.