Lithologic Control on Weathering Processes in the East River Valley, Gothic, CO, USA

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Lithologic heterogeneity within geologic systems imparts heterogeneity in pore size, abundance, and connectivity, which are primary controls on fluid pathways and residence times. These hydrologic variations in turn control surface and shallow subsurface processes that drive solute release, soil formation, landscape evolution, and bioavailability of nutrients. Our ability to quantify the effects of rock heterogeneity on earth surface processes is hindered by complex coupling of geochemical and hydrological processes and the multi-scale nature of rock properties. The goals of this study are to integrate pore size, shape, distribution, and connectivity with mineralogical, chemical, and physical characterization of variably metamorphosed Mancos Shale to link rock heterogeneity with modern earth surface and shallow subsurface processes.

The East River system in south central Colorado is located within a headwater catchment of the Upper Colorado River Basin, which supplies municipal water to more than 1 in 10 Americans, irrigation water and nutrients to >5.5 million acres of land, and supports more than 4,200 megawatts of electrical generating capacity. Contact metamorphism of the underlying Mancos Shale by tertiary-aged intrusions changes the chemical and physical properties of the rock along a gradient aligned with the East River valley. Preliminary neutron scattering data shows that metamorphism reduces porosity and pore anisotropy, and these shifts, coupled with mineralogical changes, could significantly decrease chemical reaction potential of more thermally mature rocks. Neutron scattering will be complimented with total organic carbon, permeability, gas-adsorption surface area, mineralogy, and electron imaging for all samples. This comprehensive dataset will elucidate differences in solute release experiments across the metamorphic gradient, landscape evolution, and nutrient cycling at both the lab and field scale.

Spatial variation in the Mancos Shale related to metamorphism appears to correlate with geomorphologic evolution of the river corridor. Thermal maturation of the underlying Mancos Shale will be mapped along with river features, like sinuosity, gradient, and width, to evaluate the control of the geologic template of the East River on modern landscape evolution processes.