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Separation and Characterization of Colloids from an Alpine Floodplain

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Redox gradients, often driven by changes in sediment moisture levels, organic composition, and pore structure, combined with interfaces of heterogeneous materials typical in groundwater systems, create dynamic conditions that may promote the production and transport of colloidal species within natural waters. Depending on the specific chemical conditions (e.g., pH, ionic strength, oxygen levels), colloidal fractions can be highly reactive and thus transitory, changing seasonally as water tables fluctuate. The nature, size, reactivity, and composition of colloids, along with their role in promoting the migration of nutrients and contaminants within environmental systems remains understudied. In this work, we characterized various colloidal size fractions to increase our understanding of the influence of naturally occurring colloids on downstream waters. We used Asymmetrical Flow Field-flow Fractionation (AF4) to separate colloids into different size classes across two locations within the Slate River Floodplain in Colorado over a seasonal spring to fall time period. Following separation by AF4, samples were analyzed by Transmission Electron and Scanning Transmission X-ray Microscopy (TEM and STXM) along with Nanoscale Secondary Ion Mass Spectrometry (NanoSIMS) to measure particle morphology, mineralogy, chemical composition, and carbon speciation. Differences in carbon speciation and elemental composition were observed in subsamples of the same sample and across seasons in the same depth and location. We paired carbon speciation with bulk aqueous phase total organic carbon (TOC) and dissolved iron measurements to elucidate the relationship between iron and carbon as a function of depth. This work sheds light on the predominant classes of carbon species in colloidal fractions of a natural groundwater system. A greater understanding of carbon speciation as a function of depth and season may help in predicting zones of chemical reactivity within colloid-bearing water systems.