Role of minerals in organic carbon retention in the soil critical zone

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Mineral-organic interactions are critical in controlling carbon storage, nutrient cycling, and contaminant solubility and transport in soils. Organic carbon adsorption on mineral surfaces is dictated by mineral structure and surface chemistry, organic molecule composition and concentration, and solution chemical conditions. Several researchers examined these interactions using both macroscale and molecular methods; however, these interactions are not well understood and are highly disputed. In addition, the transferability of data from clean laboratory mineral-organic carbon experiments to field scale investigations focusing on the same in soils of different climatic zones is unclear.

We conducted laboratory experiments to evaluate the selected clean mineral interactions with fluvial dissolved organic matter (DOM), and these results are compared with soils collected from different climatic regions. We used XAS at the C-edge to evaluate DOM adsorbed on minerals and in soils, and FTICR-ESI-MS and FTIR spectroscopies to evaluate organic carbon that remained in aqueous phase after reactions with minerals. The minerals selected for laboratory studies include clays (1:1 and 2:!), Al-, and Fe-oxyhydroxides, and carbonate. The reactions showed that clay minerals exhibited contrasting interactions with DOM when compared to other selected minerals, and showed preference for unsaturated carbon-containing moities. The reactions also varied with solid/solution ratio. The selected soils for this study come from boreal, temperate, and tropical forests dominated by different soil mineralogies. The spectroscopy results of clean and field samples will be compared and a discussion on transferability of datasets will be presented.