Organic-Mineral Dynamics Component of LBNL SFA2.0

Peter Nico (psnico@lbl.gov) - LBNL, Susan Hubbard (LBNL) (PI), Cristina Cismasu (LBNL); Patricia Fox (LBNL); Ben Gilbert (LBNL); Jim Davis (LBNL) (Co-PIs).

The Organic-Mineral Dynamics component of the LBL-SFA2.0 has the long term goal of developing an improved conceptual model for OM cycling in the subsurface that can be incorporated into the developing GEWaSC frame work. It takes as its fundamental premise that since the vast majority of organic matter in the subsurface is associated with the solid phase that the processes controlling the up-take and release of OM from the solid phase are key factors in regulating the decomposition of OM in the subsurface. Initial investigations have begun to characterize the chemical form of sediment associated organic matter as a function of subsurface heterogeneity at the Old Rifle, Co. field site. A comparison of Fourier transform infrared (FTIR) spectroscopy data collected on samples provided by the Watershed Controls component shows increased aromatic carbon in high organic matter hotspots across the site, consistent with the observed higher content of particulate plant derived material. FTIR analysis of sediment incubations conducted by the Metabolic Potential component shows a noticeable decrease in aromatic associated functionality after incubations of sediments from those high organic matter hotspots. Furthermore, laboratory OM release experiments using different Rifle materials have been undertaken to determine the buffering behavior of the mineral surfaces on DOM concentration and speciation. Rifle materials placed in organic matter free solutions released OM within hours until DOM concentrations similar to those observed in field samples of 2-3ppm were established. DOM concentration then held constant for a month. The initial composition of the OM as determined by excitation emission spectroscopy was again similar to that observed in pore water extracted from the fresh field materials. Additional analysis of both solid state and extractable OM by FT ICRMS at EMSL is expected to yield further more detailed molecular information. However, these preliminary results emphasize the central role of mineral surfaces in regulating the concentration and structure of DOM. With the assumption that microbial degradation of OM occurs primarily on the DOM phase, this implies a key role for mineral surfaces in controlling OM decomposition across the site.