Stabilization of Mineral Associate Simple Organic Molecules Under Varying Temperature and Moisture Conditions-- LBNL TES SFA

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Project Abstract:Soils represent an important reservoir of organic carbon. However, the accessibility of soil C and, in particular mineral-associated organic C, to microbial decomposer communities and its response to changing temperature and moisture regimes remains uncertain. To gain insight into the decomposability of mineral-associated organic C and the sensitivity of mineral associated C to environmental perturbations, we conducted a series of incubations using different types of synthetic mineral organic associations (MOAs), incubating those MOAs in soils from different depths (10-20 and 80-90 cm), and varying temperature and moisture conditions in the incubations. The two types of MOA included 13C labeled glucose or 13C labeled glycine associated with one of two different Fe (hydr)oxides. The soils are moderately acidic (pH ~6.5) sandy, mixed, mesic Ultic Haploxeralfs from a coniferous forest. The soils containing the 13C labeled MOAs were incubated at two temperatures: 25 deg. C and 30 deg. C. Additionally, the glucose containing MOA was also incubated at two different moisture levels: 20% and 30% VMC. CO2 concentration and d13C measured for synthetic MOA treated soils were compared to a natural abundance (no added 13C label or mineral) control and a non-mineral associated 13C glucose control. Perhaps not surprisingly, increases in temperature and moisture induced significant changes in decomposition of native SOC across all treatments and in both depths. However, sorption of either organic molecule to reactive mineral surfaces dramatically decreases decomposability under all experimental conditions relative to the free substrate. Additional suggested conclusions include that decomposition of MOA bound glucose is more sensitive to temperature and moisture perturbations than non-mineral associated glucose. In addition, it appears that overall temperature and moisture effects on native SOC were roughly additive whereas for the mineral bound organics the impacts were clearly not additive. It is hypothesized that this result can be explained by assuming that increases in either temperature or moisture have the impact in increasing the release of a finite pool of weakly organic matter. Since both variables act on the same pool, their impact is limited by the total quantity of weakly bound organic matter and therefore the impacts are not fully additive. If correct, the hypothesis can inform the numerical modeling of MOA dynamics in as much as it implies the need to represent a distribution of association strength with the fraction of organic associated in order to accurately capture the response of soil carbon stocks to temperature and moisture variation.