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Environmental controls on the formation of oxidized pigments and intact polar lipids

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The pigment and intact polar lipid biomarkers in biological soil crusts and microbial mats reflect the populations of producers and consumers in the microbial community as well as environmental conditions affecting their growth. Both mats and biocrusts form at the interface between atmospheric and sedimentologic/pedogenic processes. The microbial populations thus have a significant influence on climatological and biogeochemical processes. This presentation will highlight ongoing research on the application of microbial pigment and lipid biomarkers to studies of biogeochemistry in the Microbial Biogeochemistry Lab at Baylor University. Focus will be on soils and tidal flat sediments in the humid subtropical climate zone of Texas, including savanna soils from Balcones Canyonlands National Wildlife Refuge in central Texas and mud and sand tidal flats from Corpus Christi Bay on the Gulf of Mexico. On tidal flats, the role of oxidative stress associated with desiccation and exposure to visible and UV light is a function of mat position relative to sea level and hydration frequency. Drying is more persistent on dryland soils, and biocrust microbes have evolved to persist in a desiccated state. Oxidative stress affects the chemical structures of biomarkers, resulting in the formation of oxidized derivatives of chlorophylls and membrane lipids. The direct oxidation of biomarkers through the formation of oxygen containing functional groups, e.g. carbonyls and carboxyls, produces biomolecules that potentially must be repaired after rewetting but prior to restarting metabolic activity. We report on the changing distributions of oxidized pigment and lipid biomarkers in response to tidal cycles and rainfall events. These data provide context for the efficiency of photosynthesis and respiration as important components of the global carbon cycle.