Phosphorus Speciation in Atmospherically Deposited Air Particulates from High and Low Elevation Sites of California and Colorado.

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An accepted paradigm of terrestrial ecosystems in temperate climates is that nitrogen (N) rather than phosphorus (P) is the dominant limiting nutrient to plant growth. Recent studies, however, suggest that the anthropogenic release of large quantities of oxides of N into the atmosphere through fossil fuel combustion has greatly enhanced N inputs to ecosystems, such that the bioavailability of P rather than N may now control terrestrial productivity. Furthermore, even in relatively pristine environments that have low N inputs from the atmosphere but where the soil is derived from low P-bearing geological substrates, P may also regulate ecosystem productivity and the removal of the primary greenhouse gas carbon dioxide from the atmosphere. In this project, we have employed X-ray absorption spectroscopy (XAS) techniques to investigate the P-speciation in air particulates to enable us to understand the sources and seasonal changes in atmospherically deposited P to the soil. For this purpose, air particulate samples were collected from high and low elevation sites in the Southern Sierra Critical Zone Observatory (SSCZO), California (CA) and from a high elevation site the East River Watershed in the Upper Colorado River Basin (CO) (in collaboration with Lawrence Berkeley National Laboratory) during two different seasonal periods, Sep-Oct 2016 and April-Aug. 2017. Samples were analyzed using X-ray absorption near edge structure (XANES) at the P K-edge. Preliminary P-XANES results from linear combination fits (LCF) indicate a mixture of several P species, with higher amounts of organic-P of phytate origin predominating in samples from high elevation at both CA and CO sites. However, samples from the lower elevation CA site showed a mixture of organic and inorganic P mostly associated with calcium. Seasonally, the speciation of P in samples collected in both seasons were similar at the high elevation sites, while they varied between organic, sorbed organic, and inorganic P species at low elevation sites. For comparison, soil samples collected from two high elevation SSCZO sites were analyzed by P-XANES. The LCF results showed predominantly inorganic P adsorbed on clay minerals, with soil from one site high in inorganic P and also containing up to 13% calcium-associated organic - P species. Results from these studies will provide insight into the transformation processes through which atmospherically deposited reactive P species are incorporated into the soil systems.