

Poster #164

Experimental and Modeling Investigation of the Impact of Atmospherically Deposited Phosphorus on Terrestrial Soil Nutrient and Carbon Cycling, and Ecosystem Productivity

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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 relative 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 exploratory project, we are using a combination of spectroscopic methods, stable isotopes, and selective chemical extractions to determine labile or recalcitrant P species, and to evaluate sources and changes in P speciation with atmospheric deposition to soil. We are examining initial samples collected in Sept.-Oct. 2016 from two montane sites: one along a well-established altitudinal transect in the Southern Sierra Critical Zone Observatory (SSCZO), and one in the East River Watershed in Upper Colorado River Basin (in collaboration with Lawrence Berkeley National Laboratory (LBNL)). Samples were collected using passive air sampling (static pans) placed at two different elevations at each location. Particulates were washed from the pans, filtered sequentially through 10 and 0.2 micrometer PTFE Teflon filters, and air-dried. X-ray absorption spectroscopy (XAS) at the P K-edge of bulk material on filters showed differences among the two locations and two elevations in both the energy position of the maximum absorbance and in post-maximum edge features. These spectra, in comparison with solid phase reference compounds and phosphate sorbed on mineral surfaces, indicate mixtures of several P species in the dust samples. Further characterization by electron microscopy, solid-state ³¹P NMR, and stable isotopes ($\delta^{18}\text{O}$ in PO_4) is ongoing, as well as chemical analyses and selective extraction. Snow sampling will occur in spring 2017 followed by summer sampling in order to compare differences among particulate material deposited at different times of the year. These studies will help establish whether the chemical forms of P from atmospheric particle deposition have significant reactivity for incorporation into soil biogeochemical cycles, and thus may have a potentially large and disproportionate impact on net ecosystem productivity in P-limited terrestrial ecosystems.