TRACING SOURCE AND MOBILITY OF LEGACY PHOSPHORUS IN RANCH SOILS – INSIGHTS FROM URANIUM ISOTOPES

Benjamin T. Uveges[1]*, Dan Petticord*[1]*, Amartya Saha*[2]*, Jiangxiao Qiu*[3]*, Elizabeth Boughton*[2]*, Jed Sparks*[1]

[1]Cornell University, Ithaca, NY, USA

[2]Archbold Biological Station, Lake Placid, FL, USA

[3]University of Florida, Davie, FL, USA

In many modern agricultural settings long-term phosphorus (P) fertilization has led to the buildup of residual P in soil that is not immediately accessible to plants, commonly known as legacy P. This legacy P, aside from being indicative of the inefficient use of a finite resource, can be a source to local water bodies long after the cessation/reduction of P fertilizer application. Excess P loading in P-oligotrophic systems such as the Everglades can lead to harmful algal blooms and subsequent eutrophication and water column hypoxia. Understanding the form and fate of fertilizer derived P is key to inform best practices toward the management and mitigation of adverse ecological outcomes. However, natural P is monoisotopic, precluding the use of stable isotope ratios to trace sources and cycling processes as is commonly done with other major nutrient elements. Uranium (U) can serve as an analog for P in environments where their mobility is similar and has several isotopes that are long-lived relative to human timescales. In agricultural systems, elevated concentrations of U coupled with distinctive fertilizer-like U activity ratios, $(^{234}U/^{238}U)_A$, can be used to trace the influence and mobility of legacy P derived from past fertilizer applications both within a catchment, as well as through a soil profile. Here we present U isotope measurements of subtropical pastureland spodosols from Archbold Biological Station's Buck Island Ranch. Spodosols are soils common in Central Florida that are generally very sandy but are typified by a deep layer enriched in organic matter and aluminum and iron bearing minerals, otherwise known as a spodic layer. We investigate the spatial distribution of fertilizer derived U, and by extension P, in surface soils, as well as across soil depth to better understand the long-term "buffering" effect of the spodic layer on legacy P.

PRESENTER BIO: Dr. Uveges is currently a Postdoctoral associate working in the Sparks Lab at Cornell University. He received his PhD from Syracuse University, followed by a Postdoctoral associate appointment at MIT. He specializes in tracing biogeochemical nutrient cycling and microbial ecology using stable isotope ratios and organic biomarker signatures.