**Corrinoids as model nutrients to probe microbial interactions in a soil ecosystem**

Zachary F. Hallberg (zhallber@berkeley.edu),[1] Zoila I. Alvarez-Aponte,[1] Alexa M. Nicolas,[1] Hans K. Carlson,[2] Mary K. Firestone,[1] and **Michiko E. Taga[1]**

[1]University of California, Berkeley
[2]Lawrence Berkeley National Laboratory, Berkeley, CA

http://tagalab.berkeley.edu

**Project Goals: The overall goal of this research is to gain a deeper understanding of the microbial interactions that drive soil community structure. This research leverages a model group of key metabolites related to vitamin $B_{12}$, known as corrinoids, to investigate microbial interactions. Corrinoids are a structurally diverse nutrient class shared between different bacterial species, as they are produced by only a subset of the bacteria that use them. Based on the inherent specificity of bacteria for particular corrinoids, the hypothesis driving this work is that corrinoids are keystone nutrients in shaping soil microbial communities. To test this hypothesis, we examined/are examining the effects of corrinoid addition on community composition and function across multiple levels of complexity. By investigating cycling of a key nutrient in soil at levels spanning the whole community to individual isolates, this work will reveal an unprecedented view of metabolic interactions in a soil microbial community.**

Nutritional interactions in the soil microbiome drive critical environmental and ecological processes including biogeochemical cycling and plant growth. Identifying key nutrients that could predictably modulate soil communities is an attractive way to impact these processes. Nevertheless, the complexity of the soil milieu and diverse microbial community composition make it impossible to experimentally analyze all microbe-microbe interactions simultaneously using current analytical methods. We aim to identify key microbe-microbe interactions by unraveling the nutrient network produced by corrinoids, a group of structurally diverse metabolites used by a majority of the community. Exemplified by its flagship member, Vitamin B12, corrinoids are essential cofactors produced only by a fraction of the bacteria that use them, and thus are shared metabolites. Unlike other shared nutrients, corrinoids are structurally diverse: at least 16 distinct corrinoids have been described. Our group and others have shown that, bacteria that play central roles in bioremediation, plant-bacteria symbiosis, and elemental cycling possess preferences for distinct corrinoids. Thus, corrinoids appear to be an ideal nutrient by which we can pinpoint specific microbial interactions.

Here, we test the hypothesis that corrinoids are a key nutrient family that shape soil microbial ecosystems. We optimized a chemical extraction process for corrinoids from an annual grassland soil that circumvents the ability of soil to adsorb corrinoids. Using this method, we

show that, despite the ability of many soil-derived organisms to produce alternate corrinoids, Vitamin B12 is the predominant corrinoid in bulk soil. We also demonstrate that Vitamin B12 addition to soil enrichment cultures alters their species composition. Unexpectedly, despite the overwhelming presence of Vitamin B12 in this soil, addition of alternate corrinoids elicited marked responses in enrichment culture assembly. This study identifies key corrinoid-limited taxa that are desirable targets to understand corrinoid sharing in natural soil.

*This research is funded by the DOE Genomic Sciences Program Grant DE-FOA-00002059 (to MT).*