Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.24349

Rerouting microfluidic transformations of organic nitrogen and phosphorus in soils

JARED L. WILMOTH, ISABELLE E VAN BENSCHOTEN, SYLVIA R JACOBSON AND JASON S. MANZON

University of Maryland

Presenting Author: jwilmoth@umd.edu

Soils form a reactive Earth surface regulating nitrogen (N) and phosphorus (P) transformations across a wide range of spatiotemporal scales. Our work with high-resolution mass spectrometry shows that organic N and P are informative biogeochemical signatures when correlating their broader molecular characteristics to environmental perturbations involving variable precipitation, accelerated sea level rise, and shifts in vegetation composition over the last decade. However, the regulation of these molecular characteristics in the rhizosphere is a critical knowledge gap. Interconnected microchannels and micropores in rhizosphere soil, extending from plant roots and rhizomes, form a vastly unexplored microfluidic network that reroutes biogeochemical pathways during environmental perturbations. We reason with new data from high-resolution Fourier transform mass spectrometry and microfluidic soil analogs examined using agent based (ABM) and recurrent neural network (RNN) modeling that important metrics such as the mass and nominal oxidation state of organic N- and P-bearing compounds, microbial cell transport and interactions, and dynamic transitions in the interfacial chemistry of microscopic soil surfaces need to be further investigated and used to model N and P over different spatiotemporal scales. Leveraging tools like X-ray computed tomography paired with the above-mentioned techniques (e.g., mass spectrometry imaging using ion cyclotron resonance), including others like field cycling nuclear magnetic resonance, widens the scope of understanding how organic N and P signatures of past, present, and future environments emerge.