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Tracking microbial and mineral soil physiochemical processes through dissolved organic matter composition

LINDSEY BUTT[1], ALLISON MYERS-PIGG[1,2], J. ALAN ROEBUCK[1], DR. LIGIA FARIA TAVARES DE SOUZA, PHD IN ECOSYSTEM ECOLOGY[1,3] AND SUSAN E ZIEGLER[1]

[1]Memorial University of Newfoundland
[2]Pacific Northwest National Laboratory Marine Sciences Laboratory
[3]Soil Carbon Solutions Center

High-latitude regions are experiencing more frequent precipitation events due to climate change, including boreal forests, resulting in higher runoff of soil-derived dissolved organic matter (DOM) into downstream ecosystems. These forests account for 30% of global forest soil organic carbon and dissolved organic matter (DOM) is the primary source of carbon to these soil stores. Currently, the loss of soil organic carbon as DOM is not included in carbon budget models and accurate estimates are thus essential to understand its sources and the transformations it undergoes as it travels through the terrestrial landscape. Within the landscape, soil DOM experiences varying degrees of microbial degradation and interacts with reactive minerals through processes including adsorption, co-precipitation, and desorption. The purpose of this study is to understand how the composition of soil DOM changes in response to microbial degradation and mineral soil physicochemical processes, and to help establish indicators for these processes as DOM moves through the landscape. To isolate these processes, two experiments were conducted. The first experiment was a bio-incubation of soil DOM to examine changes in composition caused by microbial degradation. The second experiment applied DOM to soil columns made of boreal forest mineral soil simulating rates for an extreme precipitation event for the region (150 mm day $^{-1}$) to isolate compositional changes resulting from mineral soil physicochemical processes. Changes in biochemical composition during both experiments were investigated by analyzing dissolved organic carbon, hydrolysable amino acids and UV-Vis absorbance. An amino acid derived degradation index accurately tracks the changes in DOM composition associated with microbial degradation on timescales of days to weeks. Amino acid composition indicated that both microbial degradation and mineral soil physicochemical processes resulted in a loss of plant-derived DOM and accumulation of microbially-derived DOM. However, microbial degradation caused accumulation of chromophoric DOM while physicochemical processes caused a loss in chromophoric DOM. The findings of this study suggest combined monitoring of chromophoric, and amino acid composition of soil DOM can track the degree and type of transformation DOM undergoes in the terrestrial landscape enroute to the aquatic environment.