Poster #21-56

The Influence of Microbial Priming Effects on the Hydro-bio-geochemistry in the Columbia River and its Tributary Confluences

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BER Program: SBR
Project: University Award

A positive priming effect occurs when the microbial oxidation of terrestrial dissolved organic matter (TDOM) is enhanced by the addition of algal dissolved organic matter (ADOM). However, the prevalence of priming within river-tributary confluences, with often contrasting OM sources and composition, remains unknown. Here, we measure total dissolved organic carbon, dissolved nitrogen, chromophoric dissolved organic matter, dissolved lignin phenols, dissolved hydrolysable amino acids, and the molecular composition of DOM via FT-ICR-MS in the mainstem of the Columbia River and three of its tributaries (Snake River, Yakuma River, and Walla Walla) along an extreme hydrologic east-west gradient in the Columbia River drainage basin. Field replicates and mixtures representing river-tributary confluences were incubated in the dark for 15 days to investigate the response of the microbial community to varying DOM quantity and composition. The Columbia, Snake River, and Yakuma Rivers did not differ in DOC, fDOM, and chlorophyll-a concentrations. However, Walla Walla tributary had significantly greater DOC, fDOM, and chlorophyll-a concentrations, indicative of greater contributions from ADOM than the Columbia River and these other tributaries. The FT-ICR-MS spectra for Walla Walla had significantly more peaks corresponding to amino sugars, carbohydrates and proteins while the Columbia River had more peaks for lignin, unsaturated hydrocarbons, and condensed aromatics. When incubated for 15 days in the dark, the DOC did not decrease for Walla Walla or any of the other river and tributary samples. The DOC did decrease, however, in a mix representing the confluence of the Columbia and Walla Walla rivers, suggesting the microbial consortia of the Columbia River were primed by the Walla Walla DOM. The DOM composition, measured by the number of peaks detected via FT-ICR-MS, were significantly different for several compound classes (lignin, protein, tannin, etc.) in the incubations of unmixed river and tributary samples. However, the primed microbial community in the Walla Walla-Columbia mixture appeared to be indiscriminate of the molecular structure of the DOM as the peak count for each compound class did not change significantly. This provides preliminary evidence that the enzymes exuded during aquatic priming can hydrolyze diverse OM structures. Overall, our results indicate the presence of microbial priming effects generated by confluences that mix contrasting OM quality.