Analysis of Dissolved Organic Matter Percolated from Periphyton in Everglades and the Interaction between Percolated Dissolved Organic Matter from Periphyton and Mercury

Afia Anjuman[1], Yong Cai[1]*

[1]Department of Chemistry & Biochemistry, Florida International University, Miami, Florida, USA

aanju002@fiu.edu

FIU Center for Aquatic Chemistry and Environment
NSF Center of Research Excellence in Science and Technology

Abstract

When organic matters of various kinds decompose partially, dissolved or soluble organic matters can form. The organic matters are usually produced from plants, soil, bacteria, algae, and living organisms. The wetland of Everglades is rich in dissolved organic matters. The quantity and quality of these dissolved organic matters have significant impact on environmental factors such as biogeochemical activity, transport, absorption, complexation, and more specifically the speciation and geochemical cycling of toxic metals such as mercury (Hg). Everglades wetland is abundant in periphyton which can also be responsible for dissolved organic matter percolation and production. The DOM from periphyton, in particular when freshly produced and released into the water, would have a profound effect on mercury species present in the water, e.g., by forming mercury-DOM complexes. This experiment is designed to perform quantitative and qualitative analysis of DOM produced by periphyton and the complexation of mercury with the produced DOM from periphyton. In addition to organic carbon analysis, the samples will be analyzed for optical properties by using a spectrofluorometer for information on the sources, types, and reactivity of DOM. The project will improve the understanding of the relation between DOM and periphyton and the environmental processes of Hg impacted by periphyton.

Research aims

- Characterization of DOM percolated from periphyton in the Everglades
- Comparison of DOM from Everglades surface water and periphyton
- Analysis of Hg speciation in the presence of periphyton DOM

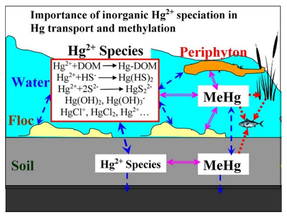

Figure 1: Mercury speciation in Florida Everglades; DOM plays a crucial role in controlling Hg speciation and transformation.

Research Methodology

- Collection of different types of periphyton and water samples from the Everglades
- Periphyton incubation and DOM leaching experiment
- Elemental Analysis by measuring total and dissolved C, N, P content
- Qualitative analysis: 3-D EEMs Fluorescence and UV-Visible Spectroscopy
- Analysis of Hg-DOM complexation

Figure 2a: Epiphyton

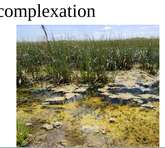

Figure 2b: Floating Mat and Epipelon

Figure 2c: Epilithon

Figure 2: Different types of Periphyton samples collected from the Water Conservation Area 3b at the North part of the Florida Everglades

Figure 3a: Before incubation

Figure 3b: During incubation

Figure 3c: After incubation

Figure 3: Periphyton Incubation and DOM leaching experiment

Results

- Dissolved Organic Matter characterization in Everglades Surface Water

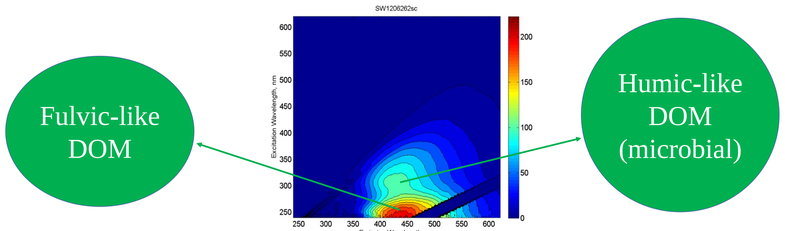

Figure 4a: Surface Water DOM

- Dissolved Organic Matter characterization in Periphyton (floating mat) Overlying Water

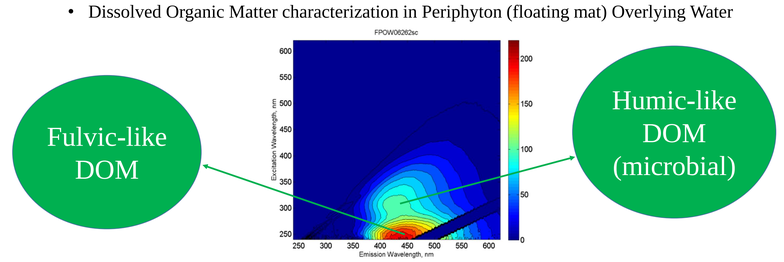

Figure 4b: Periphyton Overlying Water DOM

- Dissolved Organic Matter characterization in Periphyton (floating mat) Pore Water

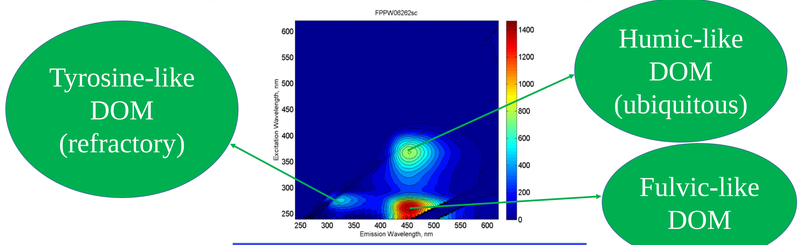

Figure 4c: Periphyton Pore Water DOM

- Dissolved Organic Matter leached from Periphyton (floating mat) after incubation

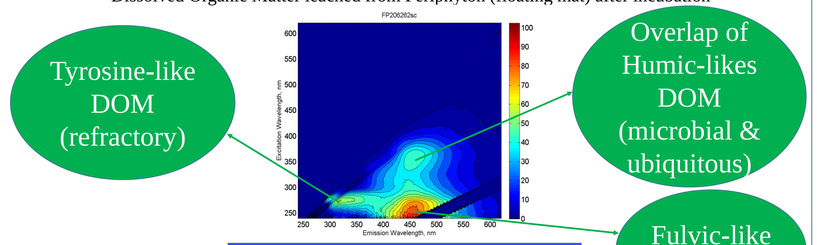

Figure 4d: Leached DOM from Periphyton

Figure 4: 3D EEMs Fluorescence Spectroscopy for DOM analysis

Findings and Observations

- Surface Water and Periphyton Overlying Water have same types of DOM: mostly fulvic-like, some humic-like (microbial origin); their DOC content is similar as well
- Periphyton Pore Water contains: mostly fulvic-like, tyrosine-like (refractory), humic-like (ubiquitous); it has higher DOC content than Surface Water and Periphyton Overlying Water
- Leached DOM after incubation contains: mostly tyrosine-like (refractory), fulvic-like, overlap of humic-like from microbial and ubiquitous origin; it has lower DOC content than Periphyton Pore Water

Discussion and Conclusion

- The quantitative and qualitative analysis of DOM from Everglades Surface Water, Periphyton Overlying Water, Periphyton Pore Water, and water sample containing leached DOM sample from Periphyton provided information on DOC content, DOM source, type, and reactivity
- However, in order to differentiate water samples from different types of periphyton, quantitative measurement of different functional groups; such as total Protein, carbohydrates, and thiols; is required
- Total Nitrogen, and Phosphorus measurement in addition to their dissolved portion is required as well to obtain information on their different nutrient conditions
- Studies with addition of mercury (Hg^{2+}) of different concentrations in leached DOM samples from different types of Periphyton will provide understanding of the interaction between mercury and DOM in depth
- Designing experiments to measure specific types of DOM from periphyton quantitatively will be aimed to test the first hypothesis that the presence of non-humic-like functional groups of different concentration in leached DOM samples from different types of Periphyton might impact the quality of Hg-DOM complexation
- Designing experiments to identify functional groups of DOM from periphyton and complexation with mercury in molecular level will be aimed to test the second hypothesis that the complexation between DOM from periphyton and Hg could affect Hg speciation, and thus will influence MeHg production in periphyton in Florida Everglades

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