MEMORIAL UNIVERSITY

MSc Departmental Seminar

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Thursday, March 21, 2024 at 1:00 p.m. (Rm: CSF-1302)

Title

Dissolved Organic Matter During the Spring Bloom in the North Atlantic Ocean Analyzed using Optical Properties and Parallel Factor Analysis

Abstract

The ocean acts as a carbon sink in the global carbon cycle however the mechanisms of carbon transfer within the ocean are still not well understood, in particular the processes affecting dissolved organic matter (DOM) within the biological carbon pump(BCP)[1]. The BCP refers to the series of mechanisms that transfer particulate organic matter from the ocean's surface to the bottom during periods of periods of biological activity such as phytoplankton blooms [1,2]. The microbial carbon pump (MCP) is intertwined with the BCP, transferring the dissolved fraction of organic matter in to the deep ocean[2]. A second area of interest is how these processes may be affected by the changing ocean environment[1]. This research focusses on samples collected from a collaborative field study in the Labrador Sea that took place during the decline of a phytoplankton bloom in May/June 2022 and focused on gaining understanding of the biological carbon pump. The samples were from two experiments: two short-term bioassays with altered temperature and nutrient conditions and a series of long-term biodegradation experiments. These samples were analyzed through UV-Vis and fluorescence spectroscopy in combination with Parallel factor analysis (PARAFAC) to create a component model used as a fingerprint for the data.

Due to the complexity of DOM, focusing on the chromophoric (CDOM)and fluorescent (FDOM) fractions is common as these fractions are attributed to being results of biological and microbial activity[3]. Pairing optical analysis and PARAFAC is a common technique utilized to gain more information on the groups of compounds present and the transformations they undergo across samples. It was found that both the bioassay and biodegradation samples had similar fluorescence signatures which were compiled and decomposed into a five-component model. These components were compared to similar datasets through the OpenFluor database and additional literature which were able to identify sources of the compounds producing fluorescence in these regions[4].

Comparing how these components intensities changed for individual samples over the timeframe of experiments; between the series of biodegradation experiments and between the conditions of bioassay experiments were able to provide insight into the DOM transformations. These comparisons were useful to explore how bloom stage, community composition, temperature and nutrient ratios affects biological DOM processes and the timeframe in which these transformations occur.

References

(1) Ridgwell, A.; Arndt, S. Chapter 1 - Why Dissolved Organics Matter: DOC in Ancient Oceans and Past Climate Change. In *Biogeochemistry of Marine Dissolved Organic Matter (Second Edition)*; Hansell, D. A., Carlson, C. A., Eds.; Academic Press: Boston, 2015; pp 1–20. https://doi.org/10.1016/B978-0-12-405940-5.00001-7.

(2) Jiao, N.; Farooq Azam. Microbial Carbon Pump and Its Significance for Carbon Sequestration in the Ocean. In *Microbial Carbon Pump in the Ocean*; 2011; pp 43–45.

(3) Stedmon, C. A.; Nelson, N. B. Chapter 10 - The Optical Properties of DOM in the Ocean. In *Biogeochemistry of Marine Dissolved Organic Matter (Second Edition)*; Hansell, D. A., Carlson, C. A., Eds.; Academic Press: Boston, 2015; pp 481–508. https://doi.org/10.1016/B978-0-12-405940-5.00010-8.

(4) Murphy, K. R.; Stedmon, C. A.; Wenig, P.; Bro, R. OpenFluor– an Online Spectral Library of Auto-Fluorescence by Organic Compounds in the Environment. *Anal. Methods* **2014**, *6* (3), 658–661. https://doi.org/10.1039/C3AY41935E.