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Dissolved organic carbon composition and reactivity in arctic Canadian Lakes

Freshwater systems are active components of the global carbon cycle and contribute to global CO_2 emissions. Freshwater studies in the Arctic are underrepresented, especially regarding lakes and their Dissolved Organic Carbon (DOC) reactivity and composition dynamics. DOC is a main part of DOM (dissolved organic matter), which drives processes central to carbon cycling, influences chemical and biological characteristics, for example bacterial production (BP) and bacterial respiration (BR), and lake DOC is usually comprised of allochthonous (terrestrial) and autochthonous (algal) sources. Within DOM, CDOM (coloured DOM) and FDOM (fluorescent DOM) are key components, which can impact productivity and act as indicators of DOC composition.

The remote area of Churchill Canada is an arctic region with an abundance of lakes, and this study aimed to investigate the relationships between microbial DOC reactivity and DOC composition in these lakes, and to improve our understanding of the influence of environmental properties, and potential CO_2 emissions. In this study, we used documented methods to investigate DOC in 54 lake samples, primarily including dark laboratory incubations over a 28-day period. BP and BR were measured using leucine uptake and dissolved oxygen concentrations respectively, while DOC composition was investigated using fluorescent spectroscopy and PARAFAC. Three fluorescent components were identified: C1 (Terrestrial humic), C2 (Marine/microbial humic), and C3 (algal protein-like).

Weak relationships between BP, BR, and the components were found, while lake area proved to be a control on DOC amount and variations in reactivity and composition. As expected CDOM and FDOM showed net production, although this varied, as C3 had the most production especially in low CDOM lakes. pCO_2 (partial pressure of CO_2) and potential CO_2 emissions were linked partially to BR, and DOC, but potentially photoreactivity is more important. The results from this study show that the role of Arctic lakes remains highly variable and is closely linked to site specific conditions. Further analysis of these and other lakes, across different environmental and hydrological conditions are suggested, to form a clearer view of the role of Arctic lakes in the carbon cycle, and the complex relationship between DOC reactivity and composition.

Keywords: Physical Geography and Ecosystem Science, Dissolved Organic Carbon, Arctic, Lake, Fluorescence, Area, pCO_2

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