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Microbial ecology of methane cycling in Arctic lakes of the Mackenzie River Delta

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The Mackenzie River Delta lies where the Mackenzie River flows into the Arctic Ocean in the Inuvialuit Settlement Region in the western Canadian Arctic. The delta is the second largest in the circumpolar Arctic and, like other such landscapes, is a dynamic ecosystem that acts as a hotspot of biological productivity compared to the surrounding tundra landscape. Previous work has identified thermokarst activity and the degree of river-to-lake connection as drivers of lake landscape heterogeneity, with the latter translating to general gradients of physical and biogeochemical properties, however little is known about the microbial ecology of methane processing in delta lakes and related seasonality. Methane production and consumption are of particular interest in a region that is experiencing warming at a rate faster than the rest of the world. My research aims to characterize seasonal shifts in the community composition and abundance of methanogens and methanotrophs in a set of delta lakes from peak methane concentrations before spring ice melt through the summer open water season along gradients of river-to-lake connectivity, CH4 concentrations, and oxygen availability. Preliminary analysis of 16S rRNA amplicon sequences shows that methanotrophs are ubiquitous among delta lake samples and that there is an inverse relationship between river connection time and under-ice methanogen abundance. Additionally, the presence of methanogens in the upper water column both under-ice and later in the open water season has been identified in one lake. Methane production in Arctic lakes has classically been thought to only occur in anoxic bottom waters near the sediment-water interface, this result provides further evidence to previous work that identified the possibility of water column methanogenesis based on CH4 diffusion modelling [1]. Further results will clarify the methane cycling component of microbial carbon processing, which, in future work, could support the development of more appropriate modelling for lakes in river floodplains and improve understanding of how Mackenzie delta lakes, and other large lake-rich deltas in the Arctic, may respond to the complex multiple forcings of global climate change.

[1] McIntosh Marcek, Lesack, Orcutt, Wheat, Dallimore, Geeves & Lapham, (2021), *Journal of Geophysical Research: Biogeosciences*, *126*(3), e2020JG006038.