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Radiocarbon and Stable Isotope Constraints on the Sources and Cycling of Organic Carbon in Mackenzie Delta Lakes

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The Arctic is undergoing accelerated changes in response to ongoing alterations to the climate system (Arctic report card 2019), and there is a need for local to regional scale records of past climate variability in order to put these changes into historical context. The Mackenzie Delta region (Northwestern Territories, Canada) is populated by numerous small shallow lakes. They are classified as no-, low- and high-closure lakes, reflecting varying degrees of connection to the river main stem, and as a result, have different sedimentation characteristics. As for much of the Arctic region, the Mackenzie Delta is expected to undergo marked environmental perturbations such as earlier melting of river ice. As a consequence, the annual flood pulse (freshet) may decline, potentially resulting in the disconnection of some lakes from the river, leading to their subsequent desiccation (Lesack et al., 2014; Lesack & Marsh, 2010). In contrast, abrupt permafrost thaw and enhanced thermokarst-related processes might lead to additional lake formation and deepening of already formed lakes.

In this study, we used sediment cores originating from several lakes within the Mackenzie Delta, representing the three types of connectivity to the river (Lattaud et al., 2021). Radiocarbon and stable carbon isotopic signatures of two groups of compounds - fatty acids and isoprenoid and branched glycerol dialkyl glycerol tetraethers (GDGTs) - are employed as tracers of carbon supply to, and cycling within the different lakes. Short-chain fatty acids as well as GDGTs serve as putative tracers of microbial production while long-chain fatty acids originate from higher terrestrial plants. The carbon isotopic signatures are used to distinguish between the relative importance of carbon inputs derived from in situ production, as well as from proximal (lake periphery) and distal (Mackenzie River) sources to the different lakes in the context of their degree of connectivity. Down-core molecular ^{14}C measurements provide insights into the temporal evolution of the lakes, providing context for their response to past and future climate change.