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# Greenhouse gas production potential and associated degradation of organic carbon in warming permafrost – an incubation experiment coupled to biomarker analyses from drained lake basin sediments on the Yukon Coastal Plain, Canada

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Permafrost carbon pools are vulnerable to a warming climate and bear the potential to alter the terrestrial carbon cycle. In the extensive drained lake basin wetlands that cover Arctic lowlands, enhanced degradation of organic-rich deposits upon permafrost thaw could lead to greenhouse gas emissions to the atmosphere. This study investigates processes and intensity of organic matter decomposition and associated potential greenhouse gas production in thawed sediment from drained lake basins on the Yukon Coastal Plain in the western Canadian Arctic. We conducted three-month low temperature (4 °C) incubation experiments, assessing the greenhouse gas production potential in the active layer, transition layer, and permafrost of sediment cores from two adjacent drained lake basins under aerobic and anaerobic conditons. The study was supplemented by comprehensive geochemical and biomarker analyses before and after the incubation experiments. Our findings revealed a higher carbon turnover of up to 2.7 % of the available organic carbon to $CO_2$ under aerobic conditions. Carbon loss from mineral permafrost layers matched that of surface peat samples, whereas nitrogen limitation constrained short term carbon mineralization in pioneer peat layers that accumulated shortly after lake drainage. The GHG production under anaerobic conditions exhibited a high depth-dependency, with permafrost layer samples deviating from the otherwise observed high methanogenesis in active and transition layer samples within the short incubation period. High contributions of the potent greenhouse gas methane of up to 94 % enhanced the climate forcing effect of anaerobic emissions. Consequently, the determined relative climate forcing is higher under anaerobic compared to aerobic conditions in active and transition layers, suggesting that waterlogged conditions within drained lake basins are more unfavorable in the short term. While established degradation proxies C:N, $\delta^{13}C$ and CPI did not distinctly trace significant degradation of terrestrial organic matter, we observed major shifts in lipid composition, reflected in increasing concentrations of n-alkanols and n-alkanes.