Unveiling Permafrost Transformations: Investigating Organic Carbon Characteristics and Dynamics in Alaskan Lowland Landscapes

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Lowland permafrost landscapes are experiencing dramatic changes as the climate in the Arctic has been warming almost four times the rate of the global average in the past four decades. On the Alaskan North Slope, extensive thermokarst processes are steering the dynamics of lakes and drained lake basins (DLBs). With progressing climate change, re-aggradation of permafrost in DLBs becomes potentially impeded. Additionally, along the Beaufort Sea coast, thaw-induced destabilization is causing substantial erosion, exposing previously frozen terrestrial deposits to the marine environment. The consequences for the biogeochemical system, which holds significant amounts of organic carbon, remain understudied. Therefore, we aim to investigate the carbon pool characteristics in thermokarst terrain close to Utqiaġvik. Sediment cores were sampled in 2022 and include two thermokarst lakes, one DLB and one undisturbed upland core. While West Twin Lake has freshwater conditions, East Twin Lake exhibits brackish water. The up to 2 m long sediment cores are investigated with a multidisciplinary approach. Bio- and hydrochemical analyses offer a detailed understanding of the current carbon pool properties. Additionally, n-alkane biomarker analyses, accompanied by carbon isotopy and the C/N ratio, serve as proxies to characterize the degradation state of organic carbon and its changes post permafrost thaw. Initial findings on carbon quantity and quality are presented, along with preliminary results from a 12-month-long incubation experiment. In this experiment, carbon dioxide and methane production rates are measured at ten depths along the sediment cores. The outcomes of this study contribute to a more comprehensive understanding of organic carbon degradation and its implications for the future carbon pool at a landform-specific level.