Stable isotope climate records from drained thermokarst lake basins in northern Yukon, Canada

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Thermokarst lakes form following the thaw of ice-rich permafrost and typically drain after a few decades to millennia. Drained lake basins become epicentres for peat accumulation and, in many areas, ice-rich permafrost re-aggradation. This aggradation may be interrupted by subsequent thaw lake formation should disturbance occur. In this study, we investigate the history of lake basin dynamics through drilling and recovery of permafrost cores from drained thermokarst lake basins (DTLBs) in the Old Crow Flats, northern Yukon. Here, we establish the hydrology and drainage histories of seven DTLBs on the basis of cryostratigraphy, pore-ice stable isotope analyses and radiocarbon dating of associated plant macrofossils. Our results indicate that only one out of the seven lakes underwent multiple thermokarst cycles. Pore-ice stable isotope analyses suggest that four of the lakes became more depleted in $\delta^{18}O$ and δD over time, reflecting increased contributions from snowmelt, while one lake shows $\delta^{18}O$ enrichment likely as a result of partial drainage and evaporative enrichment of the residual water. The two remaining lakes maintain relatively constant isotopic records, possibly due to largely unaltered basin dimensions. These findings suggest variable post-drainage isotopic histories between different thermokarst lake basins as a result of spatially varying permafrost and hydrologic conditions. Based on our isotope dataset, we argue that syngenetic peat permafrost maintains relatively unaltered meteoric water archives while epigenetic lacustrine silts are inherently more variable. Consequently, syngenetic peat permafrost from northern DTLBs may be useful for millennial-scale paleoclimate investigations as we show through our reconstruction of Holocene climate change in northern Yukon.

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