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Dynamics of organic matter thermal stability across warming Arctic river catchments

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Arctic landscapes are warming at a higher rate than the global average, modifying biogeochemical and hydrological processes. These changes put the large stocks of organic carbon in permafrost zones at risk of microbial mineralisation, with resultant greenhouse gas emissions a major uncertainty in future projections of the global carbon budget. Arctic rivers are worthy of focus for two distinct reasons. First, they carry organic matter eroded from across vast terrestrial ecosystems, and thus river sediments provide a way to quantify a landscape-scale view of organic matter stability in the Arctic. Second, Arctic Rivers are vectors of greenhouse gases from the landscape, and river sediments may also undergo remineralisation and contribute to changing future emissions. With these themes in mind, here we aim to establish the spatial and temporal changes in the age and stability of river organic carbon in the Mackenzie River catchment, Canada for the 2010-2024 period. We quantify the thermal stability of particulate organic carbon using ramped thermal oxidation. Thermograms (evolved CO_2 over temperature) were used to calculate activation energies, a proxy for organic carbon bonding strength, that reflect the diverse range of organic matter sources in the upstream catchment. We combine this data with published geochemical (e.g., %OC, ^{13}C, ^{14}C) and sedimentological (e.g., grain size) information of suspended, bedload, and bank sediments in the Mackenzie delta region and major tributaries. Spatial and temporal trends are used to improve our fundamental understanding of the sources, transport dynamics, and reactivity of particulate organic carbon. This is key to predict future changes in the carbon cycle in the Arctic and its feedback to climate.