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Biomarker-inferred terrestrial and marine organic carbon fluxes and environmental conditions during the terminal meltwater pulse in the Labrador Sea

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The terminal meltwater pulse (MWP) associated with the deglaciation of the Laurentide Ice Sheet resulted from the collapse of the Hudson Bay Ice Saddle (~8.5 kyr BP). This MWP delivered large amounts of freshwater to the Labrador Sea, perturbing circulation and primary production. However, little is known about the mobilization of terrestrial organic carbon (OC fluxes) in response to the Ice Saddle collapse. Here, we present a multiproxy biomarker data set from the Labrador Shelf, combining *n*-alkyl lipid and GDGT proxies to quantify terrestrial OC fluxes and paleoenvironmental conditions.

brGDGT-derived mean annual air temperatures increase by 4-5°C during the early Holocene and gradually decrease after 7.3 kyr BP, consistent with insolation forcing. In contrast, $TEXL_{86}$- and $OH\text{-}TEX_{86}$-derived sea surface temperatures (SSTs) decrease during the early Holocene and MWP, and remain relatively stable within ±2-3°C after 7.3 kyr BP until present, likely recording both freshwater input and circulation changes in the Labrador Sea. High mass accumulation rates (MAR) of vascular plant and soil bacterial biomarkers before and after the MWP indicate enhanced terrestrial OC input until ~7 kyr BP (derived from tundra and grass-type vegetation), likely delivered from Laurentide Ice Sheet deglaciation, followed by a substantial reduction in terrestrial OC thereafter. Low *n*-alkane carbon preference index values throughout the record indicate contributions of petrogenic OC, and peak during the MWP. High isoGDGT and low molecular weight fatty acid MAR after the MWP indicate enhanced marine production, likely linked to nutrient input. The MARs of marine biomarkers also decrease after ~7 kyr BP and *n*-alkane, *n*-fatty acid, and GDGT-based ratios indicate a relatively stable ratio of marine to terrestrial OC for the remainder of the Holocene.

Overall, our data suggest increased mobilization of terrestrial OC during the decay of the Laurentide Ice Sheet, increased petrogenic OC inputs during the collapse of the Hudson Bay Ice Saddle, and high marine OC fluxes following meltwater release. These findings are consistent with the documented deglacial transfer of petrogenic and permafrost-derived OC to the Beaufort Sea, Siberian Shelf, and Okhotsk Sea, contributing to the growing evidence of circum-Arctic meltwater/thaw-induced carbon mobilization in response to past warming.