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Paleoreconstruction of Organic Matter in the Sediments of the Beaufort Sea Using Lipid Biomarkers

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Algal blooms and terrestrial plants play an important role in the sequestration of carbon in the marine sediments of the Arctic Ocean (AO). Considering its vulnerability to the climate crisis, the pattern of origin of organic matter (OM) and the contributions of sympagic and pelagic algae to carbon sequestration are expected to change. Lipid biomarkers can provide answers to such challenges. Alkanes, sterols, fatty acids, and highly branched isoprenoids (HBIs) can identify the origin of OM, whether its terrestrial or marine, and measure the sequestration contributions of sympagic and pelagic algae within the marine compartment. In addition, the oxidation products of these lipid biomarkers provide insights into both the extent and the nature (abiotic or biotic) of the degradation affecting the OM. Combining these markers allows us to reconstruct the origin and fate of the OM produced by the terrestrial, sympagic, and pelagic compartment in the AO. In the present study, we collected a Calypso square core in the Mackenzie River canyon in the Beaufort Sea in the framework of the 2009 MALINA expedition. Lipid biomarkers and their various oxidation products were quantified via GC-MS following their extraction. An age model was built using C^{14} radiometric dating. The quantified alkanes were used to calculate the average chain length (ACL), carbon preference index (CPI), weighted averages (WAV), and terrestrial/aquatic ratio (TAR). Sterols and alkanes show time periods with significantly different OM signal, showing the variations of input from the terrestrial and marine compartments. These time periods are also significantly linked to HBIs in the core, demonstrating the relationship between algal production and OM source. HBIs also show the greater importance of sympagic algae relative to pelagic algae. The oxidation products present the high impact of photooxidation and biodegradation on these lipids. All these biomarkers demonstrate the value of the different compartments of primary producers and their contributions to carbon sequestration in the AO. In particular, the correlation between terrestrial OM and sympagic production shines a light on the complexities of this system and the impact the climate crisis can have on this fragile ecosystem.