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Fate of organic matter released from permafrost to the East Siberian Arctic Shelf: burial vs lateral transport

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Ongoing global warming may trigger the remobilization of old terrigenous organic carbon (TerrOC) pools into the modern carbon cycle, which could then provide a potential positive feedback for global warming. A better understanding of the fate of such material, released from thawing permafrost via rivers and coastal erosion into the Arctic shelves seas, is therefore crucial for anticipating its influence on putative carbon-climate couplings. The main goal of this study is therefore to explore how sources and degradation status of TerrOC on the East Siberian Arctic Shelf (ESAS) vary both spatially and over time. To compare processes occurring during the cross-shelf transport and after burial we analyzed a suite of well-known terrestrial and marine biomarkers as well as source-diagnostic bulk carbon isotopes (δ13C, Δ14C) in sediments from the vast ESAS. Sediments were collected at increasing distances from the main river outlets (Kolyma and Lena rivers) while sediment cores encompassed over a century of accumulation.

Our results show that TerrOC concentrations vary noticeably more during cross-shelf transport than during burial in sediments. The concentrations of lignin phenols and cutin acids (tracers of vascular plants) do not display clear changes down-core, whereas they decrease over one order of magnitude along the transect. From the molecular-based degradation proxies for TerrOC (CPI of HMW lipids, the HMW acids/alkanes ratio and the acid/aldehyde ratio of lignin phenols) no clear picture arises for down-core changes. With increasing distance from the coast there appears to be a trend to more degraded TerrOC. Furthermore, across the shelf bulk parameters indicate growing relative importance of marine organic matter at the expense of TerrOC. Strongly decreasing marine biomarker concentrations over time confirm the lability of this fresh marine material towards degradation. Overall, we infer that two different key processes affect the TerrOC cycling on this margin: hydrodynamic sorting and more efficient degradation under prevailing oxic conditions during the cross-shelf transport. Our study highlights therefore the importance of potentially millennia-long transport times across the world's widest continental margin.