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Sources, degradation and transport of terrigenous organic carbon on the East Siberian Arctic Shelf Seas

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Recent studies suggest that the present hydrological regime increase observed in the Arctic rivers is mainly the consequence of the changes in permafrost conditions as a result of climate warming. Given the enormous amount of carbon stored in coastal and terrestrial permafrost the potentially increased supply from this large carbon pool to the coastal Arctic Ocean, possibly associated with a translocated release to the atmosphere as CO_2, is considered a plausible scenario in a warming climate. However, there is not sufficient information regarding the reactivity of terrigenous material once supplied to the Arctic Ocean. In this study, we address this critical issue by examining the organic composition of surface sediments collected over extensive scales on the East Siberian Arctic Shelf (ESAS) as part of the International Siberian Shelf Study (ISSS). The ESAS represents by far the largest shelf of the Arctic Ocean. Samples were collected from the inner- to the outer-shelf following the sediment transport pathway in a region between the Lena and the Kolyma rivers. The analytical approach includes the characterization of marine and land-derived carbon using a large number of molecular biomarkers obtained by alkaline CuO oxidation such as lignin-phenols, cutin-derived products, p-hydroxy benzenes, benzoic acids, fatty acids, and dicarboxylic acids. Our results indicated high concentrations of terrigenous material in shallow sediments and a marked decrease of terrestrial biomarkers with increasing distance from the coastline. In parallel, lignin-based degradation proxies suggested highly altered terrigenous carbon in mid- and outer-shelf sediments compared to coastal sediments. Furthermore, the ratio of cutin-derived products over lignin significantly increased along the sediment transport pathway. Considering that cutin is considered to be intrinsically more reactive compared to lignin, high values of this ratio off the coastal region were interpreted as selective transport of fine sediments relatively rich in cutin. Finally, in addition to degradation and sorting processes, our results indicated dilution of land-derived material with marine phytodetritus with increasing distance from the shore. Results from our study indicate that the benthic sediment transport system in the ESAS is quite dynamic and acts as an efficient incinerator of terrigenous material as observed in mid-latitude settings. Therefore, considering the mega-pool of terrigenous carbon susceptible to remobilization because of climate-induced changes, our results suggest future limited burial of this material in mid- and outer-shelf deposits.