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Degradation of terrigenous organic matter on the East Siberian Arctic Shelf assessed by lipid and lignin oxidation products

Felipe Matsubara[1,2], Birgit Wild[1,2], Jannik Martens[1,2], Rickard Wennström[1,2], Tommaso Tesi[1,2,3], Oleg Dudarev[4,5], Natalia Shakhova[4,6], Igor Semiletov[4,5,6], and Örjan Gustafsson[1,2]

[1]Stockholm Univeristy, Department of Environmental Science, Stockholm, Sweden
[2]Bolin Centre for Climate Research, Stockholm University, Sweden
[3]Institute of Polar Sciences, National Research Council (ISP-CNR) Bologna, Italy
[4]Tomsk Polytechnic University, Russia
[5]Pacific Oceanological Institute, Russian Academy of Sciences (FEB RAS), Vladivostok, Russia
[6]International Arctic Research Center, University Alaska Fairbanks, USA

Warming-induced permafrost thawing is expected to intensify the remobilization of terrigenous organic matter (terrOM) to the East Siberian Arctic Shelf (ESAS) via increasing river discharge and coastal erosion. Earlier studies have focused on source apportionment and transport of terrOM, with less emphasis on its degradation state during cross-shelf transport. Since degradation of terrOM is the link between permafrost thawing and release of GHGs such as CO_2, this study focuses on the degradation characteristics. Hence, the main objective of this study is to assess the patterns of terrOM degradation across the East Siberian Arctic Shelf using molecular proxies that are specific to terrOM.

Lignin phenols and high molecular weight (HMW) n-alkanes and n-alkanoic acids are only produced by terrestrial plants which make them suitable biomarkers to assess degradation of terrestrial material throughout the ESAS. The lignin-based proxies acid to aldehyde ratios of vanillyl (Vd/Vl) and syringyl (Sd/Sl) structural units, as well as the ratio of 3,5-dihydroxybenzoic acid over vanillin (3,5-Bd/V) are expected to increase during degradation under oxic conditions. Fresh terrestrial plant material is predominated by long odd-numbered ($>C_{25}$) and even-numbered ($>C_{24}$) carbon chain length of n-alkanes and n-alkanoic acids, respectively. This dominance is described in the Carbon Preference Index (CPI). When degradation takes place, CPI values decrease accordingly, describing how much of the original material was preserved. Ratios of HMW n-alkanoic acids to HMW n-alkanes are also expected to decrease during microbial degradation owing to preferential loss of functional groups.

The data show increasing Vd/Vl, Sd/Sl and 3,5-Bd/V ratios, and decreasing HMW n-alkanes CPI values toward the outer shelf, consistent with continuous degradation of terrOM across the ESAS. While Vd/Vl and HMW n-alkane CPI did not show strong differences between east and west, Sd/Sl ratios were highest in the outer western ESAS, and 3,5-Bd/V ratios were highest in the outer east. These differences may reflect different terrOM pools along the ESAS due to differences in

vegetation zones releasing the input material through river discharge and coastal erosion. In contrast, HMW n-alkanoic acid to HMW n-alkane ratio and HMW n-alkanoic acid CPI showed inconsistent patterns across the ESAS; reasons for it are currently being investigated. These results will also be complemented by additional biomarkers to better understand the degradation of terrOM during cross-shelf transport.