Particulate and dissolved organic carbon in the Lena Delta – the Arctic Ocean interface

Olga Ogneva (Alfred Wegener Institute for Polar and Marine Research), Gesine Mollenhauer (Alfred Wegener Institute for Polar and Marine Research), Tina Sanders (Institute for Carbon Cycles, Helmholtz Centre Hereon), Juri Palmtag (Department of Geography and Environmental Sciences, Northumbria University), Matthias Fuchs (Alfred Wegener Institute for Polar and Marine Research), Hendrik Grotheer (Alfred Wegener Institute for Polar and Marine Research), Paul J. Mann (Department of Geography and Environmental Sciences, Northumbria University) and Jens Strauss (Alfred Wegener Institute for Polar and Marine Research).

Abstract

Rapid Arctic warming accelerates permafrost thaw releasing aged organic matter (OM) to inland aquatic ecosystems and ultimately, after transport via estuaries or deltas, to the Arctic Ocean nearshore. Despite the importance of Arctic deltas, their functioning is still poorly studied. Here, we examined seasonal fluctuations and spatial differences in the quantity and composition of OM in the Lena Delta, measuring dissolved and particulate organic carbon (DOC and POC) concentrations, carbon isotopes ($\delta^{13}C$ and $\Delta^{14}C$), and total suspended matter (TSM). We compared deltaic POC to the POC in the Lena River main stem over a ~1600 km transect, from Yakutsk to the Lena Delta. We further examined and compared dynamics of DOC and POC in summer and winter across a ~140 km transect in the Lena Delta. TSM and POC concentrations decreased by 75 % during transit from Yakutsk to the Lena Delta. 18 % of deltaic and 5 % of river main stem POC originated from Yedoma deposits. Thus, despite lower concentrations of POC in the delta, amount of POC from Yedoma deposits in deltaic waters were almost twice as large as in the main stem (0.07 ±0.02 and 0.04 ±0.02 mg L^{-1}, respectively). Deltaic POC was strongly depleted in ^{13}C due to significant phytoplankton contributions (~-68 ±6 %). Strong differences between winter and summer samples in DOC and POC concentrations and their properties in the Lena Delta were also found. Combined analyses of DOC and POC revealed that Pleistocene-aged Yedoma deposits were still actively degrading in winter influencing the quantity and composition of OM of the Lena Delta and exported OC loads. Deltaic processes control the type and amount of OM exported to the Arctic Ocean and require deeper investigations as crucial processes for the riverine and oceans pathways in a warming Arctic.