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Transport and fate of different components of terrestrial organic matter across the Siberian-Arctic shelves

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About one-third to half of the global soil carbon is held in the top 1-3 m of tundra+taiga permafrost PF (~1000 Pg-C) with deeper layers below as Deep-PF (~400 Pg-C) and in Pleistocene Ice Complex Deposit permafrost (ICD-PF, ~400 Pg-C), lining 4000 km of the East Siberian Arctic coast. In order to overcome the landscape heterogeneity and the stochastic nature of e.g. erosional release processes, we use the East Siberian Arctic Shelf (ESAS) in an inverse approach – as a natural integrator of the TerrOM releases from both the river drainage basins and from the erosion of ICD-containing bluffs. We are exploring how source-dependent transport and translocated degradation affect the released TerrOM.

The sources of released terrOM have been increasingly constrained using great rivers and the ESAS as natural integrators through a combination of biomarkers and $\delta^{13}C/\Delta^{14}C$ on bulk-C and on compound level. There are significant gradients in sources both E-W and S-N across each shelf sea and between water column DOM, POM and sedimentary OM. The largest source of OC to ESAS sediments is not rivers or marine plankton – it is coastal erosion of old ICD. Our initial limited dataset has now been much expanded, as has the end-member database while the statistical source apportionment method has been refined. They combine to show more efficient cross-shelf transport of river-borne "topsoil-PF" compared to ICD-PF and a clear distinction in sources of TerrOM between western and eastern ESAS regimes separated roughly along 165E, consistent with the local oceanography.

There have been good strides also in understanding degradation of TerrOM exported to ESAS. Studies are demonstrating continuous offshoreward degradation of all TerrOM, yet with large

differences between compound classes. Physical association of TerrOM with different sediment components, and sorting of the sediments exert first-order control on TerrOM distribution and degradation. An expanded dataset on specific surface area (SSA) and CuO oxidation products reveals spatial patterns across ESAS. The combination of compound-specific radiocarbon analysis of terrestrial biomarkers with SSA-normalized TerrOM signals constrains the ambient degradation rates and fluxes during the 3-4000 year timescale of cross-shelf transport. The degradation of TerrOM also causes severe ocean acidification of the ESAS.

Investigations of sources and fate of TerrOM on the ESAS – the World's largest shelf sea– provides a window to constrain permafrost-C remobilization and to study mechanisms of transport and degradability of different components of released terrestrial organic matter.