Terrestrial organic carbon and biomarker export from East Siberian Permafrost to the Arctic Ocean

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Arctic permafrost carbon represents approximately half of the global Soil Organic Carbon (OC) reservoir, with tundra, taiga and terrestrial ice complexes containing approximately twice as much carbon as the atmospheric carbon pool. Recent Arctic warming has overtaken predictions and will lead to large-scale thawing of permafrost. However, study in this area has been restricted, and the fate of OC liberated by permafrost thawing is poorly understood. We present evidence from 90 sediment samples collected across the East Siberian Shelf concentrating on the outflows of the easternmost Great Russian Arctic Rivers (Lena, Indigirka and Kolyma), investigating specific terrestrial OC biomarkers.

Glycerol dialkyl glycerol tetraether (GDGT) analysis, in line with $\delta^{13}C_{OC}$, reveals distinct regions on the shelf. Near to the coast, especially beside the Lena river outflow and in Buorkhaya Bay, the BIT index (a marine-terrestrial OC proxy) is high. Both the BIT and amounts of branched GDGTs diminish rapidly whilst the $\delta^{13}C_{OC}$ and crenarchaeol concentrations remain relatively unchanged - branched GDGTs are the controlling factor for the BIT in this area. Offshore the BIT index progressively decreases at a similar rate from all rivers, denoting a diminishing terrestrial component and an increasing marine input; a declining BIT is accompanied by a substantial increase in $\delta^{13}C_{OC}$ and crenarcheol, implying marine influx.

Our analysis, in combination with recent finds in terrestrial Arctic deposits and western Arctic rivers, indicates that the majority of the branched GDGTs on the shelf are likely originating from the rivers rather than topsoils and/or ice complex permafrost debris. In addition, once transported to the shelf the river-produced OC seems to behave differently when compared to the bulk of the exported terrestrial OC, suggesting a potentially different response to a warming climate and the associated feedback mechanism.