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Coupling between sedimentary organic carbon composition and clay mineral content in different areas of the East Siberian Arctic shelf

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Ongoing global warming causes mobilization of huge amounts of freeze-locked "old" organic carbon (OC) from vulnerable coastal and subsea permafrost deposits in the Arctic land-shelf system. The OC remobilization further promotes the changes in carbon cycle resulting in crucial ecological impacts such as ocean acidification and release of greenhouse gases (carbon dioxide and methane) to the atmosphere on the planetary scale. The mineral matrix is believed to exert a first-order control on associated OC degradation state and therefore to affect its potential involvment in biogeochemical cycles.

In this study, we investigated a non-extractable portion of sedimentary OC accumulated in western and eastern biogeochemical provinces (WBP and EBP, respectively) of the East Siberian Arctic shelf (ESAS). Besides, this is a first attempt to assess the clay mineral-OC relationships in the ESAS sediments. Pyrolysis data reflect regional differences in OC composition suggesting an increased OC freshness and significant marine contribution in the coastal EBP sediments if compared to the nearshore WBP cores which are strongly affected by terrestrial OC input. Less-degraded furfurals (polysaccharides derivatives) may be either transported with river waters offshore being protected in the smectite matrix (WBP-dominating mechanism) or get flocculated with the smectite particles upon synthesizing in marine environment (EBP-dominating mechanism). In contrast, smectite likely promotes rapid degradation of terrestrial phenols unless they are associated with coarse-grained particles. Kaolinite-associated aromatic moieties are delivered presumably via rivers, while matured aromatics sourced from degrading coastal deposits are expected to be adsorbed onto larger grains of other minerals, and these associations should be further investigated. These results imply that smectite and kaolinite minerals play a key role in the OC transport and transformation across the ESAS sediments and therefore directly affect the potential permafrost carbon-climate feedbacks in the Arctic.

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