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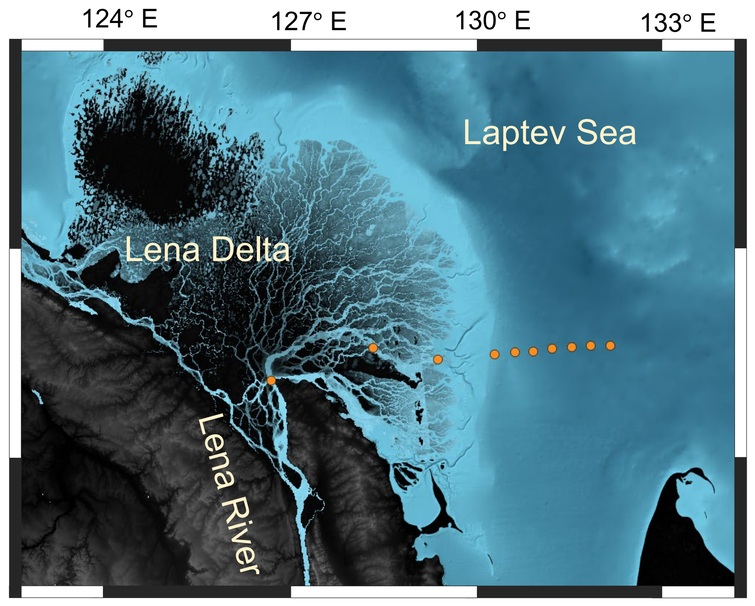
Changes of the Molecular Composition and Radiocarbon Age of Dissolved Organic Matter Along a Transect from the Lena River to the Coastal Laptev Sea

Introduction

Consequences of rising temperatures in the Arctic are accelerated permafrost thaw and associated enhanced runoff by Arctic rivers, which transport increasing amounts of potentially pre-aged dissolved organic matter (DOM) into the Arctic Ocean. DOM constitutes an enormous pool of reactive carbon, plays a vital role in biogeochemical cycles and links the terrestrial and marine systems.
In this study High-Resolution and Accelerator Mass Spectrometry were used to investigate variations of the molecular composition and the radiocarbon age of 28 solid phase extracted DOM samples taken from different water depths along a transect from the Lena River into the coastal Laptev Sea.



Key Questions

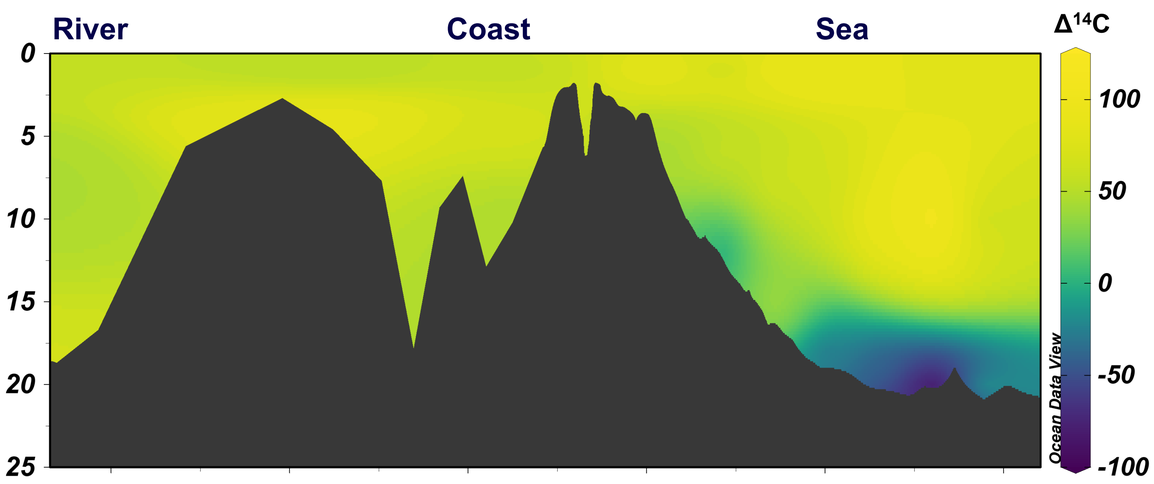
How does the DO^{14}C signal change along the transect and can variations be connected to changes of the molecular composition?

How does the molecular composition of DOM change along the environmental gradients of the river-sea transition?

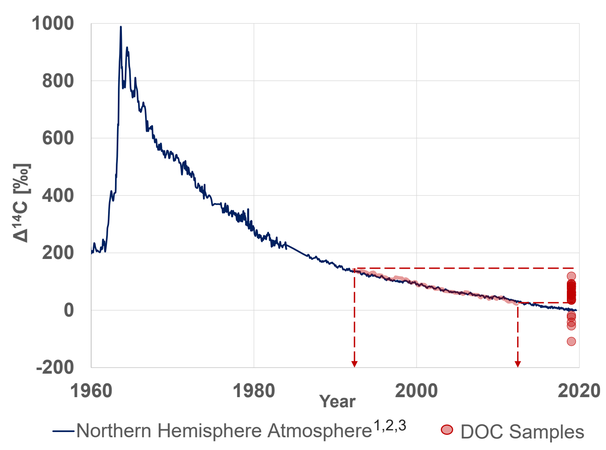
Which environmental parameters are most influential on the composition of DOM?

DO^{14}C

Riverine and marine DOM in shallow and intermediate depth of the Laptev Sea exhibits modern to hypermodern ^{14}C contents. Pre-aged DOM is only present in some deep Laptev Sea samples

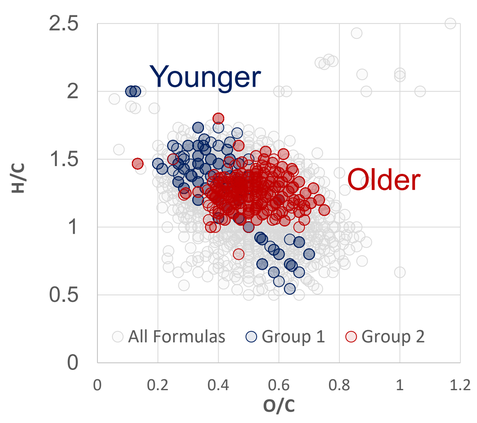


Projection on atmospheric ^{14}C curve yields an estimated organic matter formation time between 1995 and 2012.



DOM appears to be mainly derived from soil surface/topmost soil. The thawed active layer depth is not reflected in the DO^{14}C values.

Correlations between formula abundance and DO^{14}C change reveals two groups:

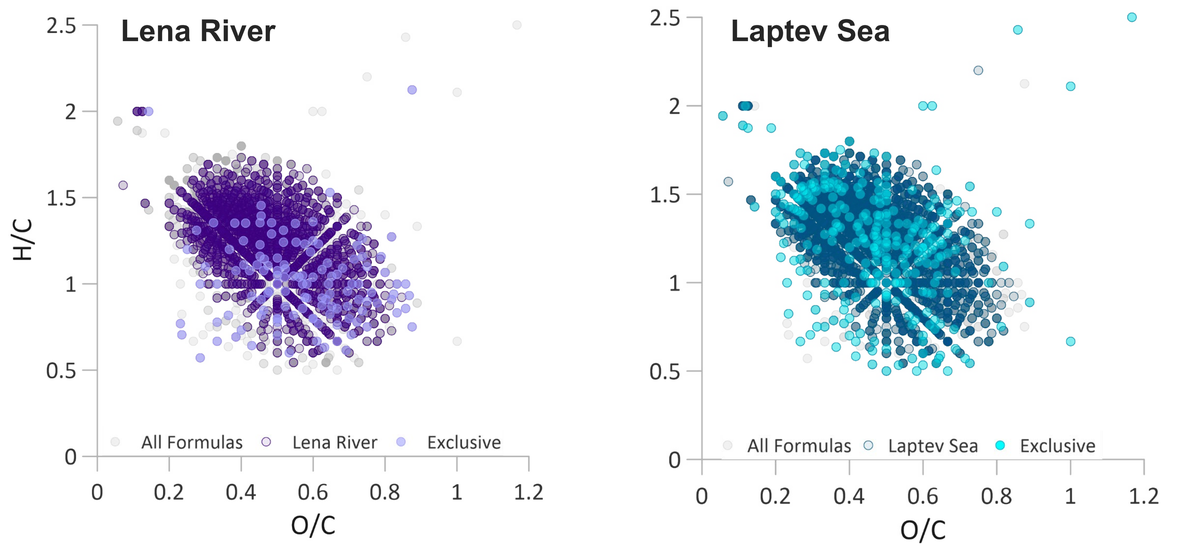


Compositional similarity:

Microbial compounds, Photo-oxidation products

Tannin, lignin + degradational products

Molecular Composition



A increased molecular diversity is present in the Laptev Sea samples. Formulas found exclusively in the Laptev Sea tend to be more aliphatic.

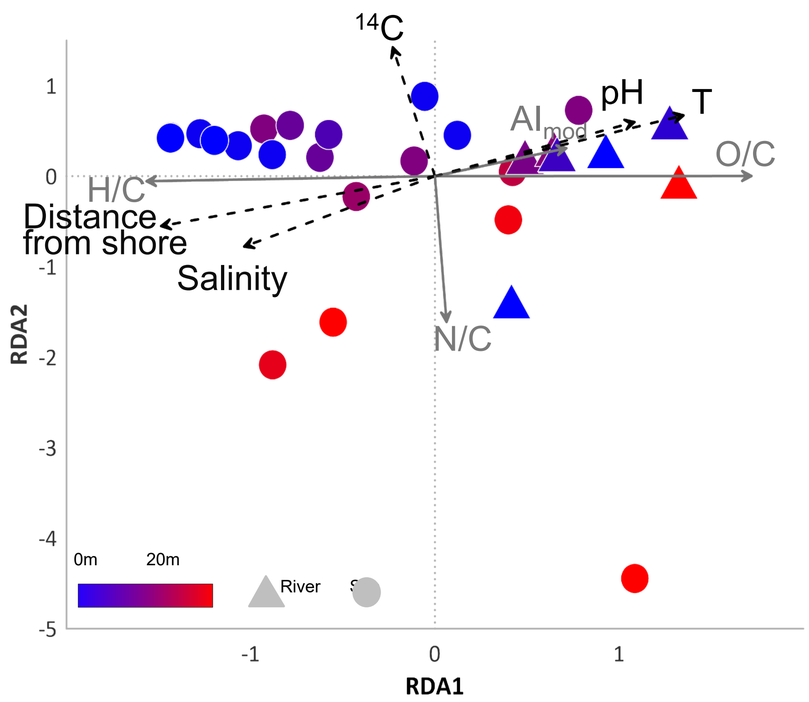
Redundancy analysis considering elemental ratios + environmental parameters shows the differences along the transect:

Lena River:
Aromatic, higher O/C

Shallow Laptev Sea:
Aliphatic, higher H/C

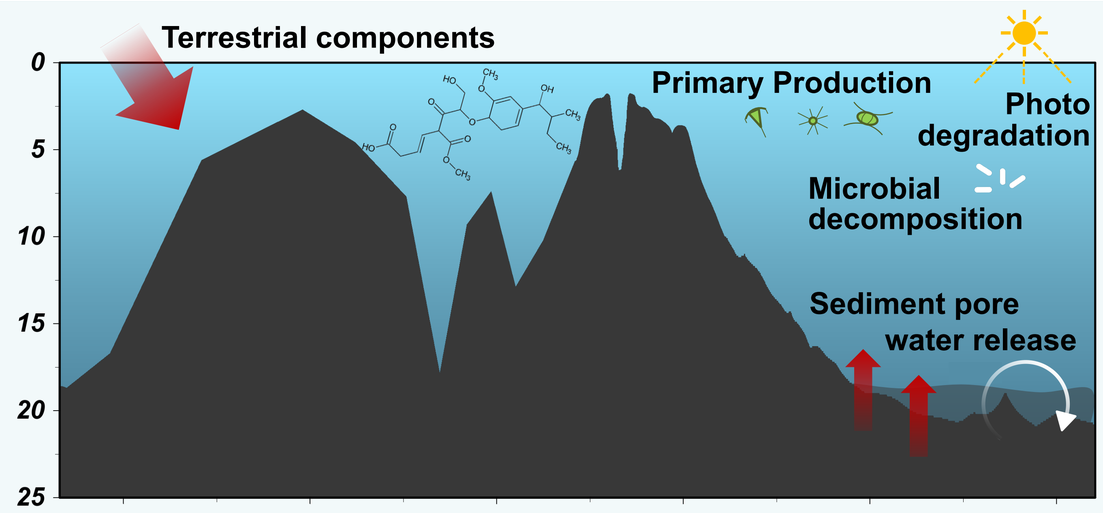
Deep Laptev Sea:
Distinct, higher N/C

Constrained variation:
26 %



Conclusion

- Lena River: Young, aromatic, high O/C DOM → terrestrial origin; lignin degradation products
- Shallow Laptev Sea: Young DOM with higher H/C → additional sources and transformation
- Deep Laptev Sea: Old DOM with distinct, N-rich composition → sedimentary pore water DOM
- Most important processes: Microbial + photodegradation, not considered in RDA → low % constrained variation



References
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