Molecular biomarkers in Yakutian permafrost sediments

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Relevance

The Arctic is warming rapidly, permafrost is thawing, organic matter can be mobilized

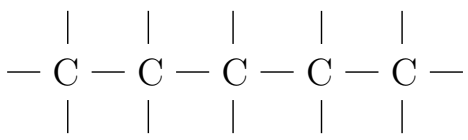
How does permafrost thaw affect organic matter storage?

Methods

Measurements of **TOC** (total organic carbon) and
DOC (dissolved organic carbon) content

Two study sites in Yakutia

Analysis of lipid biomarkers in sediments:
Extraction of organic matter from sediments by accelerated solvent extractions
Separation by medium pressure liquid chromatography
Measurements by gas chromatography mass spectrometry


n-alkanes

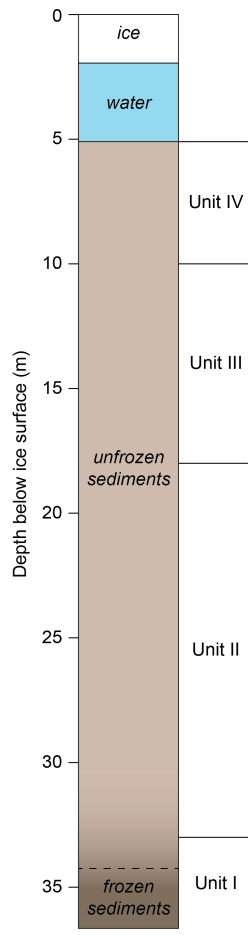
average chain length $\mathbf{ACL}_{23-33} = \frac{\Sigma\ i \cdot C_i}{\Sigma\ C_i}$

odd over even predominance $\mathbf{OEP}_{26-33} = \frac{\Sigma\ C_{27\text{-}33}}{\Sigma\ C_{26\text{-}32}}$

aquatic organic matter $\mathbf{P_{aq}} = \frac{C_{23} + C_{25}}{C_{23} + C_{25} + C_{29} + C_{31}}$

Site 1: Bykovsky

1. We distinguished 4 landscape units
2. The Yedoma deposits were organic carbon poor
3. The fluvial deposits contained more organic matter, but it was further degraded



Holocene thermokarst lake formation
and lacustrine sedimentation
Moderate total organic carbon content (~ 3.0 wt%)
Relatively fresh organic matter (OEP ~ 8.6)

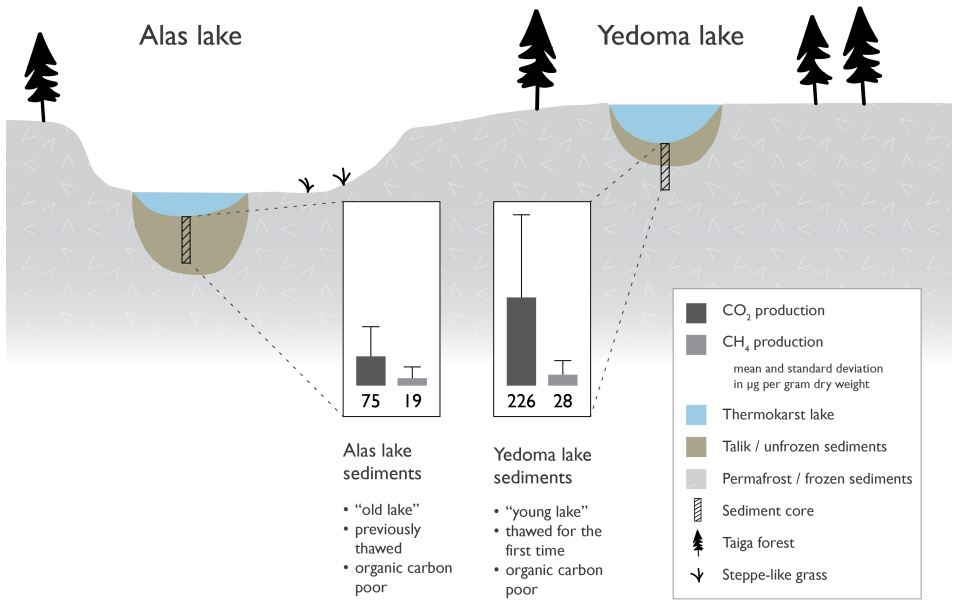
Yedoma deposition under cold-dry conditions during the Late Weichselian
Organic poor sediments
Best preserved organic matter (OEP ~ 9.4)
Dry conditions (highest Paq)

Yedoma deposits in wetland landscapes dominated by low-centered polygons
Very organic carbon poor (TOC ~ 0.8 wt%)
OM better preserved compared to Unit I (OEP ~ 5.5)
n-Alkane distribution typical of emergent vegetation (high P_{aq})

Early Weichselian fluvial sedimentation
Large pieces of wood
Highest TOC, but furthest degraded OM (OEP ~ 2.2)
Wet environment (highest P_{aq})

Site 2: Yukechi

1. Greenhouse gas production was higher in Yedoma lake sediments compared to Alas lake sediments
2. Even in organic carbon poor sediments, GHG production was substantial
3. Drivers for anaerobic CO_2 and CH_4 production differed



CO_2 production was mainly explained by the ACL and the DOC
CH_4 production could not be explained by the parameters

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