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A PYRN contribution

Permafrost Young Researchers Network

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

# Erosion of ice-rich permafrost coasts and the release of dissolved organic carbon into the Arctic Ocean

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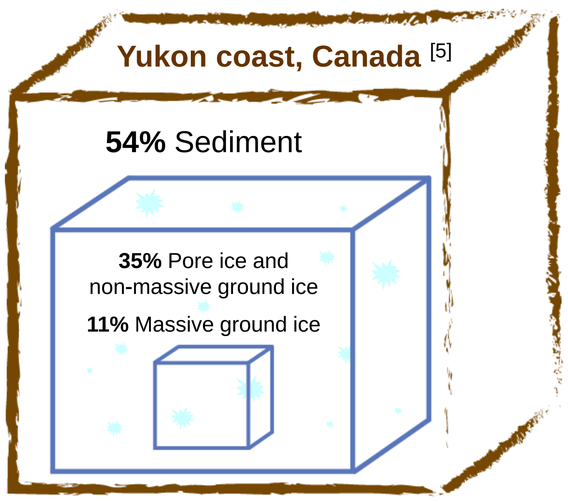
Study accepted for publishing in Global Biogeochemical Cycles (June 2016)

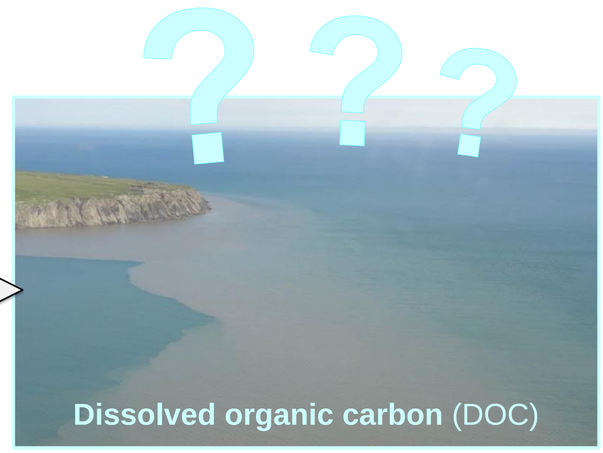
## Background

- 34% of global coasts affected by permafrost [1]
- Arctic coasts erode on average 0.6 m $yr^{-1}$ [1]
- Annual TOC fluxes of 4.9 to 14 Tg $yr^{-1}$ [2]

Permafrost coasts in the Canadian Arctic are very ice-rich and erode rapidly [1]

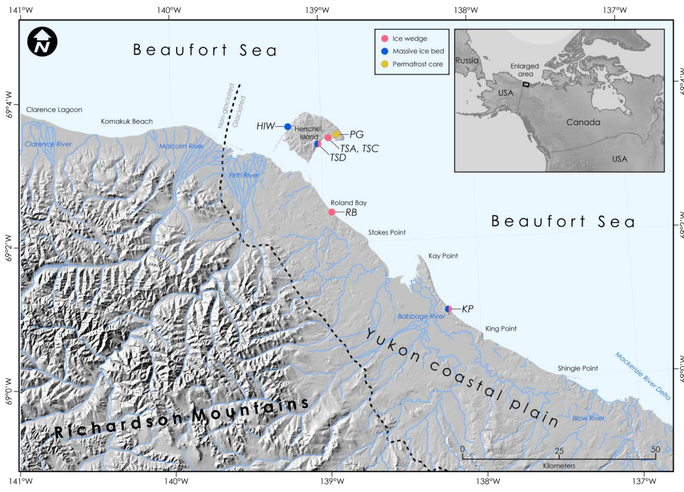
- Amount of DOC in ground ice unknown
- Fluxes of DOC fraction unknown
- DOC assumed to be highly bioavailable [3]
- Effects on nearshore ecosystems unknown [4]



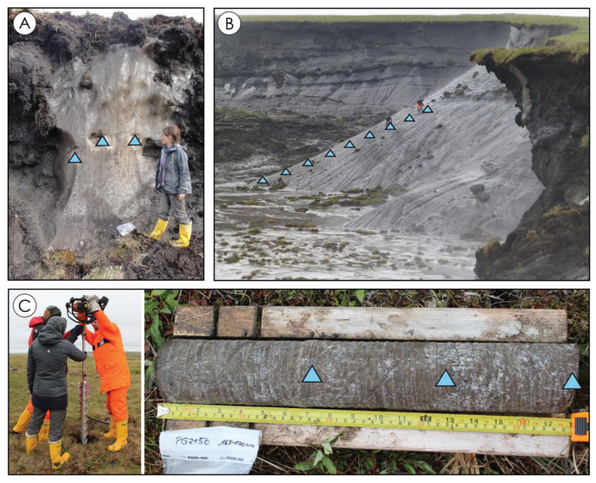




Concentration and flux of DOC?
Lability and degradation of DOC?
Fate of DOC in the nearshore zone?

## Study area and methods




*Map of the Yukon coast in the Canadian Arctic showing sampling sites on Herschel Island and the main coast*



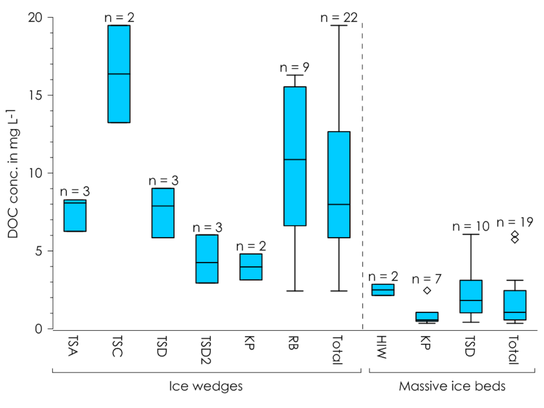

*Sampling of massive ice (A - ice wedges, B - massive ice beds) and non-massive intrasedimental ice (C)*


Thawing of ice samples → Transfer and filtering → Acidification and cold storage → Measuring of samples → Data transfer and analysis

**Calculation of DOC stock**
Volumetric ice content * Density of pure ice at -10°C * DOC conc.

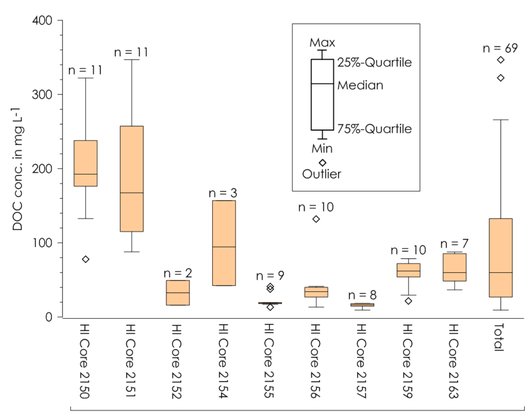
**Calculation of DOC flux**
Coastline length * Cliff height * Annual erosion rate * DOC stock

## Results and conclusion

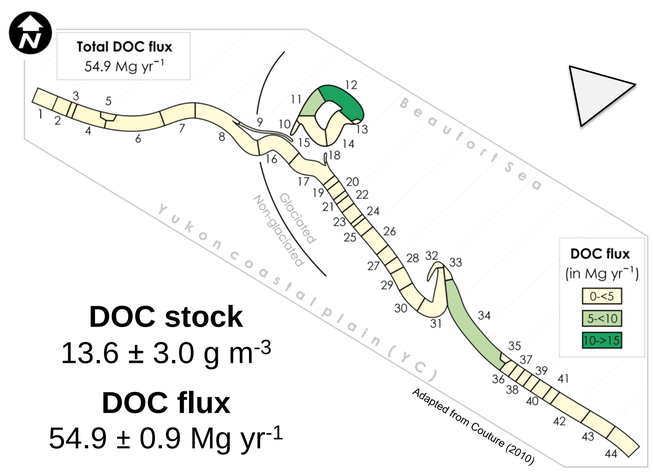



Low DOC concentrations in ice wedges (Median: 8.0 mg $L^{-1}$) and massive ice beds (Median: 1.1 mg $L^{-1}$)

High DOC concentrations in non-massive intrasedimental ice (Median: 50.7 mg $L^{-1}$)




Non-massive intrasedimental ice




**DOC stock**
13.6 ± 3.0 g $m^{-3}$

**DOC flux**
54.9 ± 0.9 Mg $yr^{-1}$

- Very low DOC storage in ground ice
- POC fluxes outnumbers DOC fluxes
- DOC/POC ratio of ~1:900
- DOC fluxes dominated by river input
- But: DOC fluxes from coastal erosion could play an important role in late summer, when river discharge is low
- The western Canadian Arctic could be a key region for DOC transport due to very high ground ice contents


## References

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