The fate of permafrost carbon from eroding arctic coasts

a study using hydrodynamic fractionation on land-sea transects

F. C. J. van Crimpen[1], L. Madaj[1], D. Whalen[2], T. Tesi[3], L. Bröder[4], M. Fritz[5], J. E. Vonk[1]

[1] Vrije Universiteit Amsterdam, The Netherlands
[2] Natural Resources Canada, Canada
[3]National Research Council, Institute of Polar Sciences in Bologna, Italy
[4] ETHZ, Switzerland
[5] Alfred Wegner Institute, Helmholtz Centre for Polar and Marine Research, Germany
Contact: f.c.j.van.crimpen@vu.nl

Background information

Around 65% of the Arctic coastline is covered by permafrost[1] which stores large amounts of **organic carbon** (OC). The Beaufort Sea in the Canadian Arctic is subject to some of the highest **coastal erosion** rates[2]. The fate of the eroded OC that enters the ocean is still poorly understood, yet its climatic impact depends on the degree of degradation after thawing and during transport across Arctic continental shelves.

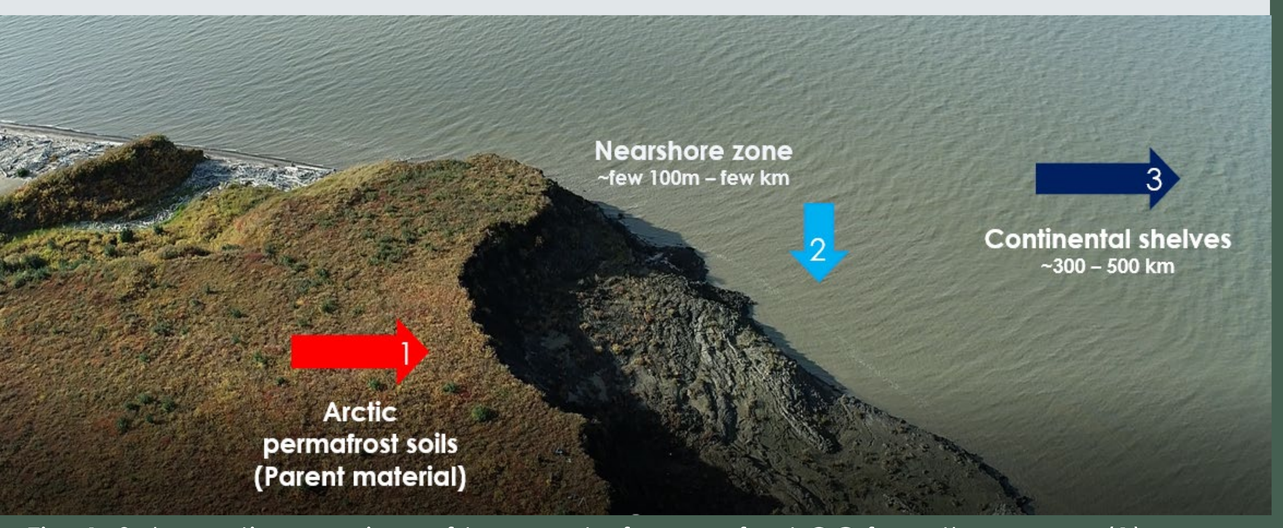


Fig. 1: Schematic overview of transport of permafrost OC from the source (1) on land, via the near shore zone (2) to the sink on the continental shelves (3). (drone image A. Robertson)

Fieldwork locations

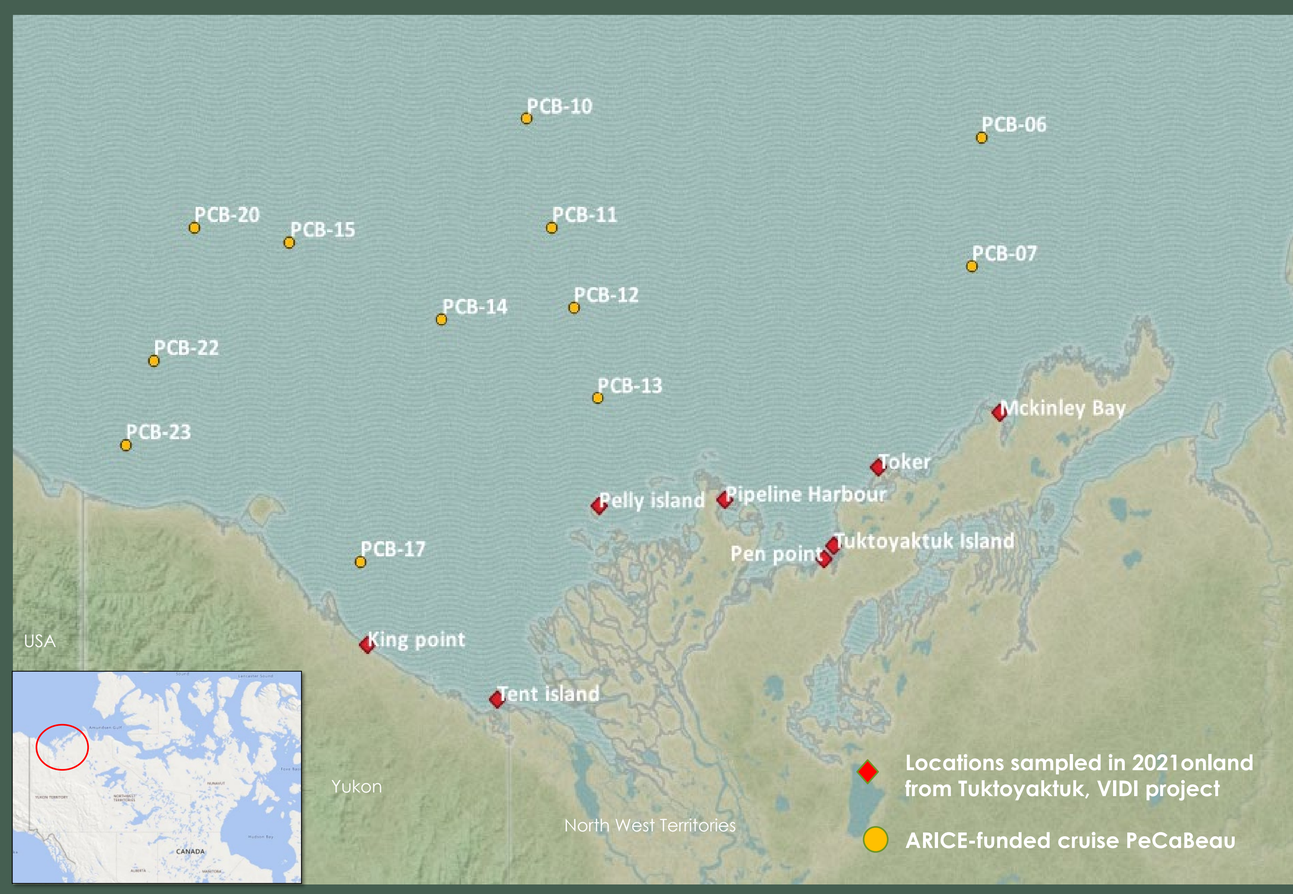
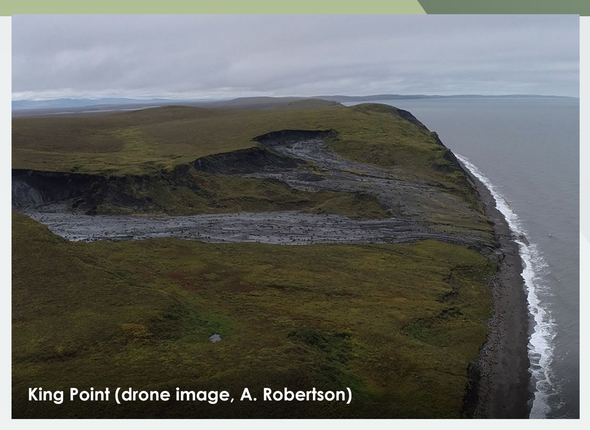


Fig. 2: Fieldwork locations which have been sampled in 2021 and the locations which have been sampled during the Amundsen cruise PeCaBeau in 2021. (Apple maps in Qgis)


Tent Island (drone image, A. Robertson)


King Point (drone image, A. Robertson)


Pelly Island (photo, F. van Crimpen)


Tuktoyaktuk Island (photo, F. van Crimpen)

Sampling took place at various sites across the Yukon and Northwest Territories encompassing a wide range of geological and geomorphological coastlines. These sites ranged from the low-lying peat (OC rich) material, large ice-rich thaw failures, high vertical permafrost cliffs to low-lying ice-wedge polygons.

Approach and objectives

The aim of this project is to understand the **hydrodynamic potential** and the **fate** and degradation of **OC** in the different sediment fractions from source to sink.

We will **use hydrodynamic fractionation** which accounts for the sediment sorting of particles when exposed to different energy conditions such as waves[3]. With this technique we will fractionate the samples based on size and density to understand the pathways of this material in the marine system.

For all sites, both surface sediments and particulate suspended matter in surface water was sampled. The samples are being analysed for bulk geochemical concentrations (**total OC/N**) and isotopes (**$^{13}C/^{14}C$**) in preparation for further fractionation. For coastal sites we also will analyse **dissolved OC**, **dissolved inorganic C**, and **water isotopes**.

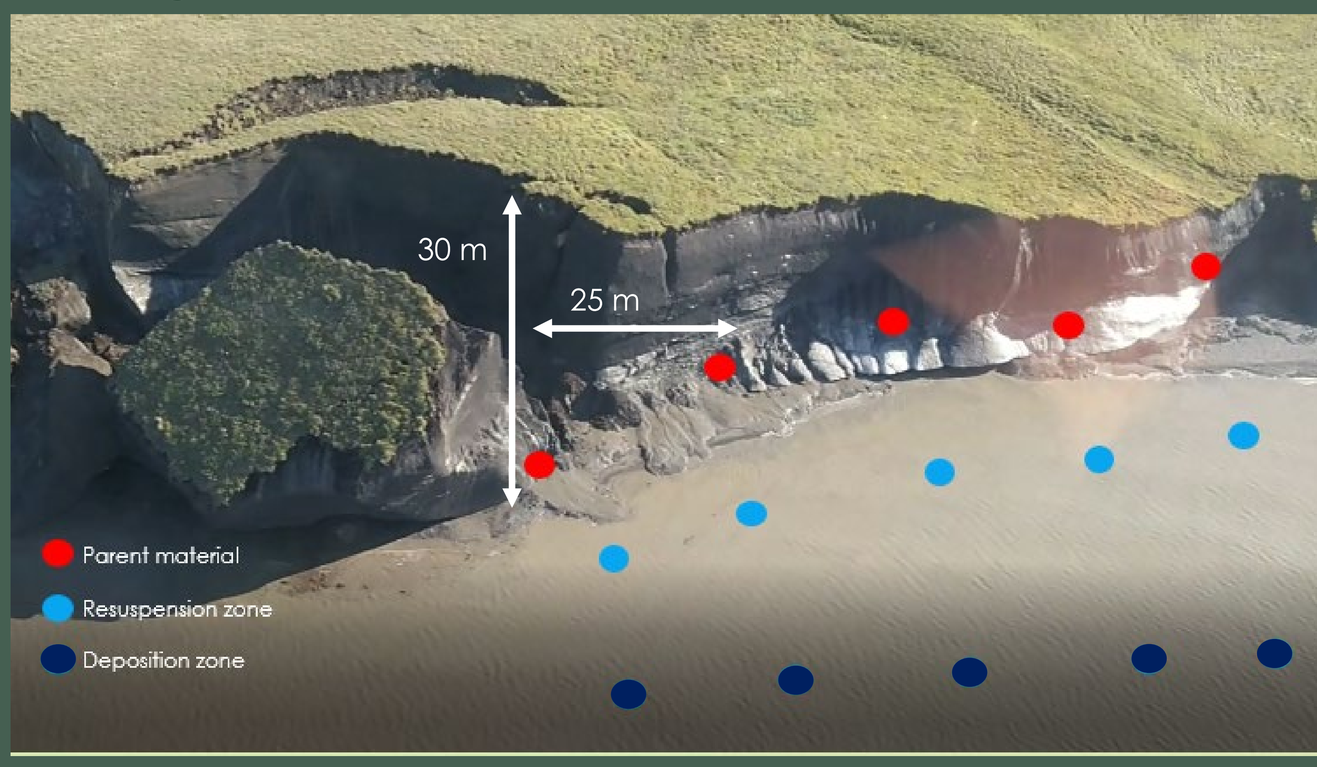


Fig. 3: Sampling strategy in the field: We collected five samples of parent material onshore (ca. 25 meters apart). In parallel, we collected five samples of surface sediment and surface suspended matter in the resuspension zone (wading along the coast) and the deposition zone (zodiac and grab sampler). (Pelly Island, photo, F. van Crimpen)

Scan the QR code to watch the video

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Thanks to Angus Robertson, Bay Barry, Obie Anikina, James Keevik, Kendyce Cockney, we had a successful first field season. This program would not have been possible without the support from the Hamlet of Tuktoyaktuk and the Tuktoyaktuk Community Corporation (TCC). We are grateful for the logistical support of Natural Resources Canada's Polar Continental Shelf Program (PCSP). Thanks to the scientists and crew of the CCGS Amundsen PeCaBeau expedition. This project is funded through the Dutch Research Council (VI.Vidi.193.100) and falls under NWT Research license: 16897 and ILA landuse permit: ILA18TN005. We are looking forward to update you on the progress of this project in 2022.

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