Multi-proxy reconstruction of Late Holocene paleoceanography and sediment dynamic over the Mackenzie slope (Beaufort Sea, Canadian Arctic)

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Introduction

The mineralogy and elemental geochemistry, as well as dinoflagellate cyst assemblages of two short sedimentary sequences (box core and trigger weight core AMD0214-03) recovered on the Mackenzie slope, were analyzed to reconstruct and document the hydrological variability over the last 2000 years in the Southeastern Beaufort Sea (Canadian Arctic), and its influence on the sedimentary dynamics.

In particular, we aim at answering the following questions:

- How have the climatic and oceanographic conditions in the Beaufort Sea changed over the time period covered by the core?
- How have sedimentation conditions (sources and transport) evolved over the last 2000 years in the Canadian Beaufort Sea?

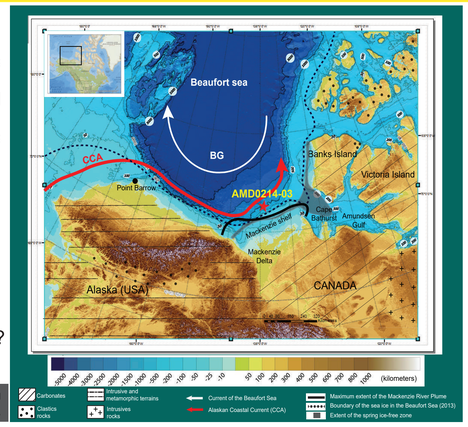


Figure 1. Bathymetric and topographic map of the western Arctic Ocean (Southeastern Beaufort Sea) and location of the coring site, derived from IBCAO data.

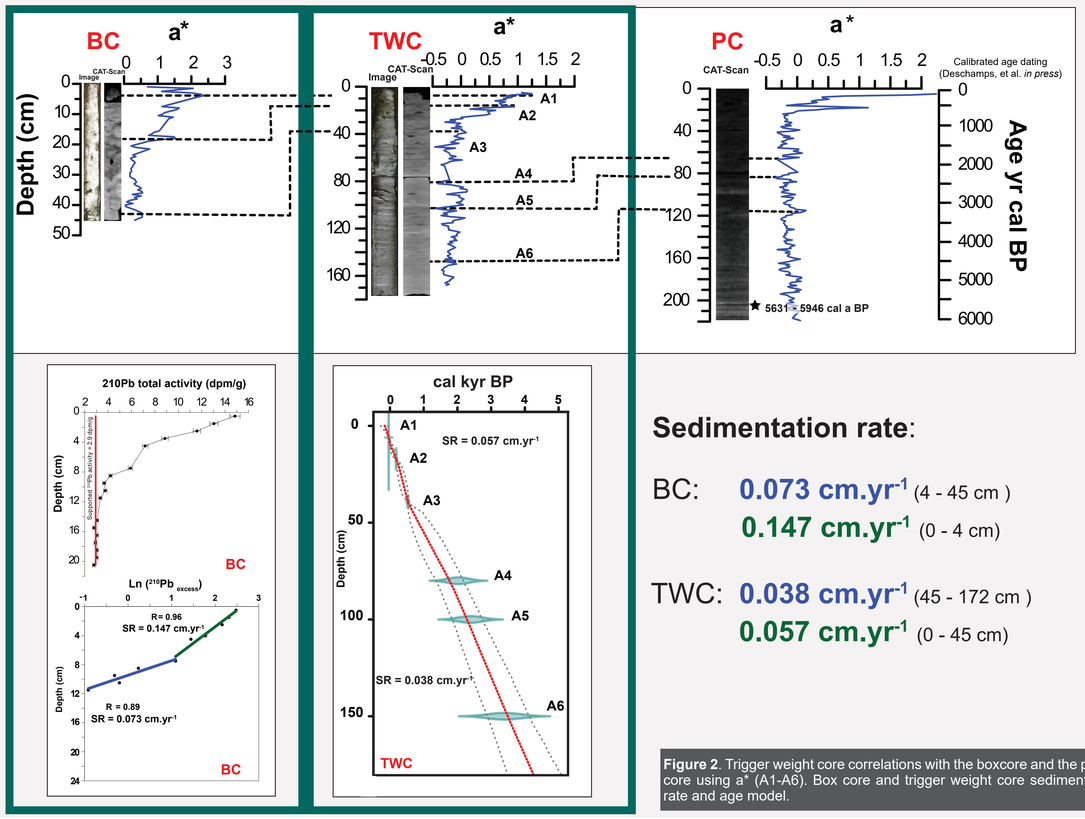
Methodology

- Physical properties of the sediments were measured using a Multi-Sensor Core Logger (MSCL) and X-ray (CAT-Scan)
- Boxcore chronology was established based on ^{210}Pb measurements for the box core
- Trigger weight core chronology was established with the boxcore and the piston core age model
- Standard palynological treatments followed by counts of all palynomorphs
- Grain size distribution measured from laser diffraction

Photoplate of selected taxa

Results

Sediment chronology



Sedimentation rate:

BC: **0.073 cm.yr^{-1}** (4 - 45 cm)
0.147 cm.yr^{-1} (0 - 4 cm)

TWC: **0.038 cm.yr^{-1}** (45 - 172 cm)
0.057 cm.yr^{-1} (0 - 45 cm)

Figure 2. Trigger weight core correlations with the boxcore and the piston core using a* (A1-A6). Box core and trigger weight core sedimentation rate and age model.

Multi-Sensor Core Logger (MSCL)

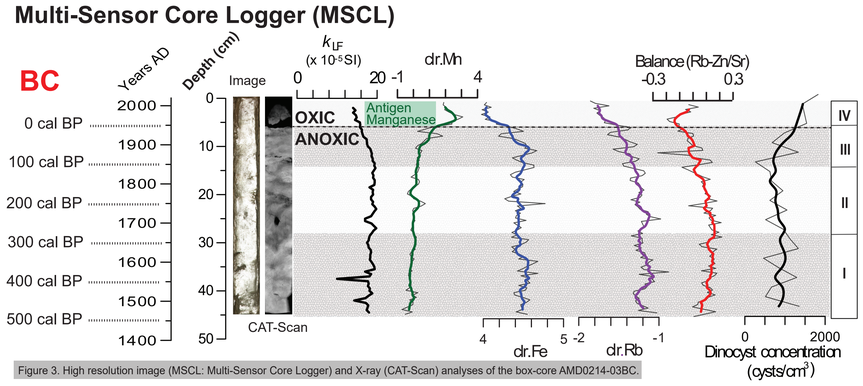
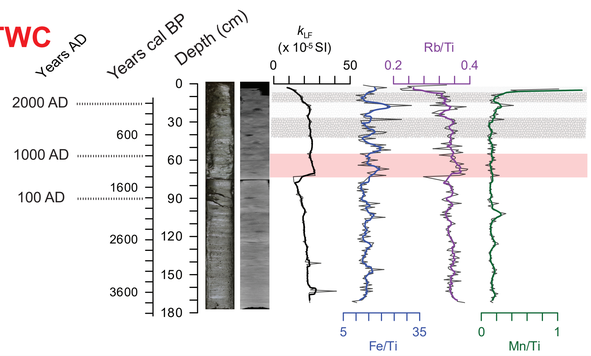


Figure 3. High resolution image (MSCL: Multi-Sensor Core Logger) and X-ray (CAT-Scan) analyses of the box-core AMD0214-03BC.

- Balance (Rb-Zn/Sr) :
  * **Plagioclases** (10 - 45 cm): higher precipitation in **southern** Mackenzie Delta basin.
  * **Phyllosilicates** (0 -10 cm): higher precipitation in **northern** Mackenzie Delta basin.



- **Medieval Warm Period** (~1000 AD; ~75 cm): Detrital sediment input from the Mackenzie River

Figure 4. High resolution image (MSCL: Multi-Sensor Core Logger) and X-ray (CAT-Scan) analyses of the gravity core AMD0214-03 TWC.

Dinocyst assemblages and reconstructions of sea surface conditions

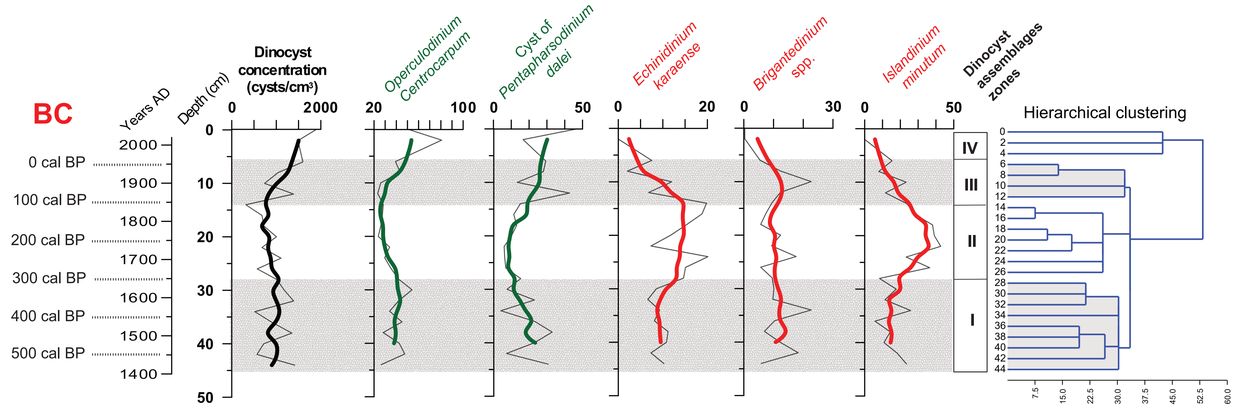


Figure 5. Dinocyst assemblage in box-core AMD0214-03BC. Autotrophic taxa (green). Heterotrophic taxa (red). Running average over 3 data points (thick curves)

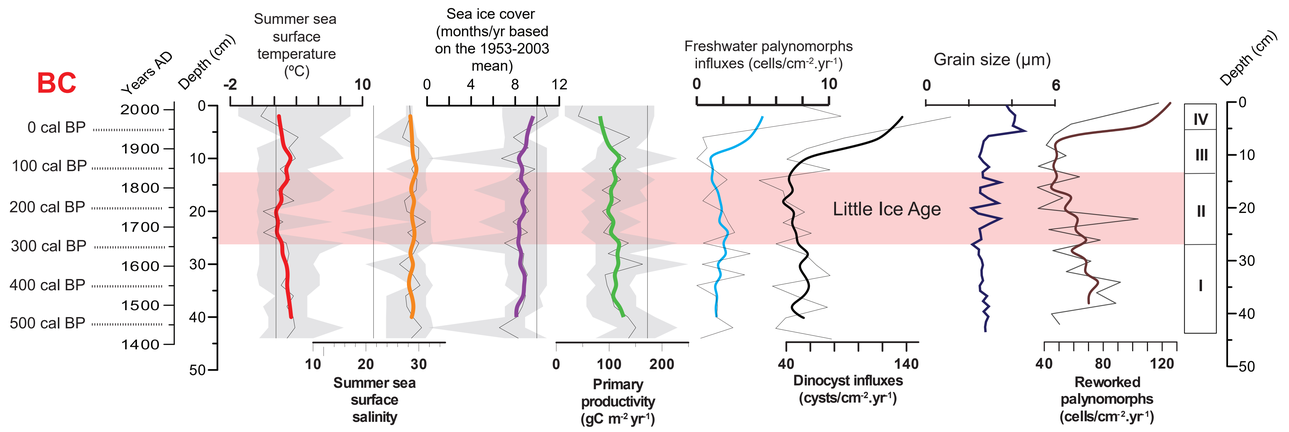


Figure 6. Sea surface reconstruction of the box-core AMD0214-03BC using the modern analogue technique (MAT). The thick curves represent a running average over 3 data points.

- **Zone I** (1400 to 1650 AD): *Dominated by Operculodinium centrocarpum* and cyst of *Pentapharsodinium dalei Relatively warm reconstructed sea surface temperature.*
- **Zone II** (1650 to 1850 AD): *Islandinium minutum* and *Echinidinium karaense*. Cooling event associated with the **Little Ice Age**
- **Zone III** (1850 to 1950 AD): *Brigantedinium* spp. Slight increase of sea surface temperature and primary productivity. Corresponds to the **Beginning of Industrial Era**
- **Zone IV** (1950 to 2014 AD): *Operculodinium centrocarpum* and cyst of *Pentapharsodinium dalei.* Establishment of modern conditions with increased influx of all palynomorphs and sediment particle size, possibly related to increased flow of the Mackenzie River.

Conclusions

This study allow to determine hydroclimatic changes with variying sedimentation rates, grain size, dinocyst assemblages and geochemistry, indicating relatively stable conditions in the Mackenzie slope over the last 555 years (box core with occasionally cooler and warmer events. Cooling of surface temperatures occurs at the end of the period corresponding to the Little Ice Age. Furthermore, around ~1925 AD, there has been an important variation in different proxy's parameters associated with relatively high discharge rates from the Mackenzie River. Hydroclimatic variations can be observed after the beginning of Industrial Era.

Acknowledgments

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