

# Sedimentological, physical, geochemical and magnetic properties of sediments from the Canadian Arctic: sedimentary processes since the last millenium

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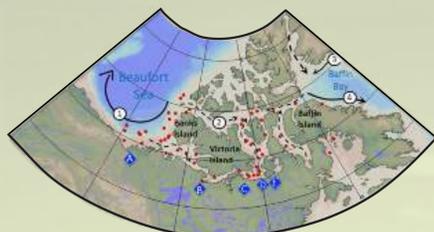
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## Background

◆ In the context of global warming, understanding the sediment dynamic variations during **changing climatic** conditions is crucial. This information will be a point of comparison to better document Arctic climate variability

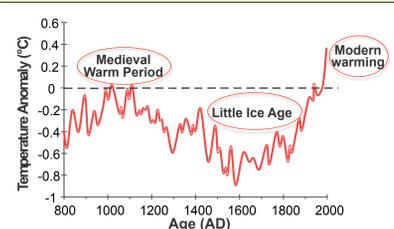


Map of core samples and principal water masses: (1) BG, Beaufort Gyre; (2) PML, Polar Mixed Layer; (3) WGC, West Greenland Current; (4) BC, Baffin Current. Dashed black arrows correspond to the PML and black arrows correspond to the Atlantic waters (BC, WGC) Modified from Ledu et al, (2008). (A) Mackenzie River; (B) Coppermine River; (C) Ellice River; (D) Back River and (E) Hayes River.

◆ 50 box cores were sampled in the **Canadian Arctic** in 2016 and 2017 on board the CCGS Amundsen

◆ Box cores are ~40 cm in length

=>Description of the last millenium



Records of NH temperature variation during the last millenium (IPCC, 2013)

## Objectives

- ✓ Compare the **sedimentological, physical and magnetic** properties of sediments during the last millenium.
- ✓ Identify the factors affecting the **origin of detrital material, sediment transport and sediment dynamics** in the Canadian Arctic during Holocene climatic periods (Little Ice Age, Medieval Warm Period & recent).

## Methodology

1 <sup>210</sup>Pb to determine recent sedimentation rates

2 **Physical & Geochemical analyses**



Radiography (Geotek XCT digital x-ray system)



Geotek Multi Sensor Core Logger (wet bulk density, magnetic susceptibility (k), diffuse spectral reflectance (L\*, a\*, b\*) and XRF core scanner)

3 **Magnetic analyses**



Alternating Gradient Magnetometer (Micromag 2900)



k vs frequency (Bartington MS2)



Cryogenic magnetometer (SRM-755)

4 **Sedimentological properties**

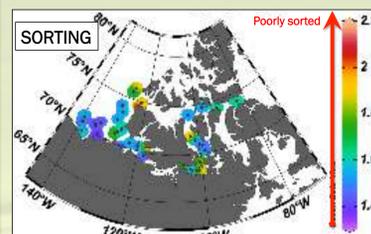
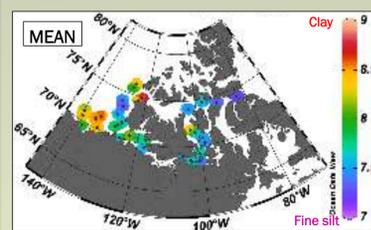
Grain-size

C<sub>tot</sub>, C<sub>org</sub>, N<sub>tot</sub> contents

Stable isotopes δ<sup>13</sup>C and δ<sup>15</sup>N

## Surface sediments

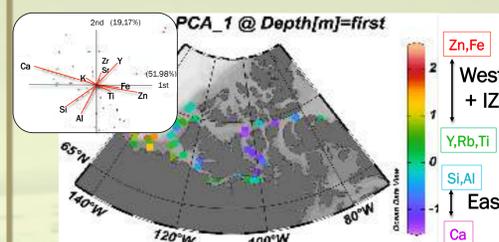
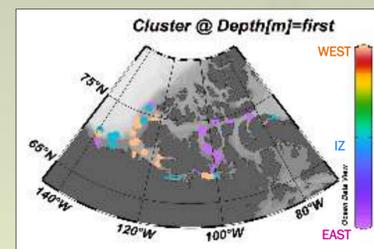
### GRAIN SIZE



**Detrital grain size reveals a West-East trend dominated by fine silts (<8µm) :**

- West = finer unsorted grains.
- East = coarser poorly sorted grains.

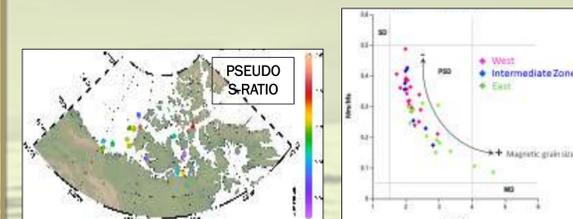
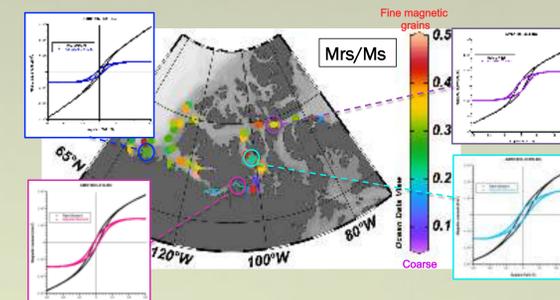
### GEOCHEMISTRY



**Geochemistry data describes different sedimentary compositions between 3 main provinces determined by clustering analyse (Ward method +log ratio) :**

- West = high detrital (Al-K-Ti-Rb-Y) and Fe oxides inputs near the mouth of Mackenzie River, and detrital carbonates in West of Banks Island.
- Intermediate Zone (IZ) = predominance of reddish sediments (a\* > 6) and redox sensitive elements (Mn-Fe-Zn).
- East = predominance of detrital elements (Ti-Fe-Si-Al-Zr-Sr-K) and carbonates gradually diminishing in proportion towards Barrow strait.

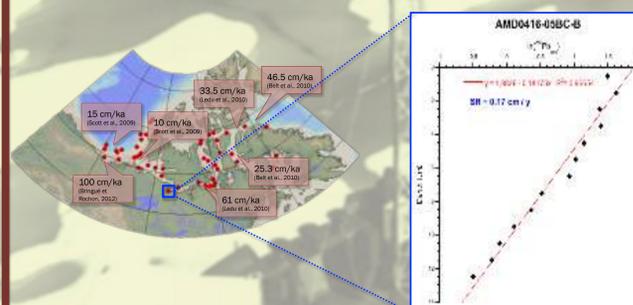
### MAGNETIC PROPERTIES



➢ Magnetic grain size (Mrs/Ms ratio) globally shows a similar trend than detrital grain size.

➢ The shape of hysteresis loops and the pseudo S-ratio (>0.94) suggest a magnetic assemblage dominated by pseudo-single domain low coercivity minerals such as magnetite.

## Chronology



<sup>210</sup>Pb measurements from the first dated core (Coronation Gulf) illustrate an average sedimentation rate of 0.17cm/yr :

- The base of the core would be close to 270 years.
- The core thus probably records the Little Ice Age

### Acknowledgements:

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## Conclusions

- ✓ All the parameters illustrate a **West-East trend with a different sediment dynamics** :
- ✓ West Province = dominated by **detrital sediment** supplies from by numerous **ivers** (e.g., Mackenzie plume, Coppermine, Ellice, Back and Hayes rivers)
  - = by **coastal erosion** of dolomite cliffs and glacial tills cropping out on the **Banks Island Shelf**
- ✓ East province = influenced by **sediment-laden sea ice and icebergs**
  - = important **carbonate inputs** from the **coastal erosion** of Ordovician-Silurian carbonate-bearing rocks cropping out in the Victoria and the Prince of Wales Islands