

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

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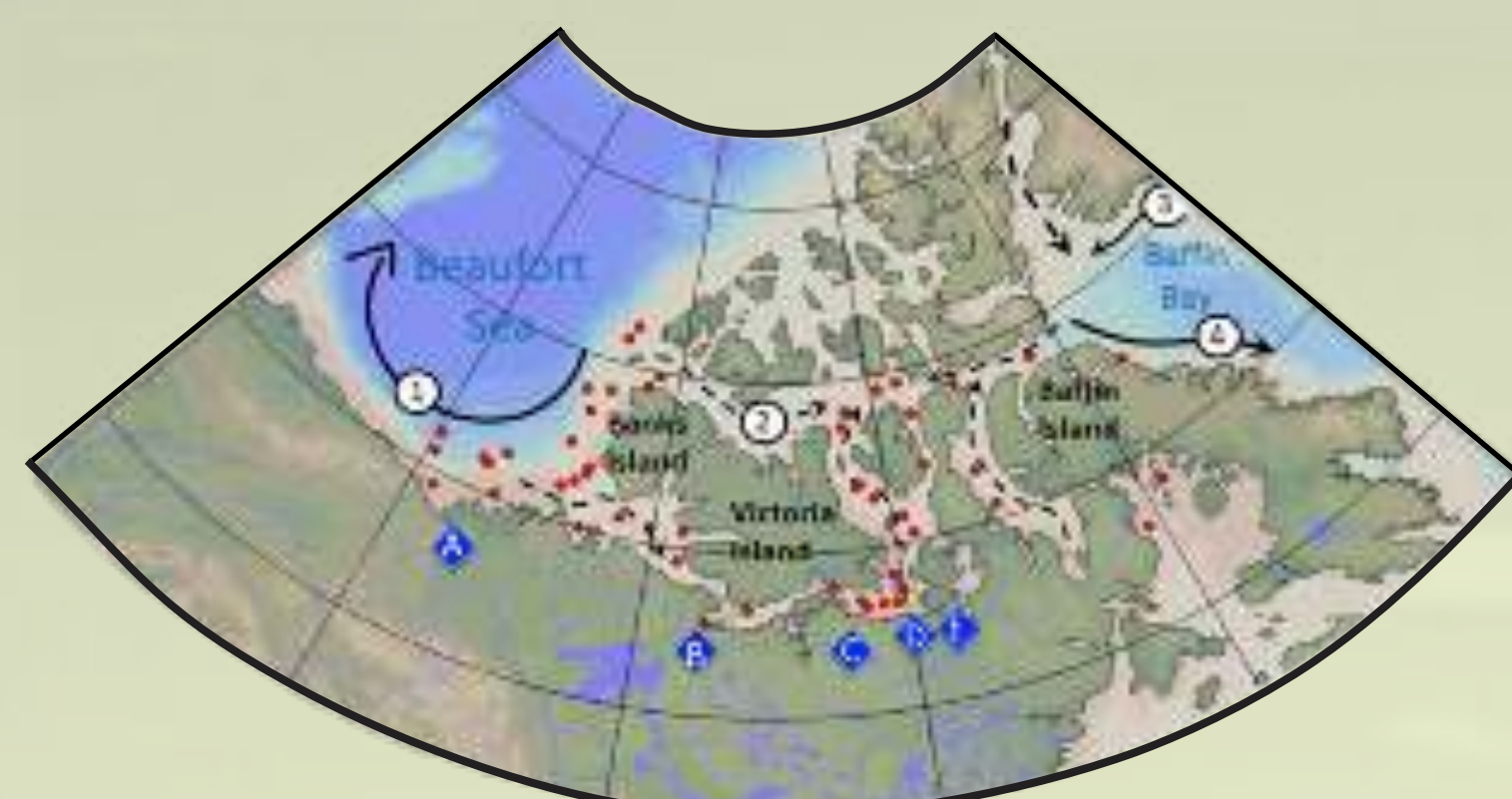
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Background

◆ 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

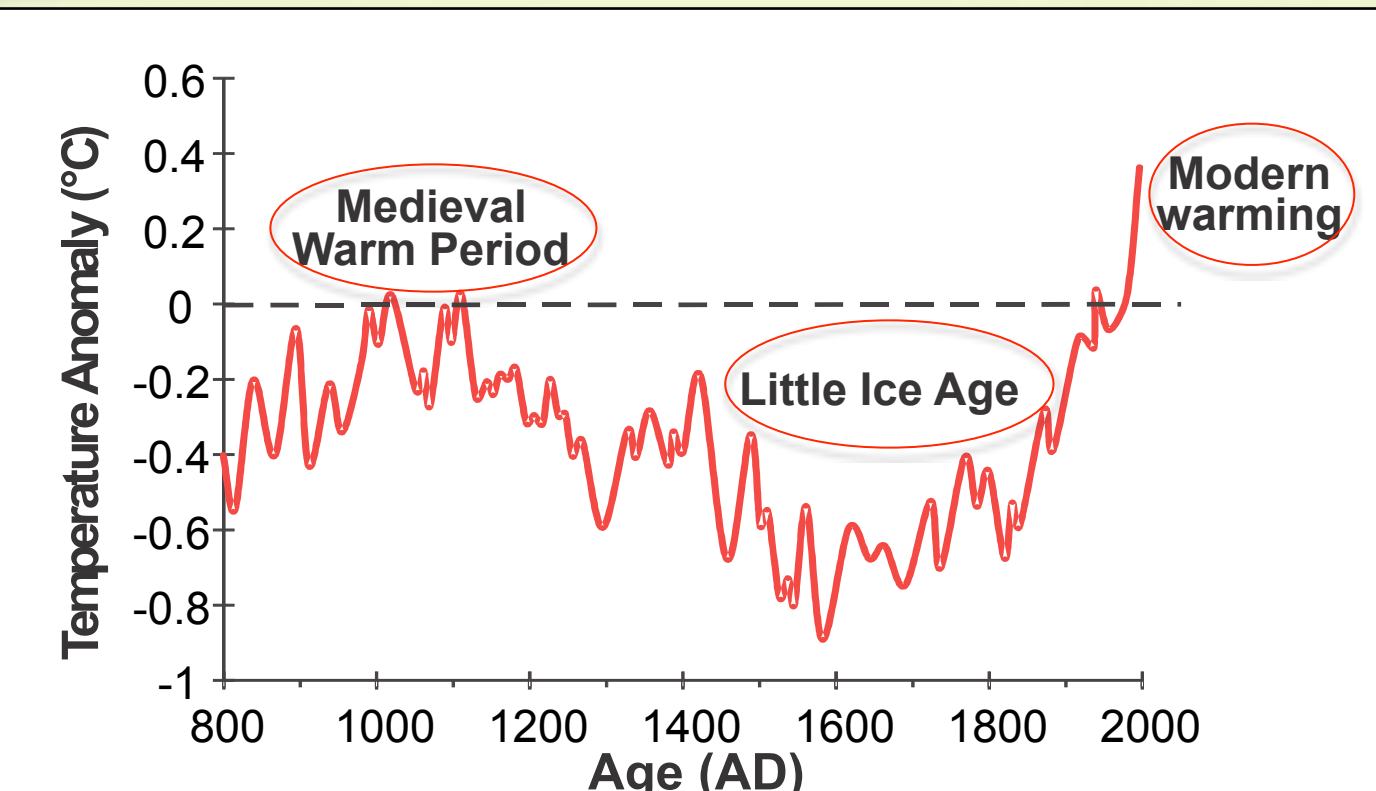


Map of core samples and principal water masses: (1) BG, Beaufort Gyre; (2) PML, Polar Mixed Layer; (3) WGC, West Greenland Current; (4) BC, Baffin Current. Dashed black arrows correspond to the PML and black arrows correspond to the Atlantic waters (BC, WGC) Modified from Ledu et al, (2008). (A) Mackenzie 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 ²¹⁰Pb 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**

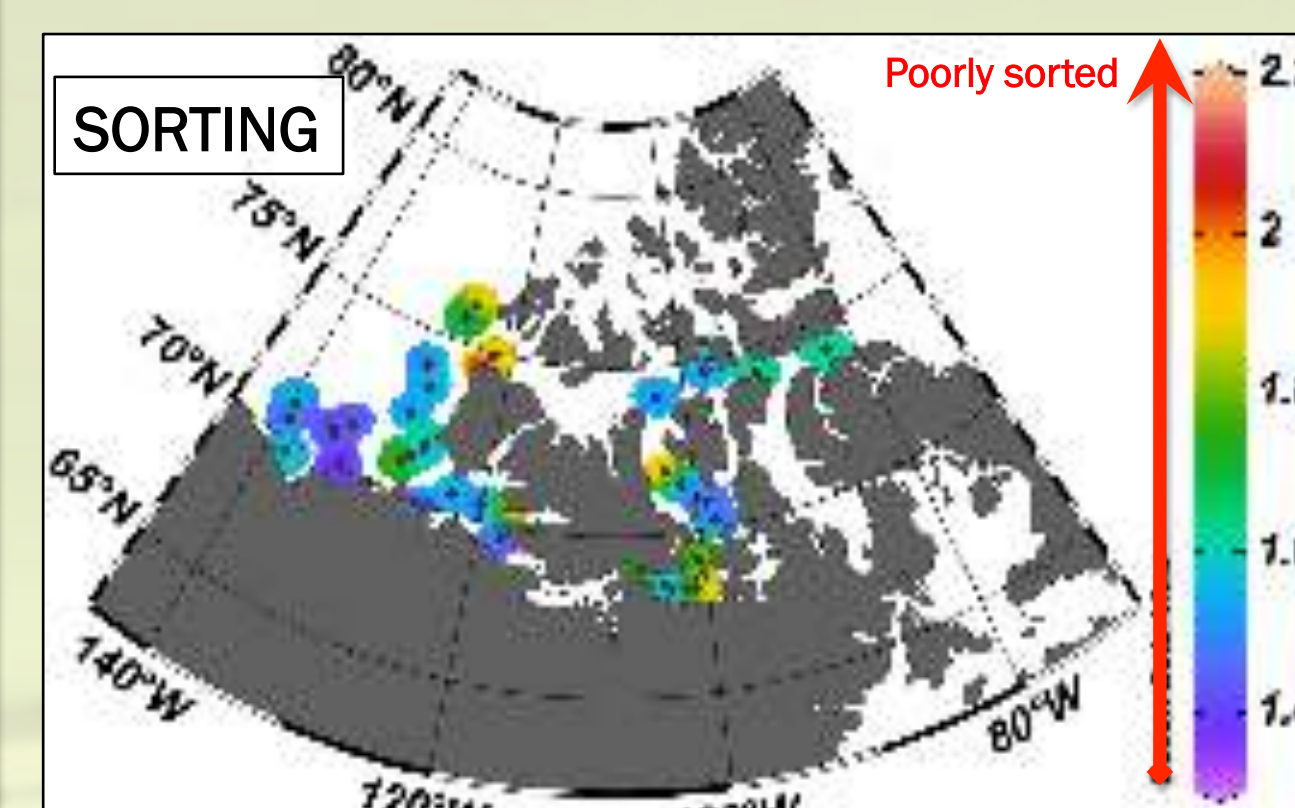
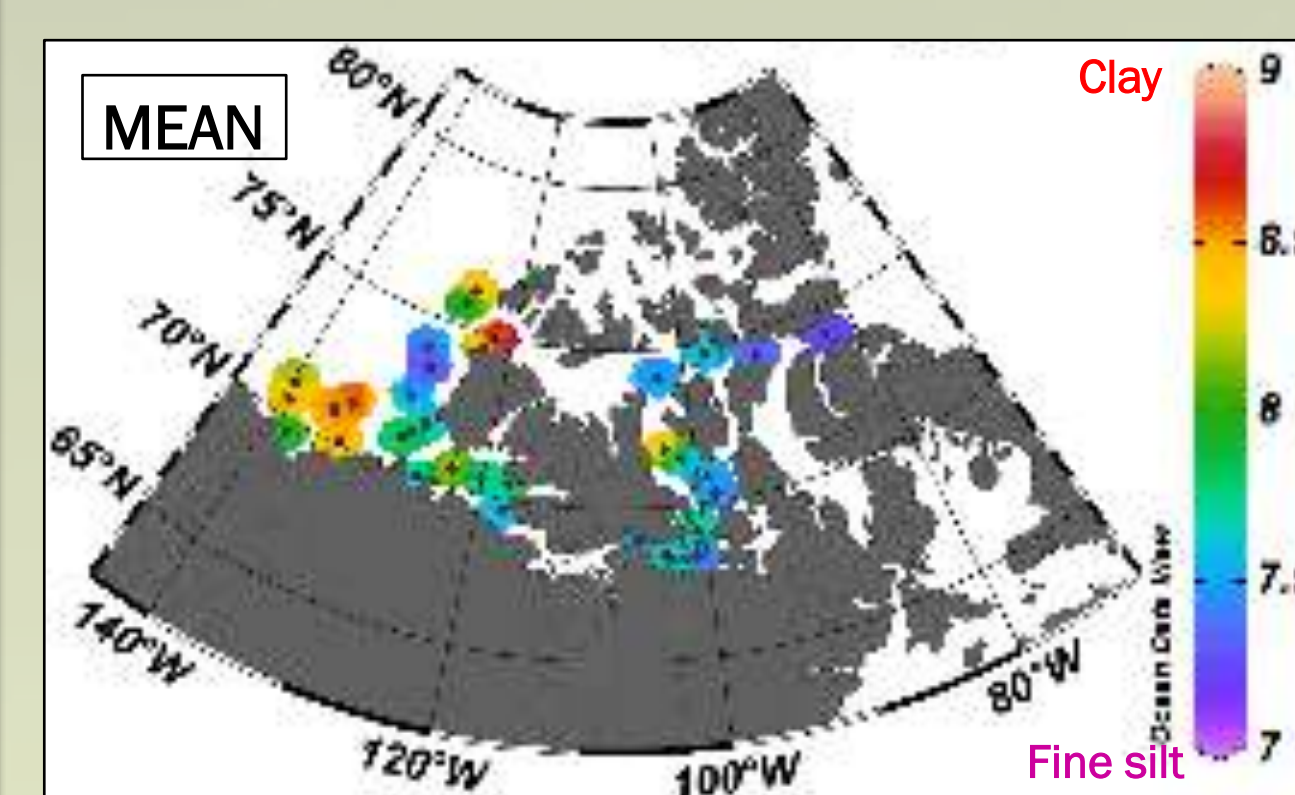
Grain-size

C_{tot}, C_{org}, N_{tot} contents

Stable isotopes δ¹³C and δ¹⁵N

Surface sediments

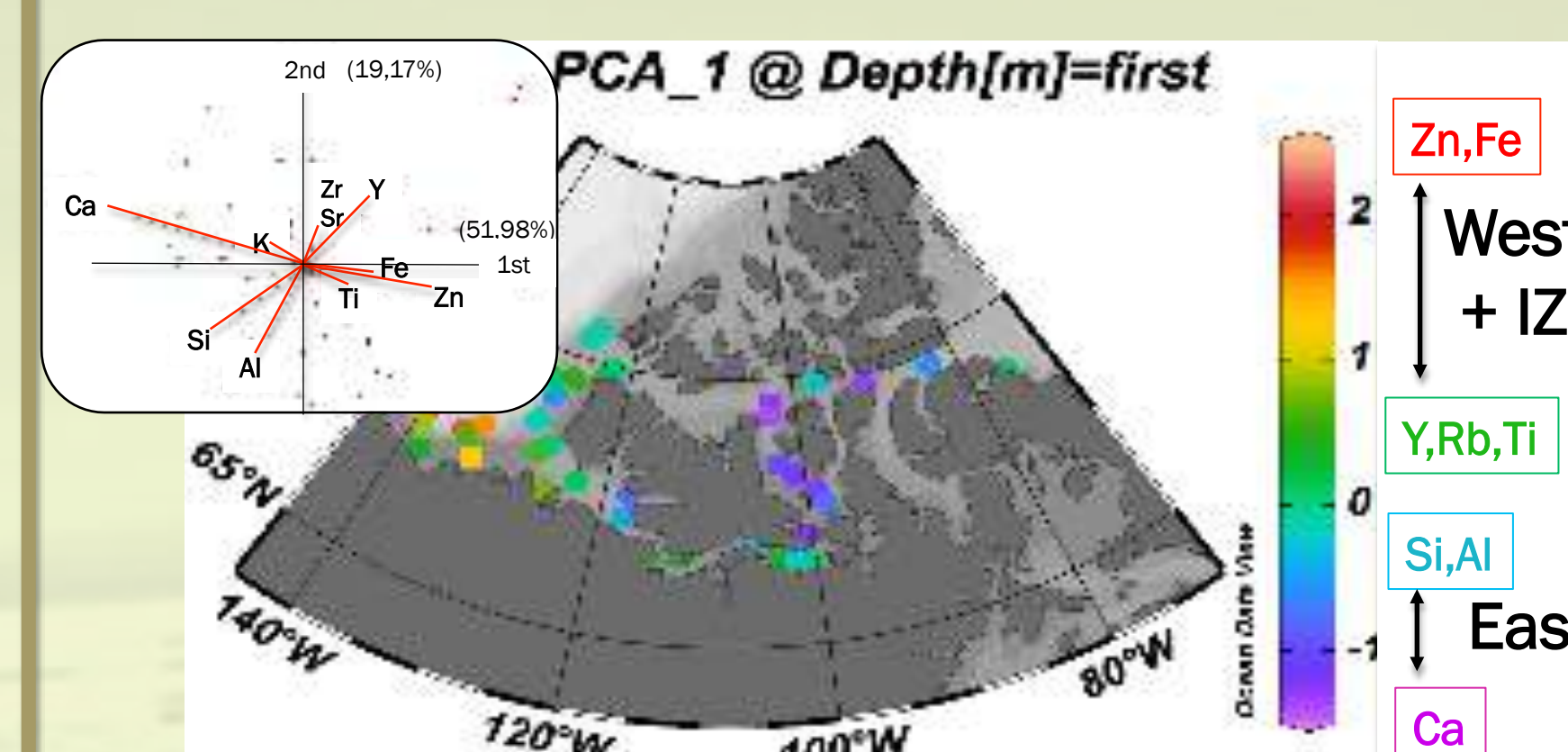
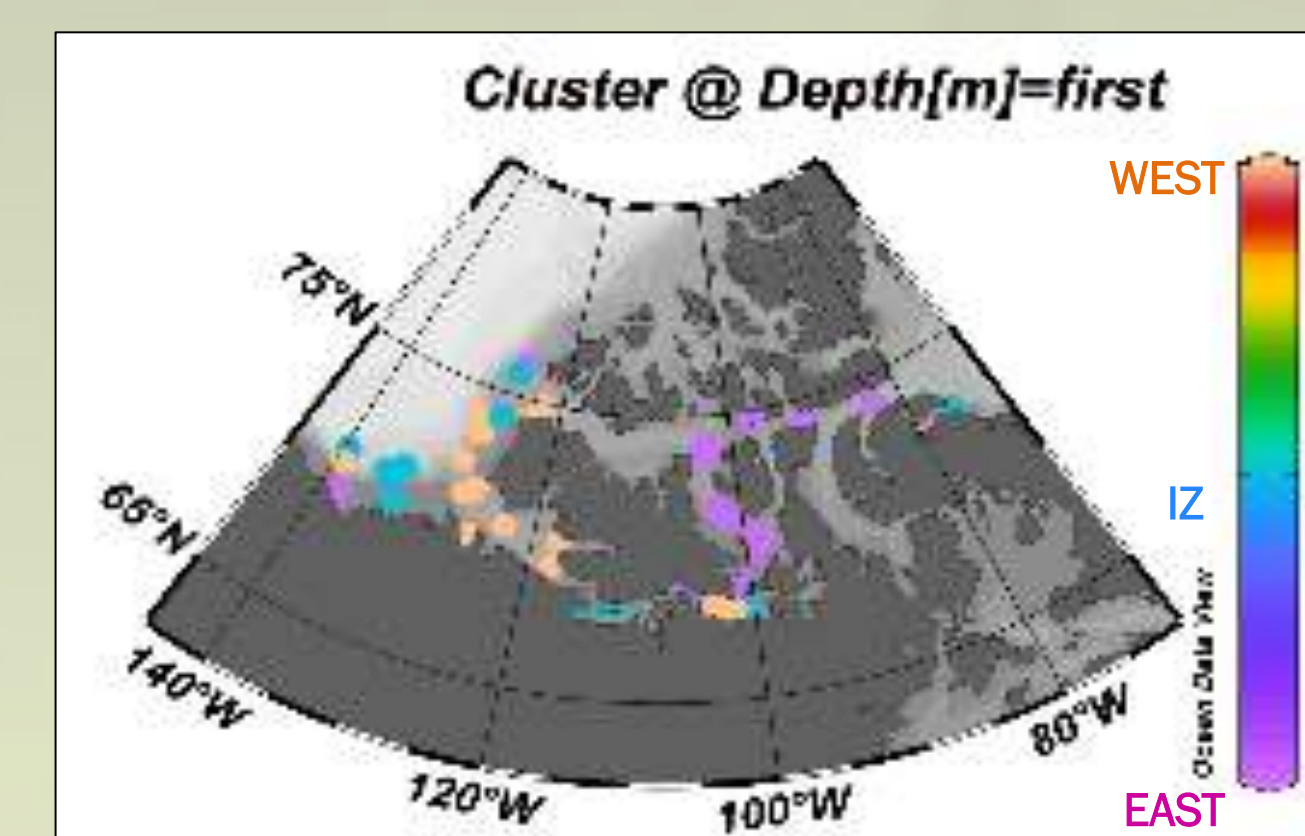
GRAIN SIZE



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

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

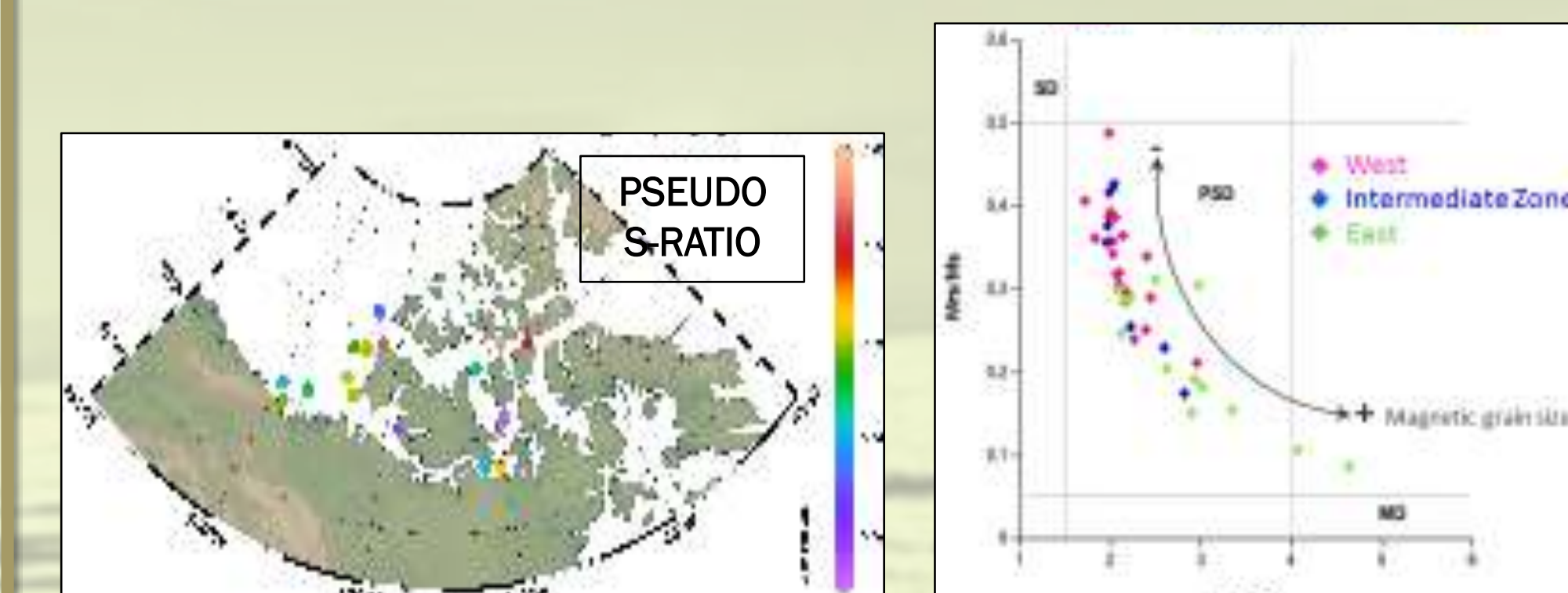
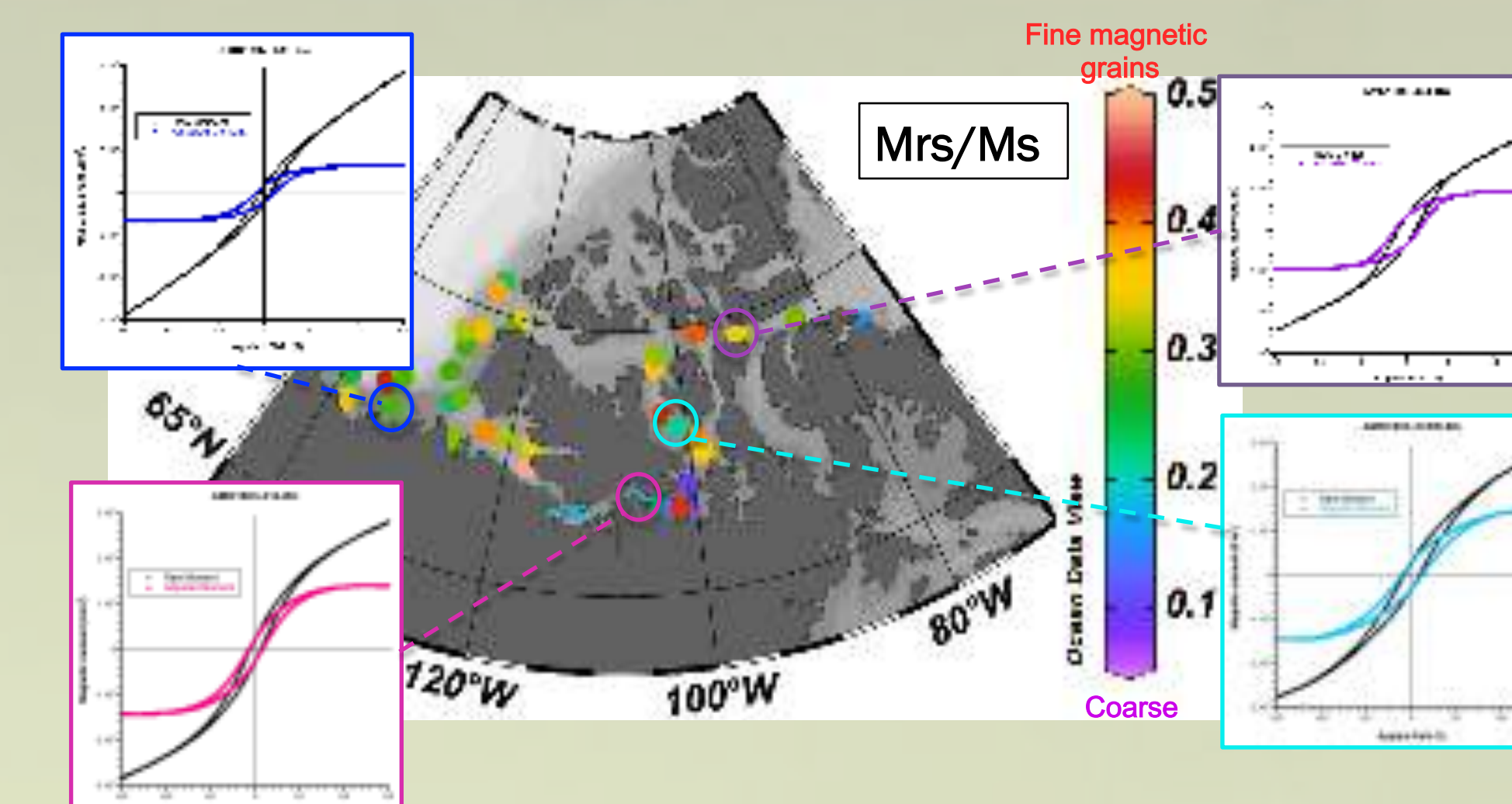
GEOCHEMISTRY



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.

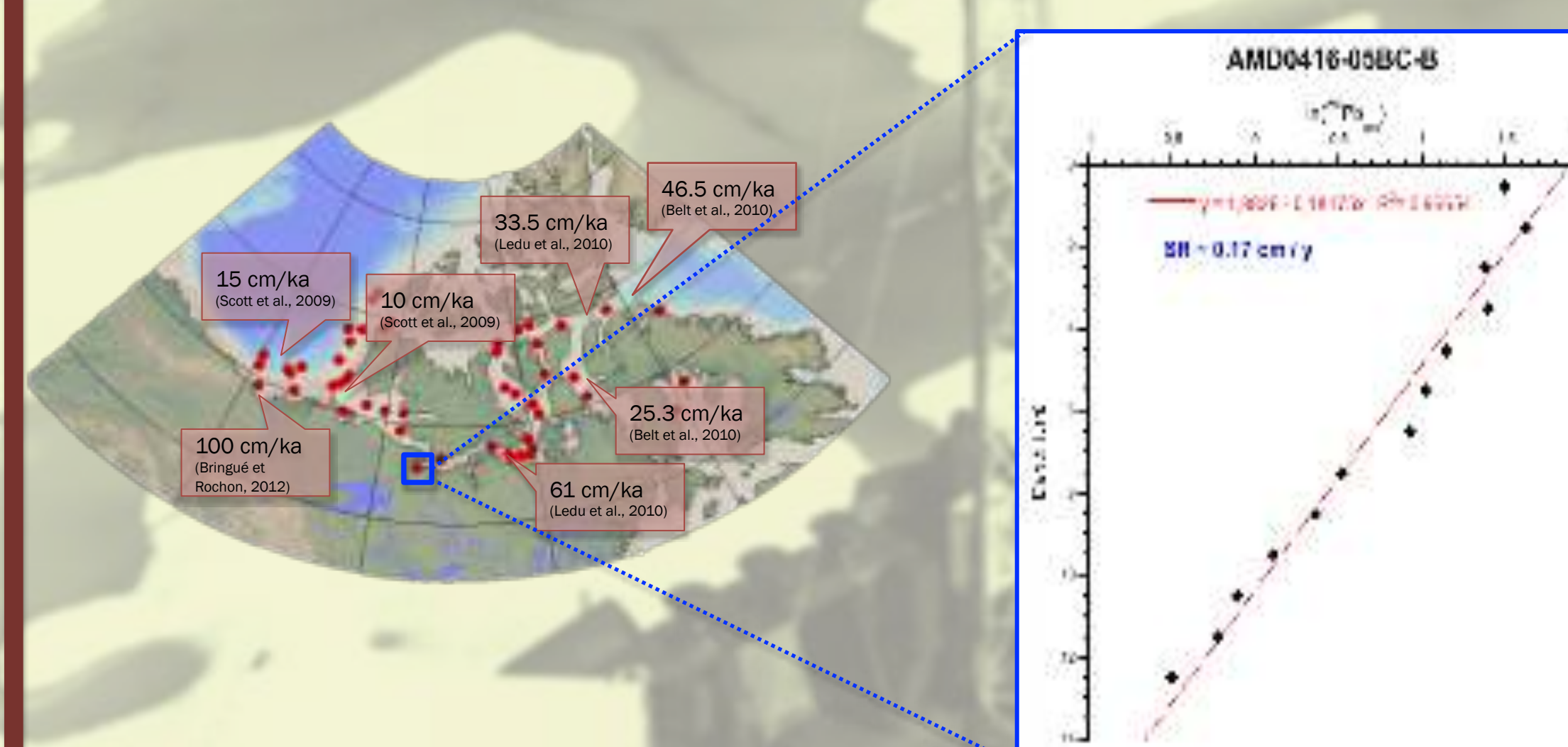
MAGNETIC PROPERTIES



➢ 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



²¹⁰Pb 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:

We sincerely thank the captain, crew and scientific participants of the 2016 and 2017 ArcticNet expeditions onboard the CCGS Amundsen. The authors are also thankful to Marie-Pier St-Onge and Quentin Beauvais for all their help in the laboratory, for data analysis and processing at ISMER. Financial support for this research project was provided by ArcticNet and the Natural Sciences and Engineering Research Council of Canada (NSERC) through Discovery and Ship Time grants to Guillaume St-Onge and Jean-Carlos Montero-Serrano.

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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