Evidence of Holocene climate change in northeastern Baffin Bay

based on sedimentological analyses and dinoflagellate cyst assemblages

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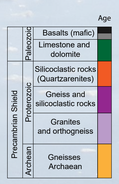
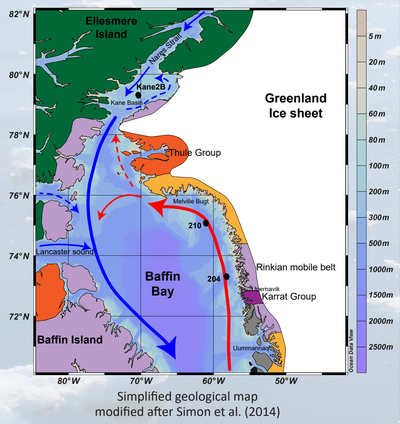
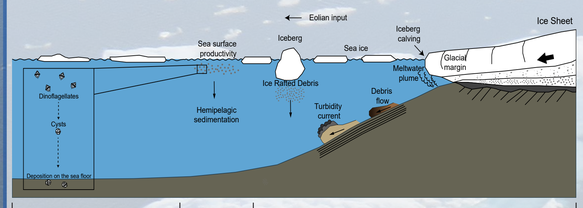
INTRODUCTION

- Two major ocean currents meet in the north of Baffin Bay (Tang et al., 2004):
  - → **Baffin Island Current** (Arctic waters)
  - → **West Greenland Current** (mixture of Atlantic and Arctic waters)
- Climatic and oceanographic changes occurred since the last glaciation, and through the Holocene.
- During the last glacial maximum, Baffin Bay was surrounded by three large ice sheets: the Laurentian, Innuitian and Greenland ice sheets (Dyke et al., 2002).
- Presence of **cross-shelf troughs** on the continental shelves (Aksu and Piper, 1987).
- Sub-glacial erosion transports sediments across the continental shelf → recording of sediment provenance.
- Glacial erosion triggers different transport and depositional processes (O'Cofaigh et al., 2013)





Simplified geological map
modified after Simon et al. (2014)



Dinocysts record sea-surface conditions when they fossilize in the sediment

Multiple sediment transport processes on the continental shelf and slope when associated to ice sheets

Did the sediment record the major climatic variations of the deglaciation and the Holocene?

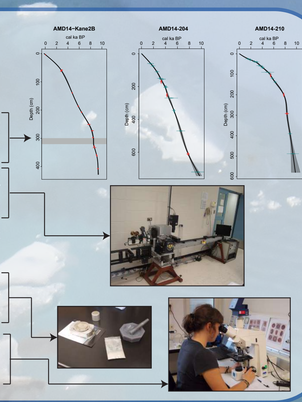
What werethe impacts of these changes on the sediment input?

OBJECTIVES

1) Track changes in sediment inputs and transport pathways
2) Estimate the evolution of sea surface conditions (temperature, salinity, sea-ice cover duration, productivity)
3) Document ocean, ice sheet and climate interactions in Baffin Bay during the Holocene

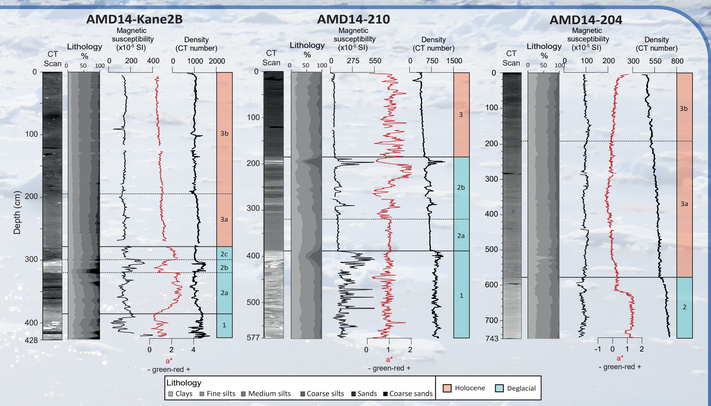
METHODS

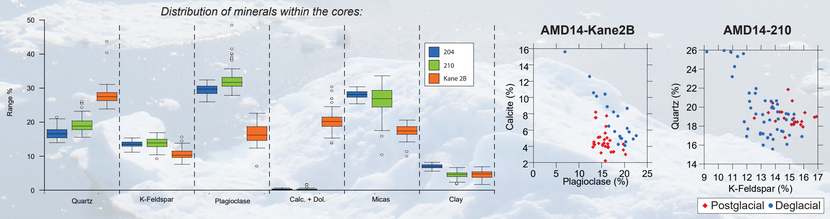
- **Three sedimentary cores** collected on the northwestern Greenland margin (2014 ArcticNet expedition - Leg1b)
- The chronology of the sediment cores was constrained by combining **paleomagnetic analyses with AMS-^{14}C ages**
- **Physical properties** acquired with CT-Scan (X-ray digital image) and MSCL (high-resolution images, sediment color, magnetic susceptibility)
- **Grain size** (laser granulometry) **and magnetic properties** (cryogenic magnetometer) analyses
- Quantitative **X-ray diffraction (qXRD) and X-ray fluorescence (XRF)**: bulk mineralogical and geochemical sediment properties
- **Palynological analyses** using the modern analog technic (MAT) to reconstruct the sea-surface conditions based on dinoflagellate cyst assemblages



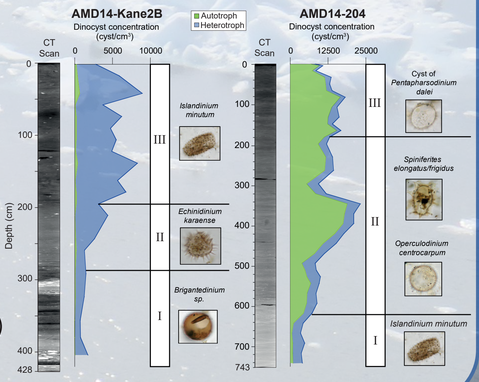
RESULTS

- A significant downcore variability is observed on these three cores and different units are determined based on this variability:
  - **Unit 1:** Glaciomarine sedimentation, ice-proximal
  - **Unit 2:** Massive to laminated hemipelagic sedimentation, ice-distal
  - **Unit 3:** Hemipelagic sedimentation, ice-distal
- Sediment provenance (detrital inputs):
  - **AMD14-Kane2B:** mainly derived from Paleozoic carbonate-bearing rocks and more Proterozoic granitic sources in unit 2 (2a and 2B)
  - **AMD14-210 and AMD14-204:** mainly derived from granite and gneiss from the Precambrian Shield



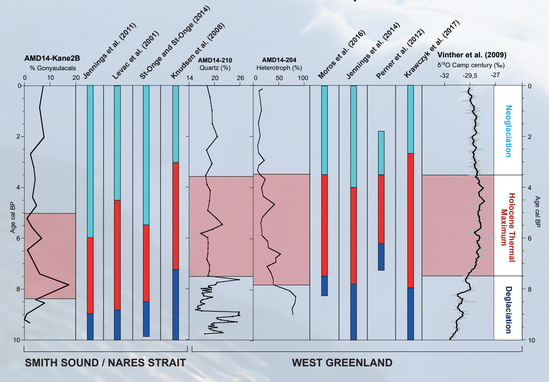


- Palynological results → three dinocyst assemblage zones determined:
  - **Assemblage I**: low dinocyst concentration, heterotrophs dominate
  - **Assemblage II**: marked by *Operculodinium centrocarpum* and *Spiniferites elongatus* dominance (AMD14-204) or occurrence (AMD14-Kane2B) and increasing dinocyst concentration
  - **Assemblage III**: marked by *Pentapharsodinium dalei* dominance (AMD14-204) or occurrence (AMD14-Kane2B) and a decreasing concentration at the top of the cores

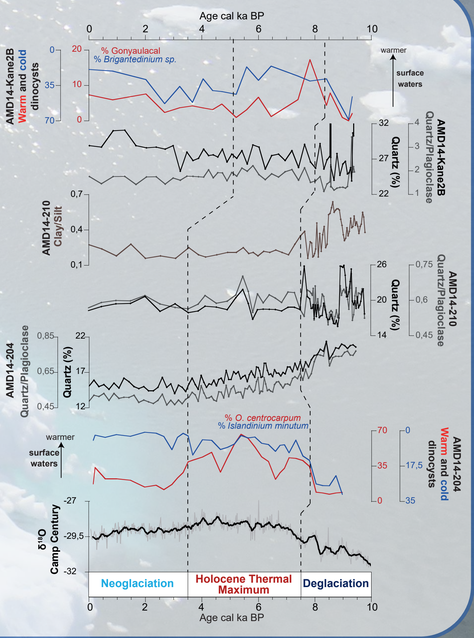


DISCUSSION

- **Lithological units 1 and 2** show a mainly deglacial (glaciomarine) sedimentation strongly affected by meltwater inputs and ice-rafting. This units are correlated to the **dinocyst assemblage zone I**, characterized by cold sea-surface temperature and an extended sea-ice cover. Thus, this period is associated to the **Deglaciation**.
- **Lithological unit 3** is characterized by hemipelagic sedimentation which indicates more stable conditions than units 1 and 2. **Dinocyst assemblage II** suggests higher productivity and generally warmer sea-surface conditions. This period is associated to the **Holocene Thermal Maximum**.



- Finally, the **dinocyst assemblage III** suggests the establishment of modern sea-surface conditions and a cooling trend after 3 cal ka BP. This period is associated to the **Neoglaciation**.
- Holocene Thermal Maximum occurs earlier in the northernmost part of Baffin Bay compared to other parts of the Arctic (e.g., Moros et al., 2016; Jennings et al., 2014)



CONCLUSIONS

The specific variations of almost all proxies measured in this study are synchronous with other regional records, supporting the following hypotheses:

(1) the Greenland Ice Sheet fluctuations are mainly driven by changes in the intensity of the West Greenland Current, themselves related to Holocene climate variability and;

(2) the Holocene is subdivided into three main climatic periods: the end of the deglaciation, the Holocene Thermal Maximum and the Neoglaciation.

ACKNOWLEDGMENT & REFERENCES

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