

Multi-proxy record of Holocene climatic changes in the Eastern Canadian Arctic: preliminary results



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1. ABSTRACT

A 6 m-long sediment core (core 2004-804-009) was collected at the eastern entrance of Lancaster Sound (Canadian Arctic) during the preliminary ArcticNet cruise in 2004 in order to reconstruct the evolution of sea surface conditions throughout the Holocene (the last 10,000 years). The core site was selected using multi-beam and sub-bottom sonars in order to avoid seabed disturbances and obtain the highest resolution possible. The core was split-opened and analyzed at the Bedford Institute of Oceanography in March 2005 and subsampled for a variety of analyses, such as palynology, micro-paleontology (foraminifer, diatoms), grain size, stable isotopes (¹³C and ¹⁵N), physical properties (density, P-wave, resistivity and magnetic susceptibility) and radiometric dating (²¹⁰Pb and ¹⁴C) in order to characterize the sedimentary environment. Reconstruction of past sea-surface physico-chemical parameters (temperature, salinity, sea-ice cover) using dinoflagellate cyst assemblages and transfer functions will also be performed in order to characterize the evolution of oceanic conditions during the Holocene.

2. SITE LOCATION



The coring site is located in Baffin Bay, just outside Lancaster Sound, the 6 m-long core (74°03.00 N, 79°56.00 W) was recovered in 800 m of water during the 2004 ArcticNet exploratory cruise (CASES Leg9).

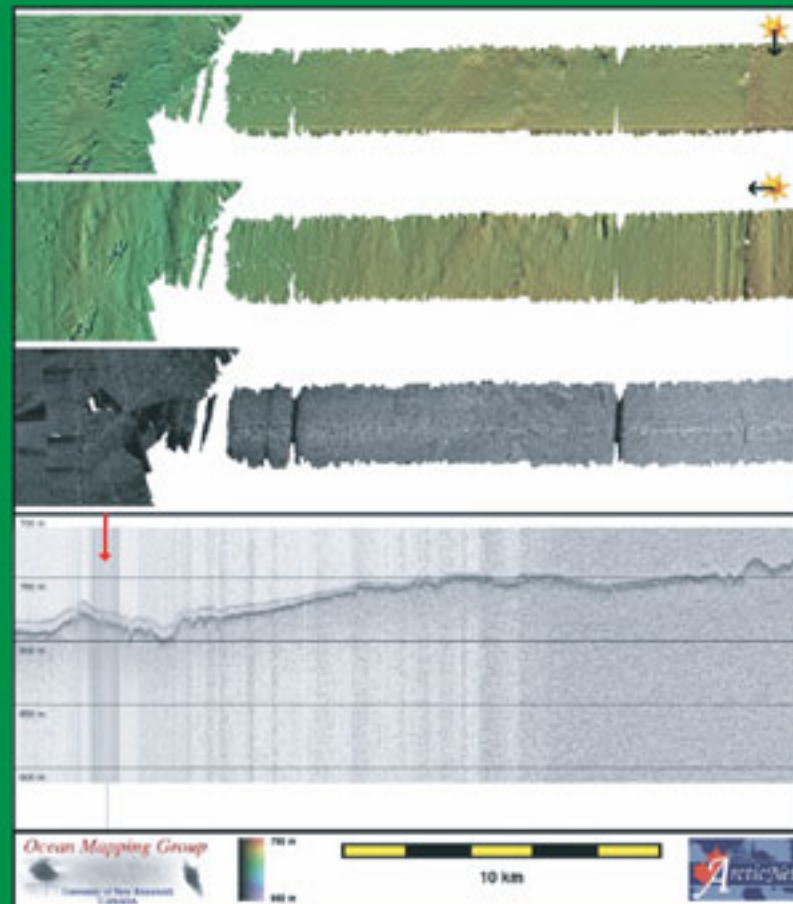
3. SITE SELECTION

In order to select the most adequate coring site we use a combination of multibeam and sub-bottom sonars. These sonars are hull-mounted and emit a signal several times per minute.

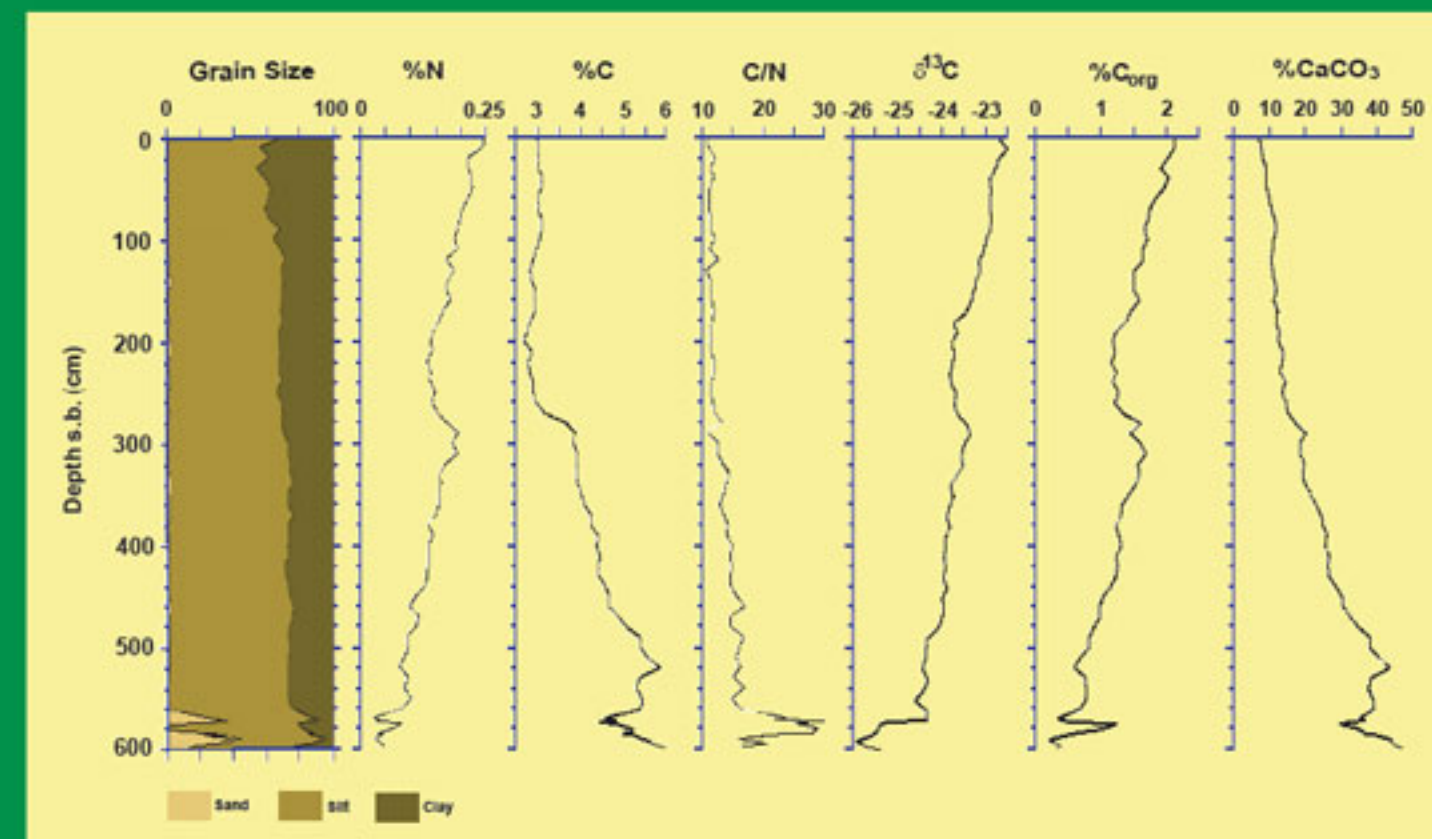
The multibeam system provides a detailed 3-D image of the sea floor, which will enable us to avoid slumping, ice scoured areas or any other sediment disturbances.

The sub-bottom sonar penetrates several meters below the sea floor and enables us to view the sediment layers, estimate their thickness or assess if there are disturbances or obstacles (e.g. rocks).

The figure to the right shows the exact location of the ArcticNet core 2004-804-009PC (red arrow). The ship track is illustrated in the upper part of the figure. The black and white track illustrates the back scattered signal, which serves to characterize the sediment type. The lower part of the figure depicts the sedimentary column below the sea-floor.

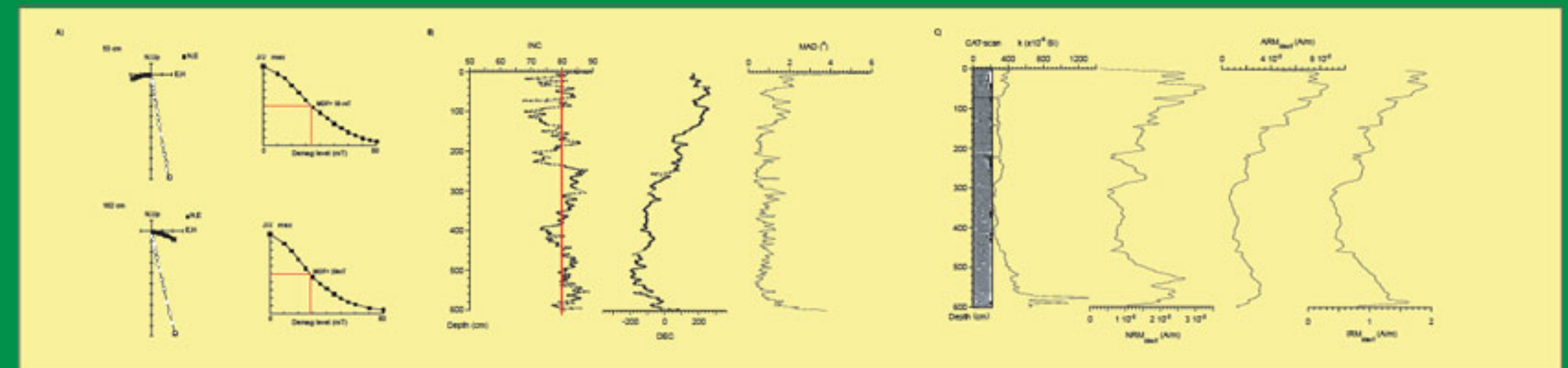


4. GRAIN SIZE AND STABLE ISOTOPES



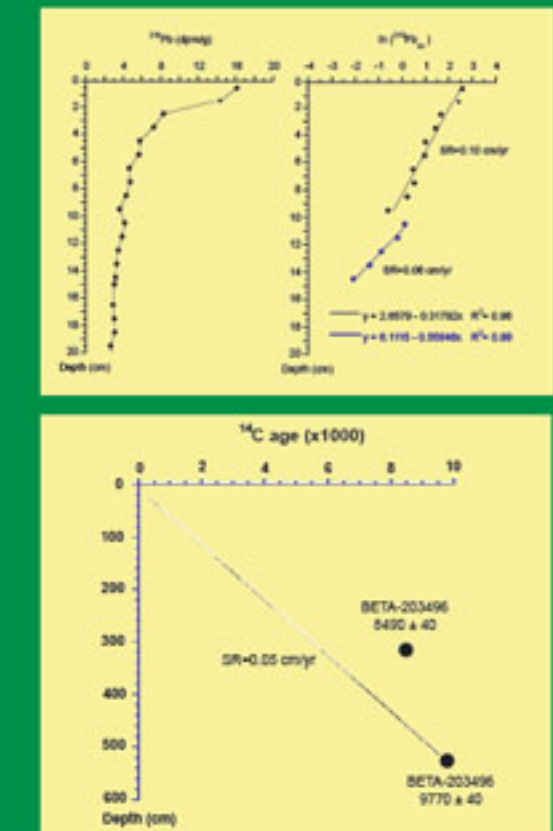
The sedimentary column is composed of silt and clay with traces of sand in the upper 560 cm, typical of Holocene marine sedimentation. The base of the core is marked by a higher percentage of sand (up to 22%), which indicates fluvio-glacial sedimentation. Stable isotope analyses show a steady increase of nitrogen, concomitant with a decrease in carbon percentages from the base to the top of the core. The fluvio-glacial horizon at the base of the core is marked by high values of the C/N ratio, together with high percentages of calcium carbonate. This indicates high inputs of detrital sediments due to important meltwater discharge during the last deglaciation. The percentages of organic carbon and ¹³C values increase steadily from the base to the top of the core, which indicates a passage from a terrestrial source toward a marine signature of the carbon content of the sediment.

6. PALEOMAGNETISM



Paleomagnetic and rock-magnetic results. A) The natural remanent magnetization (NRM) of the u-channel samples was studied by progressive alternating field demagnetisation indicating that the sediments are characterized by a strong, stable, well-defined, single component magnetization with maximum angular deviation (MAD) values (see B) generally lower than 20°. C) In addition, concentration dependent parameters such as ARM, IRM and magnetic susceptibility vary by less than one order of magnitude, whereas pseudo S ratios (not shown) are close to 1, suggesting a high proportion of low coercivity minerals such as magnetite. Component inclinations of each core fluctuate around the expected geocentric axial dipole (GAD) inclination (-80°) for the latitude of the sampling site (see B), indicating that these sediments likely recorded coherent paleomagnetic secular variations. These variations will be used to refine the core chronology by correlation to other well-dated Arctic cores and to develop magnetic proxies of environmental or climatic changes.

5. CHRONOLOGY



Chronology is one of the most important aspects of our work. Radiogenic isotopes are used to calculate sediment accumulation rates. For the upper portion of the sediment we measure the activity of ²¹⁰Pb from cores recovered with the help of a boxcorer. The upper diagram shows the results of ²¹⁰Pb analyses performed on total sediment samples. They indicate a sedimentation rate of 1 mm/yr down to about 10 cm (the last 100 yrs). Below that the sedimentation rate drops to 0.6 mm/yr. The increase from 0.6 mm/yr to 1 mm/yr at the summit of the core may be the result of anthropic activities.

For the piston core we used ¹⁴C measurements performed on shell fragments. Two ages were obtained, 8490±40 yr BP at 317 cm, and 9770±40 yr BP at 525 cm. However, the ¹⁴C analysis on the 317 cm sample suggests a "freshwater signature", which most likely indicates that the shell is reworked. If we only use the bottom age to estimate the sedimentation rate, we obtain a value of 0.53 mm/yr, which is consistent with the value obtained below 10 cm depth in the boxcorer.