Paleogeography and paleoenvironments of southwestern Baffin Island (Nunavut, Canada): post-glacial isostatic uplift and isolation of Nettilling Lake from marine influence

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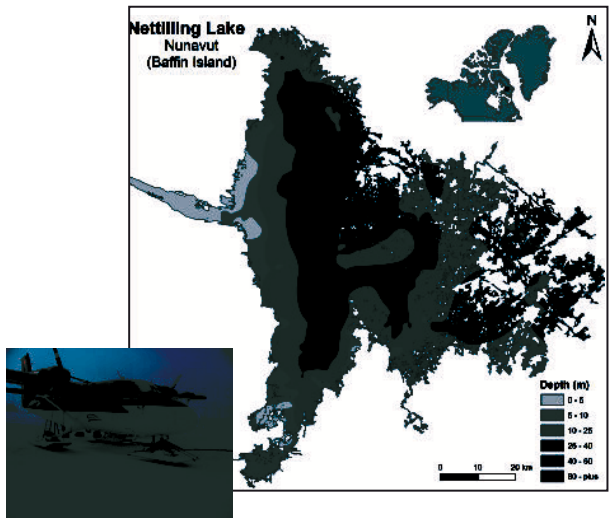
GENERAL CONTEXT AND STUDY OBJECTIVES

Here we present a pioneer study with respect to ecosystemic postglacial succession that has never been completed before in this remote region of the Canadian Arctic.

This multiproxy study will generate new paleolimnological and paleoenvironmental data by reconstructing the history of postglacial isostatic uplift and isolation of the lake basin from marine influence.
It will provide further evidence for the usefulness of multiproxy analysis (biological and geochemical indicators) in reconstructing sea-level changes and land-uplift in formally glaciated landscapes.

The paleolimnological record from the study will enable ice-sheet modelers to accurately reconstruct the past and better predict the future contribution of polar ice sheets to global sea-level change.



METHODS

A multi-proxy paleolimnological approach is used to study the sedimentary records preserved in Nettilling Lake.

Physical properties:
- LOI and magnetic susceptibility

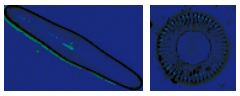
Chemical properties:
- Relative concentration of chemical elements by high resolution micro-fluorescence (µ-XRF) core scanner
- Isotope analysis

Biological properties:
- Chironomid, diatom and foraminifer assemblage analyses

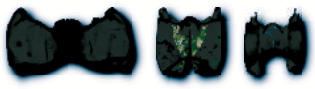
Two sampling areas were chosen based on the hypothesis that post-glacial marine transgression and the establishment of the freshwater lake would be preserved in the sediment records from the extreme opposite (west-east) parts of Nettilling Lake.

RESULTS OF MULTIPROXY SEDIMENT CORE ANALYSIS

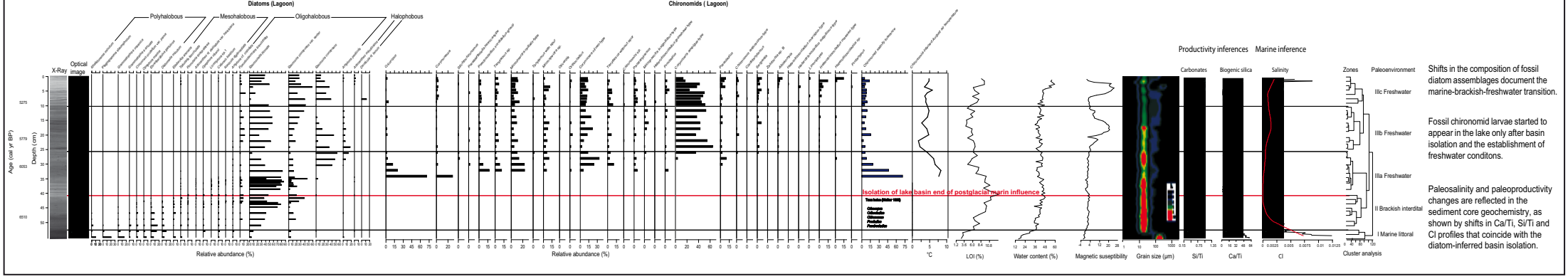
Core Ni4-7



BIOLOGICAL INDICATORS



PHYSICAL AND GEOCHEMICAL INDICATORS



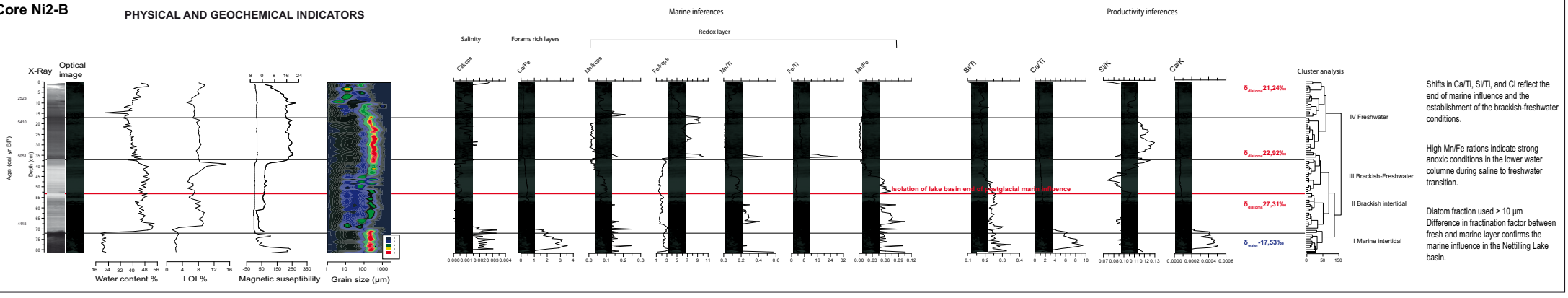
Shifts in the composition of fossil diatom assemblages document the marine-brackish-freshwater transition.

Fossil chironomid larvae started to appear in the lake only after basin isolation and the establishment of freshwater conditons.

Paleosalinity and paleoproductivity changes are reflected in the sediment core geochemistry, as shown by shifts in Ca/Ti, Si/Ti and Cl profiles that coincide with the diatom-inferred basin isolation.

Core Ni2-B

PHYSICAL AND GEOCHEMICAL INDICATORS



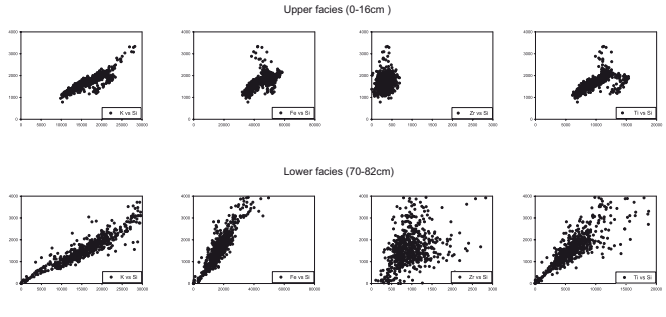
Shifts in Ca/Ti, Si/Ti, and Cl reflect the end of marine influence and the establishment of the brackish-freshwater conditions.

High Mn/Fe rations indicate strong anoxic conditions in the lower water columne during saline to freshwater transition.

Diatom fraction used > 10 µm
Difference in fractination factor between fresh and marine layer confirms the marine influence in the Nettilling Lake basin.

Core Ni2-B

GEOCHEMICAL INDICATORS

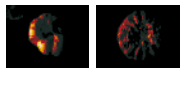


The clear difference in geochemistry of upper facies compared with lower facies:

1. Higher Ca peaks area in the low marine facies are indicative of endogenic calcite precipitation in the postglacial sea
2. Shifts in sediment source from carbonate terrain to Precambrian granites/gneiss terrain

Core Ni2-B

BIOLOGICAL INDICATORS



In this diagram, we present 63-1000 µm fractions.

We found fossil fragments from paleozoic carbonate terrain at 77 cm core depth. This confirms the shift in sediment source from carbonate terrain to Precambrian granites/gneiss terrain.

CONCLUSION

Glacio-isostatic submergence of the Earth crust moved the Foxe-Basin coastline inland by hundreds of km for much of the Holocene.

Glacio-isostatic rebound resulted in the formation of a meromictic saline lake system.

Sea water trapped in the lake during the isolation process was preserved in a dense saline and anoxic hypolimnion that lasted for several hundred years.

Nettilling Lake basin remained under marine influence until the Mid-Holocene (5000 yr cal. BP), followed by freshening and fluvial processes that supplied sediment and fresh water until the present-day.

Precise radiocarbon dating of the transitional zone in the Ni2-B sediment core will allow to refine the history of post-glacial sea extent and duration of glacio-isostatic uplift.

Studies of the diatom assemblages from the Ni2-B sediment core will further refine our interpretations of changes in diatom species in response to the effects of decreasing salinity in the lake.