Geophysical Research Abstracts
Vol. 12, EGU2010-13381, 2010
EGU General Assembly 2010

Deglacial to postglacial marine environments of SE Barrow Strait, Canadian Arctic Archipelago

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The Quaternary history of the Canadian Arctic Archipelago (CAA) has been the subject of widespread research spanning more than half a century. However, the majority of glacial, deglacial, sea-level and palaeoenvironmental records for the region are terrestrially based in an area characterized by extensive inter-island marine channels. To build upon a small number of previous marine studies from the region, we present here a near continuous core record of Late Pleistocene to Holocene sediments extending to the end of the Last Glaciation. Core 86027-144 ("144"), retrieved in southeastern Barrow Strait, was investigated for organic-walled (dinocysts; non-pollen palynomorphs) and calcareous (benthic and planktonic foraminifera) microfossils, foraminiferal oxygen isotope ratios, as well as a range of sedimentological characteristics.

On the basis of bio- and lithostratigraphy, eight palaeoenvironmental zones were identified in the core reflecting major changes in the marine environment through the Late Pleistocene and Holocene. Zone 1 (prior to 10.3 cal ka BP) records the immediate grounding line at deglaciation, with ice-sheet destabilization, float-off and subsequent break-up. This event was likely near synchronous across much of Barrow Strait, as another core nearby, as well as deglacial dates from adjacent coastlines show similar deglacial dates. Zone 2 ($\sim$10.3–9.7 cal ka BP) represents ice-proximal glaciomarine facies characterized by stratified and laminated muds likely formed during severe sea-ice conditions. Although sparse microfossils are present in Zone 2, biological activity starts in earnest in Zone 3 (9.7-9.4 cal ka BP), which marks a transitional period between ice-proximal glaciomarine deposition (Zone 2) and fully marine (zones 4-8) Arctic conditions. Of particular note is the appearance of planktonic foraminifera (Neogloboquadrina pachyderma) within Zone 3 (9.7-9.4 cal ka BP), with both polar and sub-polar forms peaking simultaneously. As planktonics are largely absent from the channels of the CAA today, these occurrences are significant, suggesting that the central archipelago was subject to greater oceanic throughflow during that period. Postglacial conditions commence in Zone 4 (9.4-7.7 cal ka BP), and are characterized by amelioration (an extended season of open water greater than at present). Although Zone 4 is postglacial in character, it nonetheless differs considerably from the Mid- to Late Holocene (zones 6-8) in terms of its microfossil content and oxygen isotope ratios. This suggests that Early Holocene conditions were non-analogous to later environments at the study site. After a transitional period (Zone 5; 7.7-6.5 cal ka BP) of rapid and pronounced regional environmental changes, "modern" Arctic conditions commence at $\sim$6.5 cal ka BP (zones 6-8). These are characterized by increased sea-ice cover, and microfossil assemblages resembling communities encountered in the CAA today.

The timing of deglaciation of core 144 coincides with that of NE Barrow Strait (core 86027-154) as well as adjacent coastlines, suggesting a region-wide destabilization of a grounded, marine-based ice-sheet at $\sim$10.3 cal ka BP. The subsequent throughflow of ocean water, indicated by abundant planktonic foraminifera, implies that the Laurentide and Innuitian ice sheets were separated by $\sim$9.7 cal ka BP. The absence of planktonics during that time period farther west in the archipelago implies that ocean circulation was opposite to modern, with inflow from the east rather than the northwest. The high abundance of planktonic foraminifera from 9.7 to 9.4 cal ka BP (Zone 3) was likely influenced by glacioisostatic factors as much as climate, because water depths would have been $\sim$100-150 m deeper than at present, favouring greater oceanic exchange. The subsequent amelioration that produced non-analogous environmental conditions in Barrow Strait at $\sim$9.4-7.7 cal ka BP is consistent with the "Holocene Thermal Optimum" previously proposed for the CAA. After 6.5 cal ka BP, core 144 suggests

the establishment of “typical” Arctic conditions marked by an increase in sea-ice persistence in the region. This research constitutes part of a broader study of glaciation, sea-level adjustment and environmental change under JE’s NSERC (Natural Sciences and Engineering Research Council of Canada) Northern Chair Program, complementing on-going terrestrial research on adjacent islands.