Foraminifera as a Proxy in Arctic

Research Question and Methodology

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Abstract

This study aims to reconstruct the environment from the most recent Ice Age to present, in the Northwest Canadian Arctic using foraminifera as a proxy. Surface samples and sediment cores were obtained during an expedition in summer 2016 onboard CCGS Amundsen. These samples were sieved, weighed and picked through in order to classify the types of foraminifera found for taxonomic and environmental information. Foraminifera assemblages were obtained from core sub-samples and targeted specimens were used for stable isotope analysis. The results of various isotope measurements will provide evidence of the environmental conditions to which the foraminifera were subject, allowing for greater inference of overall environmental conditions both past and present.

Key-words: benthic foraminifera, planktonic foraminifera, Arctic, Holocene

Introduction & Objectives

Foraminifera are classified as amoeboid protists. Foraminifera can be used as an indirect measure or proxy of environmental conditions. This study focuses on using foraminifera as a proxy to discern hydrological systems and glaciation patterns over the Holocene epoch.

The study areas are the marine channels of Arctic Canada (Northwest Passage, NWP), a route for water and heat exchange between the Arctic and Atlantic oceans. This region has changed considerably (sea ice, oceanography, ecosystems) since the Last Ice Age and also in recent decades due to climate warming.

Sediment cores and surface sediments sites (Google Earth)

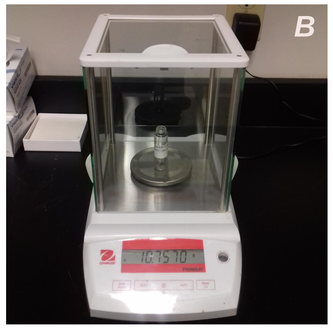
The aims of this project are to:

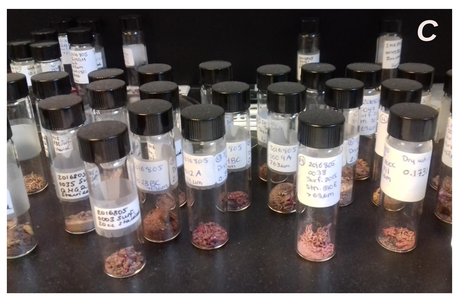
1. Assess species distributions in seabed sediments in an Atlantic-Arctic transect (Baffin Bay to NWP; ~30 boxcore samples; recovered in 2016 and to be recovered in summer 2017)
2. Link said distributions to measured environmental parameters (e.g., sea ice duration)
3. Gather biogeochemical data (isotopes of O & C tracing temperature, ecosystem productivity) from selected species (~90 samples)
4. Combine the obtained information (species-environment relationships; isotopic values) to interpret past environments

Methods

Preparing the samples

For micropalaeontological analyses, 71 surface sediment samples and 63 core sub samples have been wet-weighed (10 cc), then wet-sieved at >63µm, oven dried at 45° C and finally dry weighed. This procedure has been conducted in order to get a total concentration of the sediment being analyzed.





A: *sample sieving at >63 µm*

B: *sample weighing after being oven-dried*

C: *samples ready for microfossil picking*

Picking & identifying foraminifera

A total of 300 benthic and planktonic foraminifera have been manually picked, whenever possible. Picking has been done with a tiny microfossil brush under low-power microscopy.
As the microfossils were picked two major groups were differentiated: planktonic foraminifera and benthic foraminifera. The latter was further separated into two sub-categories: agglutinated and calcareous specimens.

Sample analysis under low-power microscopy

Stable Isotope Analysis

Stable isotope analyses (**$\delta^{13}C$ and $\delta^{18}O$**) will be conducted using laser ablation ICP mass spectrometry at Cardiff University (Wales, UK). The results will be used to:

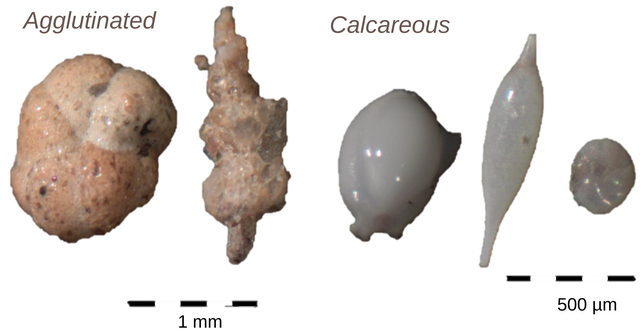
1. Determine water **temperature**
2. Proxy for oceanic **salinity**
3. Evaluate **sea ice conditions**
4. Ecosystem **productivity**

Chronology of the sediment cores

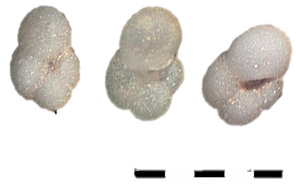
In order to provide a chronology in sediment cores filter-feeder molluscs shells were sent to NOSAMS laboratory (Massachusetts, USA) for radiocarbon dating (**^{14}C**).

BENTHIC FORAMINIFERA

Agglutinated *Calcareous*



PLANKTONIC FORAMINIFERA



References

Jones, R.W., 2014. Foraminifera and their applications. Cambridge University Press, Cambridge, United Kingdom ; New York.