North Atlantic Icebergs and Abrupt Climate Change

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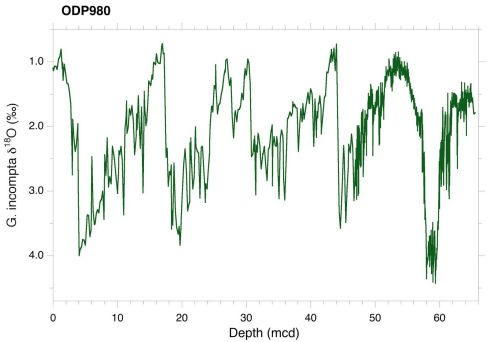
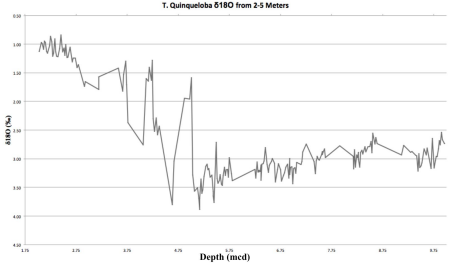
Introduction:

Foraminifera are ocean dwelling organisms that form carbonate shells known as tests. When forams die their shells are deposited on the ocean floor as sediments. Their tests fractionate oxygen isotopes according to ocean temperature, global ice volume, and seawater salinity at the time of their formation. This project used T. Quinqueloba (a surface dwelling species of foraminifera) tests as a proxy for past sea surface temperatures during the last deglaciation.

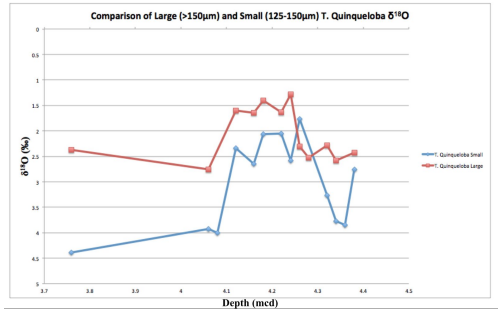


$\delta^{18}O$ record of N. Incompta indicating sea surface temperature and ice volume variations through multiple glacial cycles. High $\delta^{18}O$ represent low temperatures.

Results:

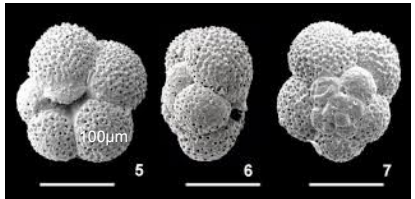


The temperature record generated from T. Quinqueloba from ODP (Ocean Drilling Project) core 984C indicate high temperature variation during the last deglaciation (2.75-5 meters composite depth (mcd). Unfortunately, T. Quinqueloba disappear at various points in the core in this interval and thus the resolution is not consistently high. There were smaller T. Quinqueloba shells present in these intervals that could be used to fill in the data gaps. Prior to this project, the relationship between the $\delta^{18}O$ of small T. Quinqueloba tests and that of their larger counterparts was not known. Therefore $\delta^{18}O$ measurements were made of both small and large tests in identical sections of the core and compared.



The comparison between small and large T. Quinqueloba tests did not yield a consistent relationship between the $\delta^{18}O$ values. This makes it difficult to apply small test $\delta^{18}O$ values in the intervals where data is missing. Unless a method of comparing small test $\delta^{18}O$ values to large ones is found, more samples with standard sized tests are needed to better understand surface ocean temperatures during the last deglaciation.

T. Quinqueloba Tests



Conclusions and Discussion:

High climate variability throughout the last deglaciation:

The period analyzed most closely in this study indicates a climate characterized by rapid warming and cooling events within a relatively short span of time. The deglaciation does not seem to have been a period of constant warming but rather of rapid temperature oscillations. Higher resolution data during this interval would clarify the degree of climate variability.

Smaller T. Quinqueloba tests yield higher $\delta^{18}O$ values:

Although the smaller T. Quinqueloba tests do not show a consistent relationship with their larger counterparts, they almost always have a higher $\delta^{18}O$. This indicates a lower temperature, which could be due to the time in which they live. If the smaller tests represent T. Quinqueloba that died prematurely then it could be the case that they did not mature through the summer and spring months. If they lived during the cooler months of the year they would show higher values of $\delta^{18}O$. There is also potential for the $\delta^{18}O$ offset to be due to biological factors that are not easily or intuitively explained.