Size matters: the response of foraminifera test size to changing climate

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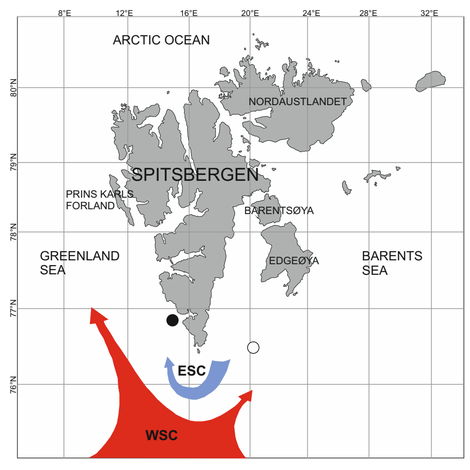
Introduction

The main aim of the presented study was to determine **how the size structure of benthic community off west Spitsbergen responded to climate-driven environmental changes since the last glaciation.** The size of particular foraminifera species is variable and strongly dependent on e.g., oxygen conditions, organic carbon flux to the seabed, and temperature. All of these environmental parameters changed since the last glacial times according to the Atlantic and Arctic water mass balance along the Spitsbergen coast. It is well known that benthic foraminifera community structure in the North Atlantic and Arctic region varied in the postglacial and Holocene sediments in terms of species composition and diversity. However, the response of foraminifera tests sizes to changing climate have not been explored.

Study area

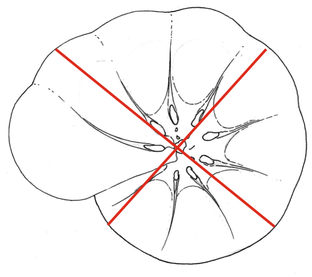


CORING STATIONS:

- HORNSUND
- STORFJORDEN

WSC - West Spitsbergen Current
ESC - East Spitsbergen Current

Methods

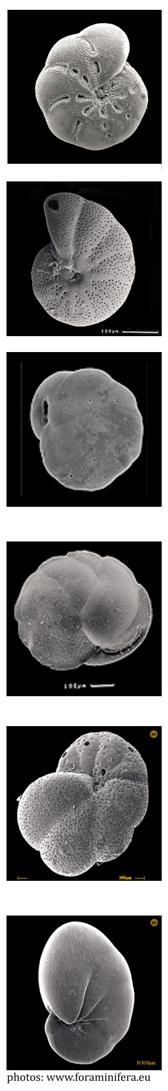


Two dimensions: the width and the length were measured in 30 specimens of each species in each sample. Samples with low quantity of tests were excluded. The test volume was approximated by 0.5 volume of a sphere:

$$\text{Volume} = 0.5(4/3\pi r^3)$$

r = mean width and length

Foraminiferal test size



photos: www.foraminifera.eu

* no data - low number of specimens

Bergmann's rule (1847)

The lower temperature/ the higher latitude - the larger size

Hypothesis

Late Weichselian and Holocene temperature variations induced foraminifera size changes, i.e. lower temperatures caused size increase in large range of foraminifera species.

Results

In both analyzed cores, all the chosen species showed roughly similar trend in the changes of the test size. During the Yonger Dryas interstadial (YD, ~12 800 – 11 500 cal yr BP) and in the mid- to late Holocene (~ 5000 – 1000 cal yr BP) foraminifera test volume was noticeably higher. During both mentioned periods, the Atlantic water was absent or its presence was less pronounced in the study area. YD was characterized by the enhanced water stratification and the presence of extensive sea-ice cover episodically limiting icebergs drift. In the mid- to late Holocene transition, a gradual cooling occurred and was accompanied by the glaciers advances. Conditions in the surface waters were polar and ice cover was more extensive than in the preceding period. In our case, there is a tendency of foraminifera test size to increase with a temperature decrease. However, it is likely that the variation in foraminifera test size is linked to the combination of temperature-related environmental variables e.g., ice cover and productivity.