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Quantitative reconstruction of paleoproductivity changes in the Arctic by regionally constrained dinocyst transfer functions

Sabrina Hohmann (1), Michal Kucera (1), and Anne de Vernal (2)

(1) MARUM, University Bremen, Bremen, Germany, (2) Centre GEOTOP, Université du Québec à Montréal, Montréal, Canada

The Arctic is experiencing a greater-than-average response to anthropogenically induced climate change. Arctic marine ecosystems are known to react quickly to changing environmental conditions and the ongoing climate change will likely affect the Arctic marine carbon cycle. A possible approach to predict future changes in the Arctic marine carbon cycle is by investigating its past variability. However, quantification of the reaction of the individual components of the marine carbon cycle to global change in the past is hampered by the difficulty to separate the bioproductivity signal in marine sediments from diagenetic processes as well as the difficulty to reconstruct past primary productivity independent of other environmental forcings. Here we make use of the observation that the composition of marine plankton communities reflects the trophic regime under which they grew and that this information is transferred into the sediment by their fossils. Our specific aim is to advance the quantification of primary productivity reconstruction for the Arctic and Subarctic Baffin Bay region by developing a regional transfer function evaluated by a rigorous statistical analysis of the relationship between assemblage data and multiple candidate controlling parameters.

We test our regional transfer function by its application on a new Holocene sediment sequence from the East Baffin Bay (core GeoB 19927-3) and the comparison of the transfer function reconstructions with other potential productivity proxies. We verify our method by its application on two already well-studied Holocene sediment sequences from the Baffin Bay and the Labrador Sea with published data for productivity.

We will resolve if by reducing the calibration dataset to 357 local samples from Baffin Bay, Davis Strait, Labrador Sea, Hudson Bay and Hudson Strait, productivity becomes the first, second or a lesser significant variable affecting the assemblage composition and if it can be reconstructed independently of other parameters. Our Holocene application reveals a trend towards higher bioproductivity in the top part of the sediment sequence, which is mirrored by other bioproductivity proxies.

We conclude that a regional dinocyst transfer function can be used to reconstruct bioproductivity patterns during the Holocene in the Arctic and Subarctic Baffin Bay region with an accuracy equivalent to that of other, not always recoverable, productivity proxies.