CHANGES IN SEDIMENTARY ORGANIC MATTER BURIAL ACROSS A RETREATING SEA ICE GRADIENT IN THE ARCTIC BARENTS SEA

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Introduction

Warming in the high latitudes is among the most pronounced globally and has led to a dramatic decrease in summer sea ice extent and thickness over the past few decades (Stroeve et al., 2012). This change impacts oceanic heat fluxes, biological communities and nutrient dynamics, present in the Arctic Ocean. Specifically, in the Barents Sea, climate change is leading to reduced water column stratification and is inducing a transition to a more Atlantic influenced system and reduced sea ice (Lind et al., 2018).

The organic matter (OM) buried at the seafloor of the Barents Sea is a complex mixture of differentially degraded marine and terrigenous organisms from a range of sources and time periods. Therefore, to understand how sea ice changes over the coming decades to centuries might impact carbon cycling it is important to ascertain how efficient carbon burial is across a N-S transect, and if this is affected by OM source. Here we present results of both the 'bound' and 'free' fraction of marine OM from sediment cores (~35 cm long) collected from 288 – 354 meters in the Barents Sea to the east of Svalbard (74° N, 30° E - 81°N, 30° E). This region is characterised by the Polar Front which is formed where warmer Atlantic water from the south meets cold Arctic currents from the north.

To elucidate changes in OM composition in Barents Sea sediments we compare i) bulk parameters of OM diagenesis (TOC, $\delta^{13}C_{TOC}$, ^{14}OC-AMS), ii) solvent-soluble indicators of OM source and transformation (e.g. *n*-alkanoic acids, sterols by GC-MS) with, iii) grouped macromolecular derived pyrolysis product distributions (e.g. phenols, pyridines, aromatics, furfurals by Py-GC-MS (Stevenson and Abbott (in press)) of the solvent-insoluble fraction of OM. In addition, we couple benthic bioturbation data from the same stations to gain new insights into how infaunal invertebrates mediate the process of OM diagenesis and burial.

Results

Our results show distinct changes in bulk, macromolecular and solvent extractable geochemical parameters across the N-S transect and with sediment depth. Across the N-S transect, the position of the Polar Front and the winter ice edge can mediate changes in the organic geochemical composition in Barents Sea sediments. With increasing sediment depth, OM concentration gradually decreases. Specifically, there is an active zone of changing fatty acid distribution in the upper ~2 cm evidenced by Carbon Preference Index (CPI (e.g. Meyers and Ishiwatari, 1993)) and relative short/long chain length (Figure 1). TOC declines and C_{org}:N ratio increases with burial depth at all stations, providing evidence of consistent longer-term diagenesis or source change associated with sea ice reduction (Figure 1). Differences between the loss of TOC and changes in the chain length of key molecular markers between northern and southern stations (Figure 1) can be partly attributed to variations in the supply of labile or

recalcitrant OM between the stations, from marine, terrestrial or sea ice algal sources associated with ice melt. Additionally, OM reactivity can be ascertained by plotting changes in i), ii), and iii) as a function of ^{14}OC-AMS age. Finally, bioturbation at the seafloor by infauna is most influential on OM diagenesis at shallower stations.

Conclusions

We demonstrate that there are systematic changes in both bulk measures and biomarker compositions across the Polar Front and sea ice edge, which indicate diagenesis of OM with sediment depth. Changing OM source associated with sea ice retreat and climate change may also help explain these trends. It has been suggested that the position of the Polar Front is moving northwards (Lind et al., 2018) across variations in Arctic sea ice cover (Belt et al., 2015). In the future the Barents Sea may experience further increased open water during summer and accelerated phytoplankton production. How much of this labile OM is utilised and buried over long time periods will have wider implications for regional Arctic carbon budgets and global climate change.

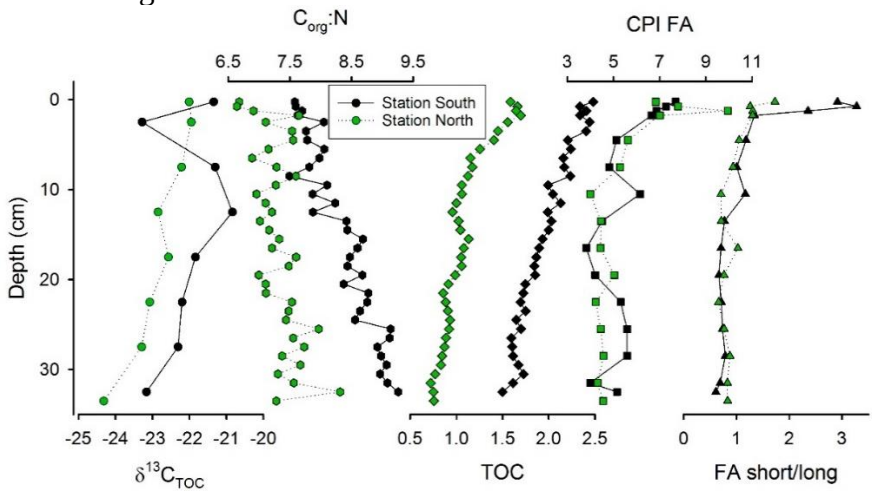

Figure 1 *Selected example changes in down-core organic matter parameters at two stations in the Arctic Barents Sea (Station South & Station North). Parameters include $\delta^{13}C_{TOC}$, C_{org}:N, TOC, Carbon Preference Index for Fatty Acids (CPI FA), and Fatty Acid (FA) short/long chain length compounds [$(C_{14}+C_{16})/(C_{20}+C_{22}+C_{24}+C_{26}+C_{28}+C_{30})$]. Both stations display trends of OM diagenesis/source change, but there are clear differences between locations.*

References

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