Sedimentary ancient DNA - a new proxy to investigate the impact of environmental change on past and present biodiversity in Nordic Seas (NEEDED) - an overview of the research project

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Key words

ancient DNA, Holocene, climate change, biodiversity, carbon burial

The vastness of the sea is full of various forms of life that dwell in the water column and at the sea bottom. Most of this marine biome is composed of microorganisms or small-sized animals that form the base of the marine food web. They are abundant and highly diverse. They play a key role in the functioning of the marine ecosystem and potentially could be a rich source of information the interplay between biodiversity and climate. Unfortunately, most of them disappeared without leaving any fossil traces. Only few microbial groups, those with hard skeletons, are preserved in the fossil record. These scarce microfossils provide a precious but very limited glimpse into the immense richness of marine biodiversity and its response to past environmental change.

Our project proposes a novel way to study the past environment using the DNA preserved in marine sediments. After their death, the organisms living in the sea sink to the bottom where they are eaten, decomposed by the other organisms or preserved in the sediment. Fortunately, their DNA remains preserved either inside the undigested cells or as free molecules attached to the sediment. Although this DNA is strongly degraded, it is still possible to recover DNA fragments and identify their origin. Thus, the marine sediments provide invaluable archives of almost everything that has been living there in the past.

In this project we will use this archived DNA to reconstruct the history of marine life in Nordic Seas during the last 20,000 years. We will analyze sedimentary DNA from six well dated cores collected at the Svalbard and Greenland shelves. By using multiple genetic markers, we will follow changes in composition of different groups of organisms, from microalgae to single-celled protists and animals. We will integrate these historical biodiversity data with the information about past environmental change provided by classical

Project financed by the Norwegian Financial Mechanism 2014–2021 (85%) and national co-financing (15%) within GRIEG Programme. "Sedimentary ancient DNA - a new proxy to investigate the impact of environmental change on past and present biodiversity in Nordic Seas". Programme Operator: National Science Centre. Project No. 2019/34/H/ST10/00682.

palaeoceanographic proxies (i.e. microfossils, stable isotopes). The results of our study will help to understand how the marine organisms responded to climate change in the past and whether this response is similar to what we observe today. In particular, we will analyze the impact of climate change on biodiversity during the mid-Holocene Thermal Maximum, about 9,000 to 5,000 years ago and compare it to the current global warming. We will test the hypothesis that the past increase of sea surface temperature in Nordic Seas was associated with an increase of biodiversity, lower productivity and reduced carbon burial. These results will be relevant for what can be expected in the near future if the Nordic Seas continue to warm at the current pace.

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