The oceans are full of various forms of life and most of them are microorganisms or small-sized animals. They play a key role in ecosystem functioning and are a potential source of valuable information about the environment. However, most of them disappear without leaving any morphological traces – only a few groups form microfossils that may be preserved in marine sediments in longer timescales. Microorganisms are therefore an important yet poorly understood component of contemporary and past marine biodiversity. Until now, the biological proxies used to reconstruct the paleoceanographic and paleoclimatic conditions were limited to a few groups of organisms that have been preserved in marine sediments. In our project, by combining genetic and geochemical tools, we propose a novel way to study the link between microbial diversity and environmental changes.

Environmental DNA is defined as DNA obtained directly from environmental samples, such as sediment or water. It consists of undigested cells or free molecules that remain in the environment after the death of the organism. Therefore, it provides a potentially extremely valuable archive of marine biodiversity. By substantially expanding the range of taxa included in the analyses, the DNA preserved in the sediments can be considered a real game-changer in the way how the past biodiversity is analyzed. In the proposed project, we will use DNA preserved in sediments to reconstruct microbial communities in the Nordic Seas over the last few thousand years. We will analyze sediment DNA in two cores collected in Svalbard and Faroe Islands. By analysis of selected genetic markers, we will follow changes in composition of different groups of organisms, from bacteria, and archaea to microbial eukaryotes. We will integrate these historical biodiversity data with the information about environmental change provided by classical palaeoceanographic proxies.

Understanding the response of marine organisms to climate change will allow a better understanding of current and past changes in the marine environment. We will evaluate the impact of climate change on marine biodiversity from the mid-Holocene to modern warming. The results of our study will also allow us to determine the direction of future climate-related environmental changes.