DESCRIPTION FOR THE GENERAL PUBLIC

The effects of ongoing climate warming are especially perceptible in the Arctic, mainly due to the rapid decline in sea ice extent over the past few decades, resulting from heat advected with Atlantic Water (a process sometimes known as “Atlantification”). The accelerated loss of sea ice in the Arctic shelf seas has a profound impact on the water column structure and therefore, on the global energy budget, the atmospheric and oceanic circulation, and the carbon cycle. In case of complete disappearance of the sea ice from the western Arctic shelf and high sea surface temperatures, the enhanced vertical stratification will reduce nutrient flux into the upper oceans, leading to reduced phytoplankton biomass and production.

To predict the further development, directions and consequences of the ongoing climatic/oceanographic changes it is essential to investigate the natural Arctic environment variability and its response to external forcing in the geological timescales. In our opinion, the “Atlantification” of the Arctic Seas is not a new process. During the warmest periods of Holocene, there has been observed accelerated inflow of Atlantic Water to the higher latitudes causing the increase in sea surface temperatures and sea ice decrease in this area. Our previous investigations revealed that during the Holocene Thermal Maximum the productivity decreased in the southwestern part of the Barents Sea. However, the vast majority of the previous paleoceanographic investigations were focused on the Atlantic Water inflow reconstruction and its influence of sea ice melting, whereas the information of sea productivity changes over the Holocene remains decidedly regional and fractured. Especially there is scarce information about Holocene productivity in the northern remote locations.

Therefore, we aim to investigate further the impact of sea surface temperatures on marine productivity along the shelf of the western and northern Svalbard since the last deglaciation in order to recognize the spatial and temporal productivity variations. Today the areas are located in the marginal ice zone and can aid understanding how the decreasing trend in Arctic sea ice cover will affect the convective water mixing. The research hypothesis of this project assumes that during warmest periods of Holocene the waters off western Svalbard were characterized by lack of sea ice, poor thermal water stratification, and low productivity, whereas the shelf waters off northern Svalbard were characterized by the seasonal sea ice presence, lower sea surface temperatures and higher productivity due to sea ice formation inducing the convective replenishing of nutrients from the bottom to the surface. To our best knowledge, the proposed project will be the first regional-scale paleoceanographic reconstruction focused on changes in Svalbard shelf productivity comprising the multidimensional and multiproxy approach. The basic deficiency of modern knowledge is that despite there are many paleoceanographic studies, there is no integrated, regional-scale view on the past impact of sea surface temperatures on primary productivity on the Arctic shelves. We argue that the multiproxy view is required if we are to understand primary productivity under forcing along climate gradients.

The results of this study will provide new information on lateral and vertical oceanographic gradients, namely on ocean vertical water mixing, thermal stratification, and marginal ice zone movement in the shelf areas west and north of Svalbard since the last deglaciation and its impact on primary productivity. We will highlight the effects of climate changes on ecosystems, focusing on the Holocene periods warmer than today, which will allow us to assess what kind of ecosystem change may be expected in the case of future climate warming. Pronounced changes in marine productivity may have broad consequences for the ecosystems of the Northern Hemisphere; for example, the oceanic uptake of carbon may be reduced. As the Barents Sea ecosystem supports some of the world’s largest stocks of fish, this issue also has global economic and societal importance. The expected results will improve our understanding of the global ocean circulation system, improving the general circulation models, thereby enabling the more accurate prediction of future results of climate changes. The strength of this project lies in its comprehensive approach to the problem of productivity changes during Holocene, with the special focus on its warmest periods (i.e. early to mid-Holocene aka Holocene Thermal Maximum).