DESCRIPTION FOR THE GENERAL PUBLIC

The Arctic is generally recognized as an area where climate changes have a disproportionally high impact. During the last decades scientists have repeatedly tried to predict the direction of the future of climate change. However, for an exhaustive understanding of the spatial and temporal patterns of past and recent climatic variability and the key mechanisms that trigged them, it is vital to build a network of high quality and high resolution palaeoproxy sources from diverse research methods.

The water exchange between Atlantic and Arctic Ocean is a key factor responsible for the largest climatic fluctuations since the last glaciation (i.e. in the last ~ 20 000 years) and affects the functional properties of the Arctic Ocean ecosystem. The majority of Atlantic water is carried northwards along the west Spitsbergen coast by the West Spitsbergen Current. However, the latest research suggests that nowadays, as well as during the warm periods of the Holocene, the Atlantic water occurred also in the east Spitsbergen coast. Oceanographic data indicates significant warming due to an increase of Atlantic water inflow into the Arctic Ocean. The aim of the proposed project is to reconstruct the intensity and dimension of flow of Atlantic water masses into the Greenland and Barents Seas during the Holocene (i.e. in the last ~ 11 000 years). Special attention will be paid to the easternmost extension of the Atlantic water in the European Arctic. We expect that during the warm periods of the Holocene, the intensification of the water exchange between Atlantic and Arctic Oceans caused the appearance of Atlantic water also in the eastern Svalbard and in the north-western Barents Sea, i.e. in the area typically dominated by Arctic water masses. The investigation will be completed with the use of classical paleoceanographic proxies, such as sediment grain size (including sediment fractions revealing changes in bottom current velocities and iceberg activity), foraminiferal assemblages, and stable isotope composition of foraminiferal tests. Moreover, investigation will be strengthened by the analysis of ancient foraminiferal DNA (aDNA).

Foraminifera are unicellular eukaryotes, widely used in palaeoceanography due to their sensitivity to environmental parameters and the preservation of their hard shells across geological times. Their presence may be an indicator of water temperature and salinity, current activity, food supply, or oxygen availability in the past. However, in some marine ecosystems, such as deep sea and polar regions, foraminiferal assemblage are dominated by soft-walled monothalmous taxa, that are never preserved during fossilization process. Therefore, they were never included in the paleoceanographic studies. It was overcome recently with the development of the aDNA-based studies. Our previous investigation in the Hornsund fjord (Spitsbergen) resulted in the groundbreaking research in the field of paleogentics. Our results proved that aDNA-based survey is an effective tool in investigating past and modern Arctic foraminiferal communities. The data inferred from molecular analyses correlated well with environmental changes and revealed even small changes that were not clearly indicated by the fossil record. By including monothalamids identified in the aDNA record, we considerably increased the number of potential proxy species. The obtained results allowed us to distinguish monothalamous species that might be the indicators of glacier-proximal, glacier-distal and highly productive environments. However, our previous and ongoing paleogenetic research is restricted to the fjords environment (i.e. local scale). The proposed project will allow us to develop a new method in reconstructing past climate and environmental changes in the regional scale (i.e. in the European Arctic) and the obtained results would be related to the large-scale processes in the Northern Hemisphere.

By integrating the classical paleoceanographic methods with innovative molecular approach, the projects results will have a strong impact on the development of paleoceanographic studies in the Arctic region. We expect that molecular record of changes in foraminiferal assemblages (in particular monothalamous taxa) will shed a new light on the interaction between the cold and warm water masses in the Svalbard region and on the key processes that influence the environmental changes during the periods of abrupt climate changes. Bringing together the data on contemporary and fossil species will allow us to create a simple method of monitoring the past and present sea environment. The obtained results will be used in further paleoclimatic studies as well as for predicting the direction of future climate changes in the Arctic and will support future environmental assessments and policy responses to the changes caused by the global warming, necessary to facilitate global sustainable development.