ABSTRACT (in English)

Marine sediments accumulate over the decades to millions of years creating a continuous archive of changes in the local environments, e.g., biological productivity, temperature, water mass changes, and ice cover. Thus, by preserving past environmental signals, marine sediment provides an excellent insight into Earth's climatic and oceanographic evolution. It may accurately reconstruct past environmental conditions by analyzing sediment layers' preserved biological, chemical, and physical properties. This entails understanding the fluctuations in ocean currents, the thickness and distribution of sea ice, and the freshwater inflow caused by deglacial processes. These records are crucial for understanding how Earth's climate system has responded to natural forcings and how it might respond to future changes.

Marine sediment cores taken from particular regions of the European Arctic were analyzed for this study. This thesis comprises a series of investigations that use marine sediment analysis to investigate the complex paleoceanographic development of the European Arctic in the late-glacial and Holocene periods. Each paper investigates specific regions: northwestern Greenland Sea (paper I), southwest Svalbard shelf (paper II), and western Barents Sea (paper III), using comprehensive multi-proxy approaches to unravel the dynamics of Atlantic Water influx, meltwater events, and climatic shifts that have shaped these environments over millennia.

The main purpose of this doctoral thesis is to improve our knowledge of the paleoceanographic variability in the European Arctic throughout the late-glacial and Holocene. More specifically, this study aimed to understand the spatial and temporal changes in bottom environmental conditions, sea surface conditions, and marine productivity variations in response to water mass changes, particularly the influx of Atlantic Water. Atlantic Water advection is the main transporter of heat and salt towards the north and is important for deep water convection. Therefore, sediment cores from climatically sensitive areas under the influence of different water masses (Papers I and II) or the direct influence of Atlantic Water masses (Paper III) have been studied.

Paper I is based on a sediment core from the northeastern Greenland continental slope. Only a few multi-proxy studies of the Atlantic Water flux over extended periods exist, while recent studies have concentrated on the paleoceanography of the East Greenland Current (EGC) across the northeastern Greenland shelf, covering the last ~13 kyr. Consequently, the Late Glacial and deglacial history of this Atlantic Water flow to the northeastern Greenland margins remains

largely unknown. Therefore, this study attempted to investigate variations in the properties and flow of the Atlantic Water, especially from the Return Atlantic Current (RAC) and associated changes over the northeastern Greenland margin during the last ~35 kyr BP by a multi-proxy study of planktic and benthic foraminiferal, ice-rafted debris, stable isotopes, and other geochemical and sedimentological proxies. Thus, this study provides insights into the routing dynamics of Atlantic Water via the RAC over the past 35 kyr. Distinct meltwater signals around 34.5 and 33 kyr BP reveal Atlantic Water-induced melting of the Northeast Greenland Ice Sheet. The Last Glacial Maximum was characterized by extensive sea ice cover associated with the presence of subsurface Atlantic Water in the northwestern Greenland Sea. The combined effect of Bølling–Allerød warming and the influx of warm Atlantic Water intensified glacier and sea ice melting, subsequently increasing the supply of meltwater to the northwestern Greenland Sea. The multi-proxy records in this study suggest that a permanent strong inflow of warm Atlantic Water via RAC to the northwestern Greenland Sea began only after the Bølling–Allerød. The Holocene Thermal Maximum like condition observed in the northwestern Greenland Sea around 7.5 and 5.5 kyr BP, shows enhanced Atlantic Water recirculation in the Fram Strait and the maximum strength of the RAC, impacting the paleoenvironment of the northwestern Greenland Sea.

Paper II explores Holocene paleoceanographic changes from a well-dated sediment core collected from the southwest Svalbard shelf. Previous research conducted in the western Svalbard region concentrated on water mass shifts and their impact on the environment during the Holocene. These studies, however, did not provide a complete understanding of the mechanisms controlling sea ice cover and its dynamics. The present study examines the physical characteristics of sediment, the distribution of faunal species, the geochemical composition of benthic foraminifera, and biomarkers to explain the development of the Holocene paleoenvironment on the southwest Svalbard shelf. The research site is a natural sediment trap and covers the entire Holocene within 2.3 m of sediments, enabling sampling resolution at decadal to centennial timescales. Here, we pay particular attention to two things: (1) the effect of the interplay between warm Atlantic Water, and cold Arctic water from the inner Hornsund on the dynamics of ice coverage and (2) how these changes impacted the local and regional oceanography and climate during the Holocene. Sea ice biomarkers and foraminiferal assemblages indicate extensive ice cover and cold Arctic Water derived from East Spitsbergen Current during the Preboreal Oscillation (11-10.2 kyr BP). The conditions observed between 10 and 6.5 kyr BP, resembling the Holocene Thermal Maximum, exhibit an increased influx of Atlantic Water via the West Spitsbergen Current (WSC), which promoted sediment erosion. Cold and unstable conditions from 6.5-3.5 kyr BP coincide with iceberg rafting and limited Atlantic Water influence, while the late Holocene reflects fluctuating ice margins and reduced Atlantic Water influx.

Paper III focused on the northwestern Barents Sea, we present a sedimentary record spanning the past 14,700 years from the lower, western, portion of the Kveithola Trough. We have implemented an array of proxies ranging from biomarkers to micropaleontological assemblages to best reconstruct the paleoenvironment and discern the presence and impact of meltwater pulses at Northwestern Barents Sea. Four significant meltwater pulses, influenced by deglacial processes and potential paleo-lake or tsunami currents, coincide with abrupt climate changes. These events are characterized by drops in sea surface temperatures, increased sea ice formation, and terrigenous supply. The Storegga tsunami (~8.2 kyr BP) redistributed sediments, highlighting the region's vulnerability to extreme paleo-oceanographic events. Strong Atlantic Water inflow after 3.5 kyr BP led to notable shelf coarsening, shaping subsequent environmental conditions.

By integrating findings from these studies across different European Arctic regions, this thesis enhances our understanding of the varied responses of marine environments to Atlantic Water dynamics, meltwater events, and climatic fluctuations during critical periods of the late-glacial and Holocene periods. These insights underscore the complex interplay between oceanographic processes and environmental changes in the European Arctic over millennia, providing crucial context for understanding current and future climate dynamics in this sensitive region.