Carbon dioxide (CO_2), generated by anthropogenic activities and released into the atmosphere, has been accumulating in the oceans for two centuries. One major consequence of this CO_2 buildup in the oceans is the acidification of seawater. Notably, this phenomenon is occurring at a rate three to four times faster in the Arctic Ocean than in other ocean basins. The accelerated acidification is attributed to the Arctic's lower water temperature, loss of sea ice, and freshwater input from melting sea ice. Surface water freshening, particularly in the inner parts of fjords, results in a substantial reduction in carbonate ions (CO_3^{2-}) concentration. This reduction is expressed as the carbonate saturation state (Ω) and triggers significant changes in ocean biogeochemistry. Over the past decade, the Svalbard fjords, have undergone substantial transformations, including atlantification due to enhanced advection of Atlantic waters from the West Spitsbergen Current, warming and accelerated glacier retreat with associated changes in marine biogeochemistry, such as carbonate variability throughout the meltwater season. These biogeochemical changes can lead to local conditions of carbonate undersaturation, indicating a depletion of carbonate ions (CO_3^{2-}), especially in the upper water column close to glacial retreat. This undersaturation results in the loss of the principal building block for many organisms producing carbonate structures, as e.g. bryozoans, spirorbis or barnacles. Consequently, it reduces the growth of calcareous skeletons and modifies their properties, affecting calcification rates, skeletal thinning, and dissolution of structures. Beyond carbonate ions, various compounds and elements originating from the ocean are incorporated into the skeleton during the biomineralization process. These elements persist in the skeletal hard parts even after the death of the organism, making carbonate skeletons essential repositories of environmental information for interpreting climate changes. Given the faster-than-predicted rate of changes in the ocean, calcifying organisms are likely to experience these changes more rapidly than they can adapt. **The project aims to determine the impact of elevated CO_2, changes in the calcium carbonate saturation state of seawater, as well as pH, temperature, and salinity on the mineral, geochemical composition, and biostructure of carbonate skeletons of marine calcifying biota in the rapidly changing biogeochemical regime of Svalbard fjords over an extended time period (17 years).** Four major groups of organisms producers carbonate structures namely bryozoa, spirorbis, serpulids and barnacles have been selected for study based on their known sensitivity to climate changes, abundance and continuous occurrence in the study area throughout the whole sampling period. Research material was collected between 2009-2023, from the shallow sublittoral and will be supplemented by newly sampled organisms from the overlapping locations and depths in Isfjorden (Spitsbergen) during fieldwork in 2025 and 2026. The response of marine organisms to environmental changes will be examined in correlation with seawater parameters, its biogeochemical composition and concentrations of key seawater elements. Skeletal mineralogical and geochemical measurements will be conducted using advanced analytical methods such as X-Ray diffraction (XRD) and inductively coupled plasma mass spectrometry (ICP-MS, ICP-OES). Two imaging techniques as micro-computed tomography XMCT and scanning electron microscopy SEM will be employed to describe changes in both internal and external skeletal structures. Tracking mineralogical and structural variability, skeleton thickness, and various other parameters from the macro to the nanoscale will enable observation of whether organisms respond to changes in local conditions, and if so, whether this response is gradual or rapid. The combination of historical data with recent field surveys will allow determination of the variable and time-dependent impacts of environmental conditions on marine biomineralizing organisms, contributing significant new knowledge to the scientific community.