Holocene environmental changes in Woodfjorden of northern Spitsbergen, Svalbard archipelago

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Following deglaciation of the Svalbard-Barents Sea Ice Sheet in the latest Pleistocene, Holocene climate fluctuations prompted abrupt environmental changes in the Svalbard archipelago, which is located along the connection between the Arctic and the Atlantic oceans. Advection of warm Atlantic water into the Arctic Ocean and its relationship with the regional climate, glacial history, and thermohaline circulation during the Holocene are the key for the mechanistic understanding of environmental changes documented in the Arctic and subarctic realms. Located at the gateway to the Arctic, the Svalbard fjords can provide an excellent setting to investigate influences of the Holocene climatic and oceanographic changes. The fjord is situated along the pathway of the West Spitsbergen Current carrying warm Atlantic water northwards, and thus can be an ideal locality to parse climatic and oceanographic history. The results of textural and geochemical analyses of the Woodfjorden core sediments exhibit compositional changes accounted for the Holocene warming and cooling climates as well as varying inflow of warm Atlantic water. Considering relatively uniform bedrock lithology (upper Paleozoic siliciclastics) underlying the area, occurrences of the calcium carbonate-rich, ice-rafted debris, which is likely transported from the Precambrian marble distributed in the head of the fjord indicate enhanced calving of tidewater glacier entraining coarse grains during periods of warming (latest Pleistocene – earliest Holocene) and formation of anchored sea-ice during cool periods (middle Holocene). Carbon isotope composition of organic matter ($\delta^{13}C_{org}$) and total organic carbon (TOC) content illustrate a striking trend showing abrupt shifts in both $\delta^{13}C_{org}$ and TOC from 6 ka to 4 ka BP, marking the transition to the late Holocene. It seemingly coincides with the records of the bottom water masses in the northern Svalbard shelf, where the advection of the warm Atlantic water diminished over a period from ~6.7 ka to 4.5 ka BP. Our data suggest enhanced marine primary production after the mid-Holocene transition which might contradict to the cooler shelf condition and diminished inflow of warm waters. We hypothesize that the cooling and expansion of fast ice likely facilitated water mass exchange between fresh fjord surface water and nutrient-rich shelf water, fueling primary production.