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An integrative approach to the Holocene climatic variations recorded in the Svalbard fjords using sediment as an archive of environmental changes

Young Ji Joo (1), Kwangchul Jang (1), Seung-Il Nam (1), Matthias Forwick (2), and Trude Hansen (2)

(1) Divison of Polar Paleoenvironment, Korea Polar Research Institute, 21990 Incheon, Korea, Republic Of (sinam@kopri.re.kr), (2) UiT The Arctic University of Norway in Tromso, 9037 Norway

Regarding the Holocene climate variations following the deglaciation of the Svalbard-Barents ice sheet initiated in the latest Pleistocene and its amplified effects in the Svalbard fjords (i.e. ∼3 ℃ warmer Holocene Climate Optimum), environmental consequences of the Holocene climate changes in the Svalbard fjords can provide invaluable information to probe not only the past oceanographic and glacial history but also the impacts of future global warming. Moreover, the steep environmental gradient between the (tidewater) glacial system and the warm Atlantic water intruded by the West Spitsbergen Current (WSC) provides an excellent setting to assess differential responses to the climate changes.

Here, we present the results of our recent efforts to investigate the Holocene environmental consequences recorded in the Svalbard fjords sediments. Sediments from Woodfjorden and Dicksonfjorden in Spitsbergen, two fjord systems with contrasting environments, were selected for the high-resolution environmental reconstruction based on sediment geochemistry. Being at the vicinity of the WSC pathway, the Holocene Woodfjorden sediment exhibits compositional changes due to the varying inflow of the warm Atlantic water mass. The carbon isotope composition of organic matter ($\delta^{13}C_{org}$) and total organic carbon (TOC) content illustrate the most prominent trends with abrupt increase in $\delta^{13}C_{org}$ and TOC from 6 to 4 ka BP, marking the transition from the early to late Holocene. It crudely coincides with the records of the bottom water masses in the northern Svalbard shelf, where the influence of the warm Atlantic water diminished over a period from ∼6.7 to 4.5 ka BP. The record from Woodfjorden contrasts to that of Dicksonfjoden, where the main control of the sediment composition is sediment provenance change due to retreating glacier in response to the global temperature changes (or solar irradiation), exemplifying the complexity of the Svalbard fjords system. Our study is complemented by adopting the neodymium isotope ($^{143}Nd/^{144}Nd$) system, in order to gain new insights to sediment provenance in the glacial-marine system and possibly changing nature of the water masses due to the differing influence of the WSC in Woodfjorden and Dicksonfjoren. This study provides new information about how the regional and global climate forcings associated with the Holocene climate changes are imprinted in the Arctic fjords system, which in turn can place a great impact on the global climate system during this critical period of global warming.