Post-glacial fluctuations in ocean currents and their impact on the environment of the Eastern Nordic Seas

Dhanushka Devendra[a]*, Magdalena Łącka[a], Małgorzata Szymczak-Żyła[a], Magdalena Krajewska[a], Natalia Szymańska[a], Marek Zajączkowski[a]

[a]Department of Paleoceanography, Institute of Oceanology, Polish Academy of Sciences, Sopot 81-712, Poland, e-mail; devendra@iopan.pl

Although the overall patterns of Atlantic Water (AW) inflow into the European Arctic during the post-glacial are well known, our understanding of regional climate changes and the behaviour of AW current and subsequent environmental responses are less well established. In particular, there is only limited knowledge on the development of ocean currents since the last deglaciation. Here, we present a multiproxy record from two high-resolution sediment cores retrieved from the eastern Nordic Seas: new data from core OCE2022-KV02-GC from Kveithola Trough and from previously published core OCE2019-HR7-GC from southwestern Svalbard shelf (Devendra et al., 2023). These locations are situated in a highly dynamic frontal area influenced by different ocean currents and local water masses. The cores are positioned beneath the Norwegian Current and the West Spitsbergen Current, which transport heat and salt into the Arctic Ocean. We reconstruct the paleoceanographic forcing of the prevailing water currents on climatic conditions and associated environmental changes during the post-glacial period by means of foraminiferal assemblages, sea ice biomarkers, stable isotopes, and various sedimentological parameters. Further, we reconstruct the surface and bottom water temperatures using alkenones and Mg/Ca. Our reconstruction documents an significant influx of sediment-laden meltwater to the western Barents Sea margin during the Bølling–Allerød interval (~14.6–12.7 kyr BP) originating from the melting Svalbard-Barents Sea ice sheet. This was followed by a sudden decrease in meltwater discharge and relatively high sea ice concentration during the Younger Dryas (~12.8–11.7 kyr BP), as evidenced by benthic $\delta^{18}O$, sea ice biomarkers and foraminiferal faunal composition. The earliest part of the Holocene was characterized by large temperature variability, including the Preboreal Oscillation (PBO). We observe extensive sea ice cover at the southwest Svalbard shelf during the PBO, although this signal was not recorded in the OCE2022-KV02-GC core. In general, similar warm environmental conditions were observed during the early Holocene, with the period between ~9.5–7 kyr BP characterized as the warmest part of the Holocene in both records. This interval is also associated with high surface water productivity and an enhanced AW influx that drove strong erosive activity at the bottom. After 6.5 kyr BP, the eastern Nordic Seas were characterized by a dynamic environment with cold and unstable conditions that persisted until 3.5 kyr BP. Again, the strengthening of AW current was observed since ~3.5 kyr BP, especially in OCE2022-KV02-GC core, similary in OCE2019-HR7-GC core, but since ~2 kyr BP.

The research work at the Institute of Oceanology was financially supported by the Norwegian Financial Mechanism for 2014-2021, project no 2019/34/H/ST10/00682. MŁ, NS and MZ contribution were supported by National Science Center project no. 2022/45/B/ST10/02033.

References:

Devendra, D., Łącka, M., Szymańska, N., Szymczak-Żyła, M., Krajewska, M., Weiner, A. K., ... & Zajączkowski, M. (2023). The development of ocean currents and the response of the cryosphere on the Southwest Svalbard shelf over the Holocene. Global and Planetary Change, 228, 104213.