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Influx of Atlantic Waters into the Arctic Ocean assessed using I-129, U-236 and neodymium isotopes

Recent studies indicate that the Arctic is warming up to four times faster than the global ocean. This accelerated warming is partly due to an increased influx of warm Atlantic waters into the Arctic basin. The Santa Anna Trough (SAT) is a strategically important location within the Arctic Ocean, where the two main Atlantic water branches—the Barents Sea Atlantic Waters (BSAW) and the Fram Strait Atlantic Waters (FSAW)—converge and mix. Additionally, freshwater from Siberian rivers, and ice melt contributes to the surface layers of this region. The interactions between these three components are crucial for the downstream flow of the Transpolar Drift system. Despite the SAT's significant role, studies in this region remain scarce.

In this study, we aim to address the following research questions: (i) What are the sources, pathways, tracer ages, and mixing of surface waters? and (ii) What are the mixing dynamics and trajectories of the two Atlantic branches? To address these questions, seawater samples collected during the Arctic Century Expedition in 2021, onboard the icebreaker Akademik Tryoshnikov, were processed and measured for I-129 (AMS), U-236 (AMS), and neodymium isotopic composition (MC-ICP-MS).

Based on our results, we identify minimal mixing between BSAW and FSAW in the SAT. Additionally, we trace the entrance of FSAW almost all the way to Novaya Zemlya island. This is confirmed by the distinct trajectories of both water masses, with BSAW following a northward path along the seafloor, while FSAW follows a cyclonic trajectory above BSAW. Surface waters also follow a northward trajectory, likely influenced by seasonal wind patterns in the area. Finally, the Nd isotopic composition confirms its potential as a tool to provide additional information on freshwater inputs to the surface layers of the Arctic Ocean.

Although this region is likely affected by inter-annual variability, our findings enhance the understanding of the mixing dynamics and circulation patterns in the SAT. These insights improve transit time distribution calculations and underscore the importance of further research in this region.

Student Submission

No

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