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Reconstructing Late Glacial Atlantic Water Advection in the Western Fram Strait: Insights from Marine Sediment Cores

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The western Fram Strait, a critical gateway connecting the Arctic and Atlantic Oceans, is presently characterized by the dominance of cold, sea-ice-laden waters from the Arctic Ocean. Nevertheless, the dynamics of the Return Atlantic Current, facilitating direct east-west recirculation across the Fram Strait, contributes significantly to the southward flow along the East Greenland shelfbreak. This study delves into the influence of Atlantic Water (AW) in the western Fram Strait over the past ~35 thousand years, employing a comprehensive analysis of marine sediment cores, including two newly acquired records.

Our investigation utilizes planktic foraminiferal assemblages, stable isotopes, and X-ray fluorescence (XRF) data to unravel the historical patterns of AW advection. During late Marine Isotope Stage 3 and the Last Glacial Maximum, the findings reveal a noteworthy influx of AW, likely occurring beneath a substantial layer of surface Polar Water. The spatial extent of AW varied, reflecting the dynamic interplay with the Greenland Ice Sheet's expansion.

Throughout the deglaciation phase, the western Fram Strait experienced disruptions in AW inflow due to the influence of meltwater, further shaping the regional dynamics. The interplay between AW and environmental factors, such as the evolving Greenland Ice Sheet, emerges as a key driver influencing the spatial distribution of AW during this critical climatic transition.

Challenges arise in reconstructing the Holocene history of the western Fram Strait, marked by carbonate dissolution and low sedimentation rates. However, our data point towards persistent and robust AW advection to the region, extending at least since the onset of the present interglacial period. Despite limitations in the Holocene reconstruction, the cumulative evidence underscores the enduring influence of AW on the western Fram Strait, revealing a complex interplay of climatic and glacial dynamics.

This research sheds light on the intricate relationship between AW dynamics and regional environmental changes, offering valuable insights into the past variability of the western Fram Strait. The findings contribute to a deeper understanding of the factors driving oceanic circulation patterns in this pivotal gateway, with implications for comprehending broader climate dynamics and projecting future changes in the Arctic-Atlantic interface.