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North Atlantic deep water sources and export since MIS3: implications from Nd isotopes

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Deep water formation in the North Atlantic represents an integral link between the atmosphere, cryosphere, and the deep ocean: heat loss from warm surface waters supplies moisture to the high latitudes and their subsequent sinking ventilates the deep ocean and sequesters greenhouse gases from the atmosphere. This moisture supply supported the formation of immense ice sheets in the region during the last glacial, which in turn affected climate. While many studies have improved our understanding of these processes for past glacials, a comprehensive picture including the significance and variation of deep water export from the Nordic Seas is still missing. Furthermore, recent observations suggested the export of a previously unknown bottom water mass from the glacial subpolar North Atlantic.

In this study we investigate the distribution and sourcing of water masses in the subpolar North Atlantic since MIS3 with the help of authigenic Nd isotopes. This method benefits from the large heterogeneity in Nd isotopic compositions of source rocks in this region, but the post-depositional dissolution of detritus within the sediments can also impede interpretations of individual records. We thus compare several Nd isotope records from the subpolar North Atlantic and Nordic Seas in order to define distinct deep water mass end members and estimate their prevalence and mixing in the subpolar North Atlantic during the last 30 ka. Our observations suggest that Nordic Seas deep water overflowing the Greenland-Scotland Ridge during MIS2 reached into the deep subpolar North Atlantic. Furthermore, its spatial distribution implies that overflow across Denmark Strait into the Irminger Basin was more pronounced than overflow into the Iceland Basin further south. The hydrographic configuration during the Last Glacial Maximum thus appears to have been more complex and more similar to today than previously thought.