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Investigating Pleistocene ice sheet and ocean dynamics in the Subpolar North Atlantic using cosmogenic nuclides in IRD and foraminifera-bound nitrogen isotopes

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To better understand ice sheet and ocean dynamics in the subpolar North Atlantic, we are applying two relatively novel proxies - cosmogenic nuclides (^{10}Be and ^{26}Al) in ice-rafted debris and foraminifera-bound nitrogen isotopes (FB-δ^{15}N) - to North Atlantic sediment cores across the Pleistocene as well as Heinrich events during the last glacial period. Cosmogenic nuclides accumulate in land surfaces exposed to cosmic rays, but decrease in concentration when surfaces are ice covered due to radioactive decay and erosion. The faster decay of ^{26}Al compared to ^{10}Be also causes their ratio to decrease during burial, yielding information about the duration of ice cover in sediment source regions. When measured in ice-rafted debris, these isotopes reflect an integrated history of exposure and erosion along flow lines discharging icebergs to the ocean. Additionally, FB-δ^{15}N reflects the degree of surface nitrate assimilation in the subpolar North Atlantic region, which has been shown to increase in response to iceberg-associated meltwater input and ocean stratification. Together, these two proxies may better constrain the evolution and coupling of ice sheet and ocean dynamics in the Pleistocene.

We have generated preliminary records of cosmogenic nuclides spanning the last glacial period and FB-δ^{15}N spanning the last glacial period and Mid-Pleistocene. We find depressed ^{26}Al/^{10}Be ratios and low, declining ^{10}Be concentrations on the western side of the North Atlantic basin, which suggests a persistent Laurentide ice sheet that rarely or briefly disappeared during interglacials since the MPT. Preliminary FB-δ^{15}N results appear to show an increase from the MPT towards the present, which suggests the efficiency of the biological pump in the North Atlantic has likely increased. Our pending hypothesis - that persistent ice may be related to the inferred increase in biological pump efficiency - will be clarified by continued development of these records.