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Atlantic Meridional Overturning Circulation since 800 AD and its link to surface climate variability

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An increasing number of paleoclimate archives provide evidence that there is significant natural climate variability on multi-decadal to millennial timescales. Understanding the source and expression of these low frequency modes of natural climate variability is crucial for determining their role in current and future climate changes. The most recently recorded climate oscillations such as the Little Ice Age (LIA) are particularly well described and thus offer a natural starting point for understanding how they come about. Low frequency climate oscillations are often postulated to result from changes in the ocean's meridional overturning circulation (MOC). Testing this hypothesis for historically recorded climate changes such as the LIA requires decadally resolved constraints on the state of ocean circulation spanning these events.

Here we use a well dated (^{210}Pb and ^{14}C) 46cm long sediment core (Multicore GS06-144 03MC, 48˚26'N, 48˚38'W, 3440m) from the Eirik drift to infer the timing, amplitude, and nature of deep-water changes since 800 AD. The Eirik drift accumulates rapidly due to the influx of sediment eroded from the Denmark Strait and eastern Greenland margin suspended in Denmark Strait Overflow Water (DSOW). DSOW combines with North West Atlantic Deep Water (NWADW) before flowing over our site on its western boundary flow path southward. Thus, this location is well situated to monitor changes in the past circulation and properties of newly formed Lower North Atlantic Deep Water (LNADW) along its western boundary flow path.

Our benthonic foraminiferal oxygen and carbon isotopic records (*C. wuellerstorfi*) are used to reconstruct the physical and chemical properties of the lower branch of the MOC (the deep overflowing branches from the Nordic Seas), whereas the changes in surface hydrography co-registered in our planktonic foraminiferal isotopic records (*N. pachyderma* s. and *G. bulloides*) are used to assess possible linkages between MOC and climate. Our initial foraminiferal isotopic results show increasing δ^{18}O values in both surface and deep water records that closely align with the timing of the LIA. The multi-centennial cold event started at approximately 1400 AD and was terminated by a distinct warming starting at 1850 AD and continuing until the present. Higher frequency oscillations are superimposed on the centennial scale cooling and the subsequent warming trend observed over the past century and have a frequency similar to that of the Atlantic Multidecadal Oscillation. Our results suggest a close coupling between surface climate and the properties of Lower North Atlantic Deep Water on multidecadal to centennial timescales over the last millennium. The implications of these changes in LNADW for deep water circulation and its coupling to surface climate are discussed.