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Rapid Reductions of North Atlantic Deep Water During the Peak of the Last Interglacial Period

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One key uncertainty in future climate projections involves changes in the ocean meridional overturning circulation (MOC) and its response to possible increases in freshwater fluxes in a warmer future. During the peak of the last interglacial period (MIS 5e) climate of the North Atlantic region had a number of elements in common with the projected future. Thus, a detailed characterization of North Atlantic Deep Water (NADW) properties and circulation over this period is instrumental for constraining the potential sensitivity of NADW to possible future warming and freshening of the North Atlantic.

As a part to the FP7 'Past4Future' project, we present new high-resolution records of bottom water properties spanning MIS 5e from two North Atlantic core sites: MD03-2664 from the Eirik Drift just south of Greenland, and ODP Site 658 located 165 km west off northwestern Africa. Core site MD03-2664 lies at 3442m below the main axis of the sediment laden Western Boundary Undercurrent on the Eirik Drift, and is optimally situated for monitoring changes in newly formed lower NADW—the deep southward flowing branch of the MOC. Site 658 is located at a shallower depth (2263m) in the subtropical Atlantic, and provides a vertical and geographical constraint necessary for assessing the scale and source of property variability. We use the carbon and oxygen isotopic composition of benthic foraminifera (*C. wuellerstorfi*) to reconstruct bottom water chemical and physical properties at both sites. In addition, the evolution of near surface water physical properties at MD03-2664 is reconstructed using planktic (*N. pachyderma* s.) oxygen isotopic records. The extreme interglacial sedimentation rates at MD03-2664 provide sub-centennially resolved proxy records ($\sim$30 year sample spacing) over MIS 5e, while our Site 658 records have centennial resolution.

Our results show relatively high benthic δ^{13}C values at both MD03-2664 and Site 658 during the first millennia of MIS 5e. Following this initial high-δ^{13}C interval, several distinct large-amplitude ($\geq$0.5‰) reductions in benthic δ^{13}C are recorded at both sites. The MD03-2664 benthic record reveals δ^{13}C shifts with amplitudes of up to $\sim$1‰ over this period, with absolute values reaching -0.5‰ over three prolonged intervals. These early to mid-MIS 5e δ^{13}C reductions are affected rapidly and last a number of centuries before recovering to background values. Subsequently, δ^{13}C values increase at both core sites and stabilize near modern NADW levels (0.5-1.0‰) for the remainder of MIS 5e. Our results suggest that the influence of NADW was intermittently curtailed when the surface waters off southern Greenland were at their freshest and/or warmest during MIS 5e. Using an array of bottom water records spanning the abyssal Atlantic we show that the magnitude and spatial geometry of the deep water anomalies is consistent with an expansion of southern source deep water as the influence of NADW waned—analogous to deep ocean changes during the 8.2 ka BP event and to millennial scale events of the last glaciation.