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Multi-proxy constraints on North Atlantic Deep Water properties in the Northwest Atlantic across the Industrial Era transition

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Ocean circulation is a key component of Earth's climate system, transporting vast amounts of heat, carbon, and nutrients around the globe. In particular, the subpolar Northwest Atlantic is of critical importance, encompassing both regions of North Atlantic Deep Water (NADW) formation and its principal export pathway via the Deep Western Boundary Current (DWBC). Yet our understanding of links between circulation and climate remains largely limited to the instrumental period, which spans barely 150 years. To move beyond this narrow observational window, we must turn to the geological archive, where paleoceanographic reconstructions from marine sediments place modern observations within a much longer temporal context. Geochemical tracers preserved in marine sediments are of particular importance, as they provide a means to reconstruct past deep-ocean temperature, which acts both as a key driver of large-scale ocean circulation and as a conservative water-mass tracer, providing insight into ocean structure and water-mass distribution. Here, we present new multi-proxy geochemical data from a suite of sediment cores retrieved along the US and Canadian East Coast that constrain changes in deep water properties over the last ~1000 years, including across the industrial-era transition, helping to address the scarcity of high-resolution deep-ocean paleo records from this climatically important region. Using a combination of multi-species benthic foraminiferal stable oxygen isotopes, Mg/Ca-derived temperatures, and neodymium isotopes, we investigate variability in NADW within the DWBC. These data provide new insight into changes in deep-ocean temperature and help to constrain the vertical structure of NADW. Our multi-proxy approach also demonstrates the utility of integrated geochemical methods for assessing recent changes in ocean circulation.