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Coupled surface and deep water changes in the subpolar North Atlantic during the Last Interglacial

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We report stable isotope records of multiple species of foraminifera for the last interglacial period (LIG) from the Gardar Drift in the North Atlantic. IODP Site U1304 (53^o 3.4'N, 33^o 31.8'W, 3082 m water depth) possesses an expanded section of the "MIS 5e plateau" (128 to 116 ka) and MIS 5d (116 to 107 ka). This unique section includes the preservation of laminated diatom mats (LDM) and oozes (LDO), which were deposited with an average sedimentation rate of 40 cm kyr^{-1} at the Subarctic Convergence front. The high tensile strength of the LDM/LDO sediment suppresses benthic activity and hinders bioturbation, thereby providing a rare opportunity to produce records of past oceanic change at ultra-high resolution. The composite section of Site U1304 has been sampled thus far at a constant 5-cm spacing (equivalent to 125 years), but much higher resolution is possible.

Benthic $\delta^{18}O$ reveals a broad plateau of unchanging values (2.69 $\pm$0.08‰, n=86) for 4.88 m during MIS 5e. The interval of lowest planktonic $\delta^{18}O$, indicating warmest and/or freshest surface conditions, varies among planktonic species. The two species with maximum spring abundance (*G. bulloides* and *G. inflata*) show early LIG $\delta^{18}O$ minima that last from 128 to 125.5 ka, and 128 to 124.7 ka, respectively. The $\delta^{18}O$ pattern of *N. incompta*, which inhabits the surface mixed layer (0-100 m) and has a maximum abundance peak in summer (July-September), shows a broader interval of low $\delta^{18}O$ from 128 to 120 ka. The end of the LIG is characterized by a brief low in $\delta^{18}O$ of *G. bulloides* and *G. inflata* centered on 116 ka followed by a nearly monotonic increase in benthic and planktonic $\delta^{18}O$ from 116 to 105 ka, marking the inception of the last glacial period.

Changes in deep-water circulation are inferred using benthic $\delta^{13}C$ at Site U1304, and by comparing results with sortable silt from nearby core NEAP-18K (52°46' N, 30°21' W, 3275 m water depth). No significant change occurred in benthic $\delta^{13}C$ or sortable silt across Termination II, and values remained low during the early part of MIS 5e from 128 to 124.5 ka when planktonic $\delta^{18}O$ was at a minimum. Iceland Scotland Overflow Water may have remained weak during the earliest LIG period in response to warming and/or lowered salinity from glacial meltwater at peak boreal summer insolation. More positive $\delta^{13}C$ and higher sortable silt values occur between 124 and 117 ka, followed by discrete $\delta^{13}C$ lows at 116.5 and 113 ka. The latter event corresponds with the lowest sortable silt values of the record. From 113 to 105 ka, benthic $\delta^{13}C$ and sortable silt increase reaching their greatest values at 105 ka.

Changes in deep-water chemical (benthic $\delta^{13}C$) and physical (sortable silt mean grain sizes) properties are correlated with $\delta^{18}O$ of planktonic foraminifera at this site, indicating a tight coupling between deep-water circulation and surface climate. Increased nutrients and reduced vigour of deep water flow coincide with warmer/fresher surface water. These results may have implications for how Atlantic Meridional Overturning Circulation might respond to a future warmer, fresher subpolar North Atlantic as a consequence of global warming.