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Subsurface warming in the subpolar North Atlantic during rapid climate events in the Early and Mid-Pleistocene

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A new high-resolution reconstruction of the temperature and salinity of the subsurface waters using paired Mg/Ca-δ18O measurements on the planktonic foraminifera Neogloboquadrina pachyderma sinistrorsa (sin.) was conducted on a deep-sea sediment core in the subpolar North Atlantic (Site U1314). This study aims to reconstruct millennial-scale subsurface hydrography variations during the Early and Mid-Pleistocene (MIS 31-19). These rapid climate events are characterized by abrupt shifts between warm/cold conditions, and ice-sheet oscillations, as evidenced by major ice rafting events recorded in the North Atlantic sediments (Hernández-Almeida et al., 2012), similar to those found during the Last Glacial period (Marcott et al, 2011). The Mg/Ca derived paleotemperature and salinity oscillations prior and during IRD discharges at Site U1314 are related to changes in intermediate circulation. The increases in Mg/Ca paleotemperatures and salinities during the IRD event are preceded by short episodes of cooling and freshening of subsurface waters. The response of the AMOC to this perturbation is an increased of warm and salty water coming from the south, transported to high latitudes in the North Atlantic beneath the thermocline. This process is accompanied by a southward shift in the convection cell from the Nordic Seas to the subpolar North Atlantic and better ventilation of the North Atlantic at mid-depths. Poleward transport of warm and salty subsurface subtropical waters causes intense basal melting and thinning of marine ice-shelves, that culminates in large-scale instability of the ice sheets, retreat of the grounding line and iceberg discharge. The mechanism proposed involves the coupling of the AMOC with ice-sheet dynamics, and would explain the presence of these fluctuations before the establishment of high-amplitude 100-kyr glacial cycles.

Hernández-Almeida, I., Sierro, F.J., Cacho, I., Flores, J.A., 2012. Impact of suborbital climate changes in the North Atlantic on ice sheet dynamics at the Mid-Pleistocene Transition. Paleoceanography 27, PA3214.

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