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Ocean circulation as driver for the Younger Dryas – Holocene transition

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The coastal waters of southeastern Newfoundland represent an ideal location to study past variability in the Atlantic Meridional Overturning Circulation (AMOC). Influenced by water masses from the cold Labrador Current and the warmer and more saline Gulf Stream waters, the area is currently situated at the boundary between the North Atlantic Subpolar Gyre and the Subtropical Gyre. Although in this region several records of the Younger Dryas – Holocene transition are available from the terrestrial realm, marine records spanning this interval at high resolution are so far rare. In this study we present results from a multi-proxy reconstruction of oceanic conditions and sea ice variability at the onset of the Holocene.

Marine sediment core AI07-14G was taken from 239 m water depth in Placentia Bay off the south coast of Newfoundland. Based on 6 radiocarbon dates, the 510 cm core spans the age interval from 12.9 to 9.9 cal. kyrs. BP. With an average accumulation rate of 5.7 years/cm, the core provides a high resolution record of the Younger Dryas – Holocene transition. After X-ray fluorescence (XRF) core scanning, the core was subsampled and analyzed for diatoms, benthic foraminifera, grain size distribution, calcium carbonate content, total organic carbon content, and the geochemical diatom sea ice proxy IP25.

The Younger Dryas termination is clearly reflected in the record as a stepwise succession of events, with changes in ocean circulation preceding the main transition into the Holocene. In our record, the transition is first characterized by a gradual decrease of the Labrador Current intensity, followed by an intensification of Gulf Stream – North Atlantic Current water transport accompanied by a rapid decline of sea-ice cover. Although relatively large uncertainties may exist regarding the local marine reservoir age for this time period, the identification of a detrital carbonate layer associated with Heinrich Event 0, indicates that the observed changes in ocean circulation took place well before the Younger Dryas termination, defined as the shift in atmospheric circulation seen in Greenland ice cores. This infers that changes in ocean circulation took place prior to the atmospheric shift, and thus were the driver for this large scale rapid climatic transition.