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Surface and subsurface Labrador Shelf water mass conditions during the last 6,000 years

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The Labrador Sea is important for the modern global thermohaline circulation system through the formation of intermediate Labrador Sea Water (LSW) that has been hypothesized to stabilize the modern mode of North Atlantic deep-water circulation. The rate of LSW formation is controlled by the amount of winter heat loss to the atmosphere, the expanse of freshwater in the convection region and the inflow of saline waters from the Atlantic. The Labrador Sea, today, receives freshwater through the East and West Greenland Currents (EGC, WGC) and the Labrador Current (LC). Several studies have suggested the WGC to be the main supplier of freshwater to the Labrador Sea, but the role of the southward flowing LC in Labrador Sea convection is still debated. At the same time, many paleoceanographic reconstructions from the Labrador Shelf focussed on late Deglacial to early Holocene meltwater run-off from the Laurentide Ice Sheet (LIS), whereas little information exists about LC variability since the final melting of the LIS about 7,000 years ago. In order to enable better assessment of the role of the LC in deep-water formation and its importance for Holocene climate variability in Atlantic Canada, this study presents high-resolution middle to late Holocene records of sea surface and bottom water temperatures, freshening and sea ice cover on the Labrador Shelf during the last 6,000 years. Our records reveal that the LC underwent three major oceanographic phases from the Mid- to Late Holocene. From 6.2 to 5.6 ka BP, the LC experienced a cold episode that was followed by warmer conditions between 5.6 and 2.1 ka BP, possibly associated with the late Holocene Thermal Maximum. Although surface waters on the Labrador Shelf cooled gradually after 3 ka BP in response to the Neoglaciation, Labrador Shelf subsurface/bottom waters show a shift to warmer temperatures after 2.1 ka BP. Although such an inverse stratification by cooling of surface and warming of subsurface waters on the Labrador Shelf would suggest a diminished convection during the last two millennia compared to the mid-Holocene, it remains difficult to assess whether hydrographic conditions in the LC have had a significant impact on Labrador Sea deep-water formation. This study was conducted within the HOSST research school with the aim to improve our understanding of the critical processes involved in the North Altantic thermohaline circulation, which is particularly important in light of

current climate change.