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Hydrographic changes in the subpolar North Atlantic at the MCA to LIA transition

Dmitry Divine, Arto Miettinen, Katrine Husum, and Nalan Koc
Norwegian Polar Institute, Fram Centre,Tromso, Norway

A network of four marine sediment cores from the northern North Atlantic is used to study hydrographic changes in surface water masses during the last 2000 years with a special focus on the Medieval Climate Anomaly (MCA) to the Little Ice Age (LIA) transition. Three of the cores are recovered from the sites located on main pathways of warm Atlantic water to the Arctic: M95-2011 (Vøring plateau, Norwegian Sea), Rapid-21 COM and LO-14 (Reykjanes Ridge, south of Iceland). The fourth core MD99-2322 is from the SE Greenland shelf (Denmark Strait), and it is influenced by the cold water outflow from the Arctic. The cores were analyzed continuously for planktonic diatoms with a high decadal to subdecadal temporal resolution. Past changes in the spatial distribution of surface water masses have been studied identifying factors, or typical species compositions, in downcore diatom assemblages. To derive the factors a Q-mode factor analysis has been applied to the extended modern calibration data set of 184 surface sediment samples from the North Atlantic, the Labrador Sea, the Nordic Seas, and Baffin Bay. SSTs have also been reconstructed using transfer functions. Variations of the reconstructed SSTs and loadings of major contributing factors reveal a complex regional pattern of changes in the structure of circulation during the MCA/LIA transition (1200-1400 AD). In the Norwegian Sea, the factors associated with assemblages typical for warmer and saline North Atlantic waters are partly displaced by colder and fresher water dwelling diatoms suggesting an eastward migration of mixed Arctic/Atlantic water masses into the Norwegian Sea. The two cores south of Iceland show a westward propagation of a warm water pulse as evidenced by the dominance of assemblages, which today are typical for the waters ca 5° further south than the current study sites. At the SE Greenland shelf an abrupt shift (ca. 50 years) in factors associated with different sea ice zone dwelling diatoms signifies an intensified inflow of the cold and saline mixed water masses advected from the area north of Iceland and/or partly formed by the Irminger current. Such regional patterns of hydrographic changes agree well with a hypothesis of a persistent shift in the vigor of the two main branches of the North Atlantic Drift (NAD) during the onset of LIA, namely strengthening of the Irminger current and a parallel weakening of the Norwegian Atlantic current. Modeling studies also corroborate this hypothesis demonstrating the possibility of such shift triggered by persistent negative volcanic/solar forcing during the studied period.