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A multi-decadal study of Polar and Atlantic Water changes on the North Iceland shelf during the last Millennium

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The region offshore North Iceland is known to be sensitive to broad scale climatic and oceanographic changes in the North Atlantic Ocean. Changes in surface and subsurface water conditions link to the varying influence of Polar-sourced East Icelandic Current (EIC) and Atlantic-sourced North Irminger Icelandic Current (NIIC). Cold/fresh Polar waters from the East Greenland Current feed the surface flowing EIC, while warm/saline Subpolar Mode Waters (SPMW) from the Irminger Current (IC) feed the subsurface flowing NIIC.
Here, we present a new and well-dated multi-proxy record that allows high-resolution reconstruction of surface and subsurface water mass changes on the western North Iceland shelf. An age-depth model for the last Millennium has been developed based on the combined information from radionuclide measurements (137Cs, 210Pb) dating, 25 AMS 14C radiocarbon dates, and identified Tephra horizons. Our dating results provide further support to previous assumptions that North of Iceland a conventional reservoir age correction application of 400 years (ΔR=0) is inadequate (e.g., Eikíksson et al., 2000; Wanamaker Jr. et al., 2012). The combined evidence from radionuclide dating and the identified Tephra horizons point to a ΔR of c. 360 years during the last Millennium.
Our benthic and planktic foraminiferal assemblage and stable oxygen isotope ([U+F064]18O) record of Neogloboquadrina pachyderma s. (NPS) resolve the last Millennium at a centennial to multi-decadal resolution. Comparison of abundance changes of the Atlantic Water related species Cassidulina neoteretis and NPS, as well as the [U+F064]18O record agree well with the instrumental data time series from the monitoring station Hunafloi nearby. This provides further support that our data is representative of relative temperature and salinity changes in surface and subsurface waters. Hence, this new record allows a more detailed investigation on the timing of Polar (EIC) and Atlantic (NIIC, IC) Water contribution to the North Iceland shelf that links to large-scale atmospheric and oceanic changes in the North Atlantic region. We find, during the time of the Medieval Climate Anomaly (MCA), an increased influence of Atlantic waters on surface water conditions, suggesting a stronger inflow of the NIIC, and thus of SPMW from the IC. This influence decreases markedly at the transition from the MCA to the Little Ice Age (LIA) and remains weak during the 20th Century, which likely relates to an enhanced inflow of cold/fresh Polar surface waters to the North Iceland shelf. During the MCA and LIA subsurface water conditions remain predominantly influenced by SPMW from the IC. However, from c. 1950 AD towards the present, this influence and thus likely subsurface water temperatures, decrease on the western North Iceland shelf.