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A High-Resolution Multi-Proxy Lake Sediment Record from Torfdalsvatn Suggests an Enhanced Temperature Gradient Between North and South Iceland During the Early Holocene

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Torfdalsvatn (66° 3'41.73"N, 20°23'14.26"W) is a relatively small (0.4 km2) and shallow (z=5.8 m) lake on the Skagi Peninsula of northern Iceland approximately 0.5 km from the modern coastline. This location is ideal for comparison with the many marine core records from the North Iceland Shelf that record variability in the northern extent of the warm Irminger Current, one of the primary controls on regional climate. To develop a record of north Iceland Holocene terrestrial climate, we analyzed a 8.4 m sediment core at 15-30 year resolution from approximately 12 ka to present using multiple proxies including sedimentary pigments, organic carbon flux, carbon to nitrogen ratio and stable isotopes, as well as biogenic silica measured by Fourier Transform Infrared Spectroscopy (FTIR-S). Results show gradual warming during the early Holocene, with stable soil development and peak aquatic productivity not occurring until after 8 ka. Increased aquatic productivity and a stable terrestrial environment between 6 and 2 ka indicate peak Holocene warmth in this interval. Aquatic productivity abruptly decreases at 1.8 ka associated with an increase in minerogenic material from landscape destabilization in the catchment with the onset of late Holocene cooling. At 1ka, the proportion of terrestrially-derived organic matter deposited in the lake sediment increases, indicating significant destabilization of soil horizons due to continued cooling and potential human settlement. This record is in good agreement with composite north Iceland chironomid-inferred July air temperatures from Axford et al. (2007), which show peak summer temperatures occurring between approximately 5 and 2 ka. The time of peak warmth at Torfdalsvatn is associated with peak biogenic carbonate concentration in the marine core MD99-2269, indicating an influx of warm Irminger waters. This is in contrast with Holocene climate records obtained from lakes in south and west Iceland, implying that there was an enhanced climate gradient between south and north Iceland during much of the Holocene. A comparison of the data from this core with other high-resolution regional climate records can lead to a better understanding of the relationship between marine and terrestrial climate, as well as the differences in climate histories between north and south Iceland.