Institut für Geographie
Universität Innsbruck
Innrain 52
A-6020 Innsbruck

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Abstract

The period since the mid-19th century, when instrumental meteorological recording started in Iceland, has shown climate conditions close to, or even at, both Holocene pessimum and optimum levels. The 19th century part of the Little Ice Age represents a thermal minimum, whilst temperatures during the 1930s were close to the optimum thermal conditions that can be reconstructed for the Holocene (Stötter et al., 1999a; Stötter and Wastl, in press). A simple model describing the relationships between the extent of the sea-ice in the northern North Atlantic, climatic parameters (temperature and precipitation) and glacier behaviour in Northern Iceland in this period has been developed, providing a basis for quantitative palaeoclimatic reconstructions for the Holocene as a whole (Stötter et al., 1999a; Wastl et al., in press). The variations of the upper limit of tree or shrub birch (Betula pubescens) growth, on the other hand, can provide relative proxy data on temperature variations in Northern Iceland for the pre-landnám Holocene (Stötter et al., 1999a).

Tephrochronological evidence shows that glaciers in Northern Iceland had reached dimensions at or within their Little Ice Age limits before ca. 9000 BP (= uncalibrated radiocarbon years) (see Stötter and Wastl, 1999). For the post-Preboreal Holocene, ten glacier advance periods have been reconstructed on the basis of radiometrically and tephrochronologically dated moraines (Häberle, 1991a, 1991b; Stötter, 1991a, 1991b; Stötter and Wastl, in press). The maximum glacier extents during these periods were only in slightly advanced positions relative to those of the Little Ice Age. Thus thermal minima since the Preboreal were comparable to the coldest periods in the second half of the 19th century. The range of temperature variation against the Holocene thermal optima was at least ca. 3 K. This was accompanied by a doubling in precipitation from the thermal minima to the maxima (Stötter et al., 1999a).

Macrofossil and pollen analyses of a series of sections and cores from the Vesturárdalur area on the Tröllaskagi peninsula of Northern Iceland show that Betula pubescens grew up to an altitude between 450 m and 500 m a.s.l. during optimum thermal conditions in the Holocene (Stötter et al., 1999b; Stötter and Wastl, in press). The pollen profile of core Vesturárdalur 2 at ca. 450 m a.s.l. (Stötter et al., 1999b; Stötter and Wastl, in press), covering the time from ca. 9000 BP to present, thus represents the first continuous high-resolution record of vegetation development at the ecological upper limit of tree or shrub birch growth in Northern

Iceland, where changes in thermal conditions have an immediate effect on the prevailing vegetation communities. The reconstruction of the variations of Betula pubescens at this site (Stötter et al., 1999b; Stötter and Wastl, in press) relies both on the palynological investigations and on the analysis of the birch macrofossils in the core. The time control is based on 12 radiocarbon dates and a detailed tephrochronology, which also allows the direct comparison with other palaeoenvironmental and palaeoclimatic records both within Northern Iceland and on a North Atlantic scale. The macrofossil record of core Vesturárdalur 2 shows that tree or shrub birch grew at an altitude close to its maximum Holocene distribution by at least ca. 7600 BP. Between ca. 6700 BP and ca. 6000 BP a distinct maximum of Betula pubescens, with pollen accumulation rates reaching their highest values for the entire Holocene, indicates optimum thermal conditions (Stötter et al., 1999b; Stötter and Wastl, in press).

Around ca. 3300 BP there is a very pronounced minimum of trees, shrubs and dwarf shrubs in the pollen profile of core Vesturárdalur 2. This can be correlated with evidence for increased geomorphological activity on slopes (Stötter et al., 1999b; Wastl et al., in prep.) and a period of glacier advance in Northern Iceland (Wastl and Stötter, in press). Diatom-based reconstructions of summer sea surface temperatures on the North Icelandic shelf provide another indication of cold conditions for this period (Jiang et al., 1999). The vegetation and tree-line history documented in the sections and cores from Vesturárdalur is further discussed in comparison with reconstructed peat accumulation rates at the present upper limit of peat growth in Northern Iceland.

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