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Abstract

Until the mid-1990s, the Holocene tephrochronological record in Northern Iceland comprised 14 tephra layers or series of tephra layers for the last ca. 9000 radiocarbon years (Häberle, 1991; Stötter, 1991, 1994; Björck et al., 1992; Pétursson and Larsen, 1992; Dugmore et al., 1995). As a result of tephrochronological investigations on the Tröllaskagi and Flateyjarskagi peninsulas of Northern Iceland over recent years ca. 70 tephra layers have been identified covering the time from ca. 9700 BP (= uncalibrated radiocarbon years) to present (Stötter and Wastl, in press). The tephrochronological record is based on two reference sections from present to ca. 9000 BP and ca. 9000 - 9700 BP respectively, which are linked through the chronohorizon of the Saksunarvatn tephra deposited ca. 9000 BP.

A detailed tephrostratigraphical description of the reference sections is presented. The identification of the tephra layers is based on both visual inspection and X-ray analysis. The tephras have been geochemically fingerprinted by means of shard-specific electron microprobe analysis of the major elements. The age control is provided by multiple radiocarbon dates combining both conventional and AMS dates on a range of material from various depositional environments in Northern Iceland.

The geochemical analyses show that tephras from different eruptions of the same volcanic system can be distinguished on the basis of electron microprobe analyses of the major elements. Furthermore, at least two Hekla tephras older than Hekla-5 have been identified in Northern Iceland. The results of the radiocarbon datings for the Hekla-3, Hekla-4 and Hekla-5 tephras are compared to published radiocarbon ages for these ash layers (Stötter and Wastl, in press). The dates for Hekla-3 and Hekla-4 are in good agreement with recent results obtained by Dugmore et al. (1995) from sites in Northern Iceland. For the Hekla-5 tephra, the new datings suggest a slightly older age than those published by Stötter (1991) and Häberle (1991). The new detail available in the tephrochronology provides a high-resolution series of chronohorizons for dating Holocene records of environmental and climatic change in Northern Iceland. In addition to this, due to the location of Tröllaskagi and Flateyjarskagi outside the volcanically active zones of Iceland, these tephras originate from volcanic events connected with tephra fallout covering a rather large area. Thus tephra layers from this sequence have been identified in Scandinavia, on the British Isles, in Northern Germany, in

marine cores from the North Atlantic, and in the Greenland ice cores, making them potential isochrones for wide parts of the North Atlantic region.

Absolute age determinations of marine sequences from the North Atlantic by means of radiocarbon dating are hampered by the uncertainties connected with spatial and temporal variations of the marine reservoir effect. On the other hand, the comparison of the radiocarbon ages of 20 samples of wood, peat, gyttja from the lower contact of the Saksunarvatn tephra in sections and cores from Northern Iceland (Stötter and Wastl, in press) with published radiocarbon dates as well as ice core and varve ages for this chronohorizon (Björck et al., 1992; Grönvold et al., 1995; Ingólfsson et al., 1995; Birks et al., 1996) demonstrates that even in undisturbed terrestrial sections the radiocarbon ages can differ several hundred years from those determined by counting of annual layers. This means that environmental proxy data which is purely based on (single) radiocarbon dates must be interpreted with great caution, and underlines the importance of independently dated chronostratigraphic markers. Against this background, tephrochronology defines exactly dated time markers for correlating records of environmental and climatic change from different environments (terrestrial records from North-West Europe, marine cores, Greenland ice cores) in the North Atlantic region. These isochronous marker horizons become even more important in view of the fact that in the time of instrumental meteorological recording climate conditions in this area have shown extreme variations within few decades (Stötter et al., 1999), which is beyond the present temporal resolution of radiocarbon dating.

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