



Research paper

First evidence of cryptotephra in palaeoenvironmental records associated with Norse occupation sites in Greenland



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ARTICLE INFO

Article history:

Received 26 March 2014

Received in revised form

13 February 2015

Accepted 24 February 2015

Available online 26 February 2015

Keywords:

Greenland

Norse

Tephra

Palynology

Radiocarbon

ABSTRACT

The Norse/Viking occupation of Greenland is part of a dispersal of communities across the North Atlantic coincident with the supposed Medieval Warm Period of the late 1st millennium AD. The abandonment of the Greenland settlements has been linked to climatic deterioration in the Little Ice Age as well as other possible explanations. There are significant dating uncertainties over the time of European abandonment of Greenland and the potential influence of climatic deterioration. Dating issues largely revolve around radiocarbon chronologies for Norse settlements and associated mire sequences close to settlement sites. Here we show the potential for moving this situation forward by a combination of palynological, radiocarbon and cryptotephra analyses of environmental records close to three 'iconic' Norse sites in the former Eastern Settlement of Greenland – Herjolfsnes, Hvalsey and *Garðar* (the modern Igaliku). While much work remains to be undertaken, our results show that palynological evidence can provide a useful marker for both the onset and end of Norse occupation in the region, while the radiocarbon chronologies for these sequences remain difficult. Significantly, we here demonstrate the potential for cryptotephra to become a useful tool in resolving the chronology of Norse occupation, when coupled with palynology. For the first time, we show that cryptotephra are present within palaeoenvironmental sequences located within or close to Norse settlement ruin-groups, with tephra horizons detected at all three sites. While shard concentrations were small at Herjolfsnes, concentrations sufficient for geochemical analyses were detected at Igaliku and Hvalsey. WDS-EPMA analyses of these tephra indicate that, unlike the predominantly Icelandic tephra sources reported in the Greenland ice core records, the tephra associated with the Norse sites correlate more closely with volcanic centres in the Aleutians and Cascades. Recent investigations of cryptotephra dispersal from North American centres, along with our new findings, point to the potential for cryptotephra to facilitate hypothesis testing, providing a key chronological tool for refining the timing of Norse activities in Greenland (e.g. abandonment) and of environmental contexts and drivers (e.g. climate forcing).

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1. Introduction

The Norse/Viking occupation of Greenland was part of the spread of human communities across a largely uninhabited North Atlantic region. The colonisers came from Scandinavian homelands and, in part, from the British Isles, at times coincident with the

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supposed Medieval Warm Period of the late 1st millennium AD (Ingstad, 1966; Fitzhugh and Ward, 2000; Dugmore et al., 2005). Although the initial date of settlement (*landnám*; ‘land-taking’) in Greenland is historically documented and accepted at AD 985 (Krogh, 1967), the date of abandonment by the Norse is less secure, as indeed are the reasons for the ultimate demise of European colonies. Climate is often implicated in this process – especially the Little Ice Age (Grove, 1988) – but many inter-related causes, both social and environmental, are likely to have been involved (Seaver, 2010; Dugmore et al., 2012; Massa et al., 2012). Archaeologically- and palynologically-related radiocarbon (^{14}C) dates suggest that the Greenlandic settlement areas (Fig. 1) ceased to be occupied by the end of the 15th century AD and this was certainly earlier in some areas (Arneborg et al., 1999; Edwards et al., 2011a, 2013).

Chronologies for Norse occupation sites in Greenland have been based totally on radiocarbon, biostratigraphic and artefactual

dating (Gulløv et al., 2004; Edwards et al., 2011a; Schofield et al., 2013). Pollen-analytical and other palaeoenvironmental approaches have been providing unprecedentedly detailed evidence for the nature and course of Norse settlement, particularly from organic deposits lying within or in close proximity to archaeological sites (cf. Edwards et al., 2008; Buckland et al., 2009; Golding et al., 2011; Bichet et al., 2013; Ledger et al., 2013). A recurrent issue, however, has been the availability of suitable deposits for investigation and attendant dating problems. Mires located close to Norse ruin groups display a range of problems in that they are: (1) infrequent; (2) typically shallow with slow accumulation rates; (3) often hiatused; (4) commonly devoid of plant macro-remains other than rootlets; (5) subject to secondarily eroded inputs; and (6) rarely ombrotrophic. Lakes and ponds may provide an alternative, but allochthonous inputs and biological activity may impose dating constraints. Even the use of terrestrial macrofossils (e.g. seeds,

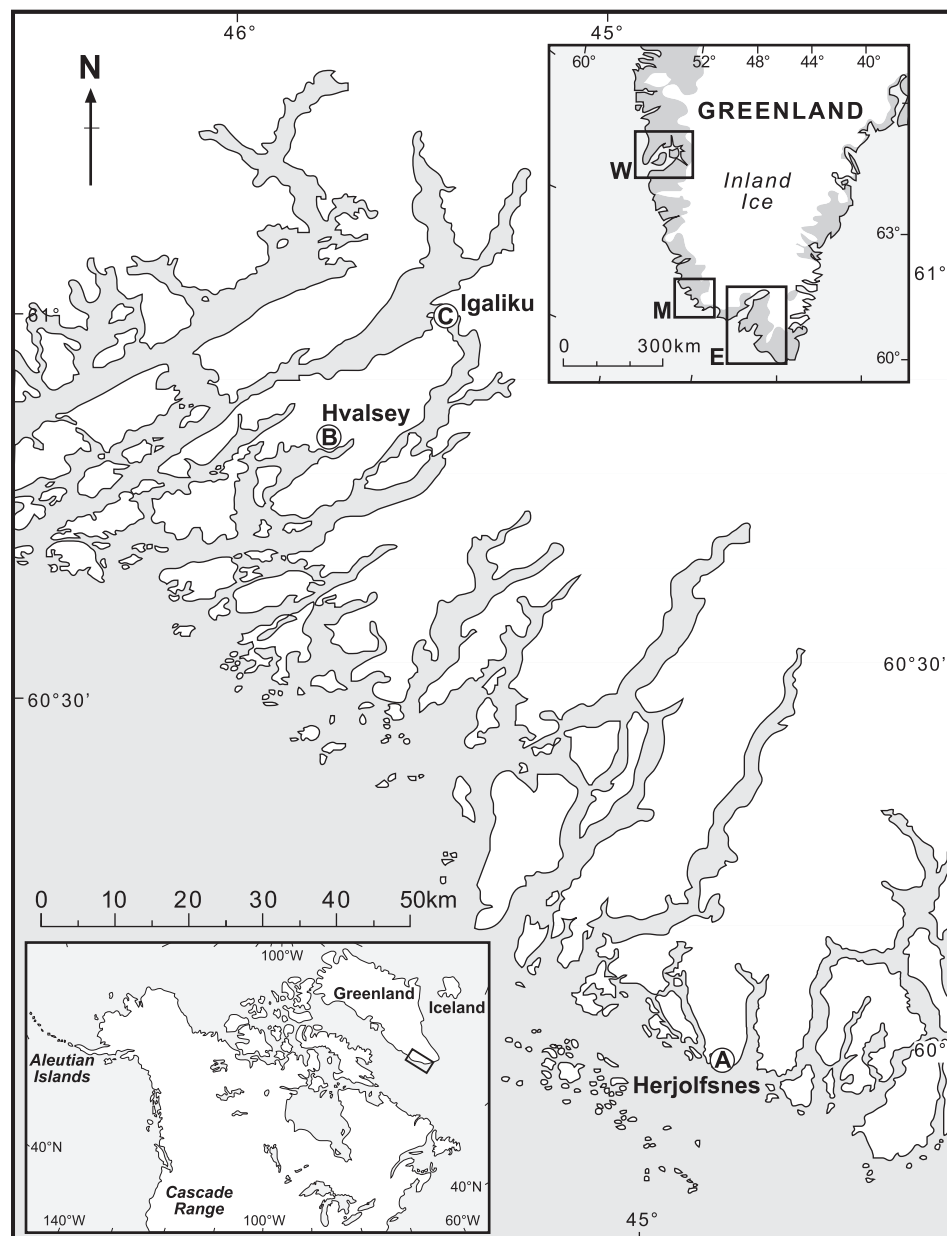


Fig. 1. Locations of the three field sites within the Norse Eastern Settlement of southern Greenland featured in this study. Inset (top right): the Eastern (E), Middle (M) and Western (W) Settlements (boxed). Inset (bottom left): locations of major volcanic centres mentioned in the text, depicted relative to Greenland.

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