Review of Palaeobotany and Palynology 236 (2017) 1–11

Contents lists available at ScienceDirect

Review of Palaeobotany and Palynology

journal homepage: www.elsevier.com/locate/revpalbo

Competing hypotheses, ordination and pollen preservation: Landscape impacts of Norse *landnám* in southern Greenland

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ARTICLE INFO

Article history:
Received 1 March 2016
Received in revised form 7 October 2016
Accepted 31 October 2016
Available online 02 November 2016

Keywords:
Greenland
Norse
Taphonomy
Pollen preservation
Ordination
Multiple working hypotheses

ABSTRACT

Peat sequences in close proximity to former Norse farmsteads in southern Greenland are valuable palaeoecological archives for exploring the impacts of the 10th century Norse colonisation. Unfortunately they are far from widespread and many would be considered suboptimal for palaeoecological analysis owing to the taphonomic complexities perceived to be associated with their depositional environments. This paper explores the value of one such archive from the Vatnahverfi region of southern Greenland. On the basis of field observations, a problematic depositional context was anticipated and this is borne out in the contradictory palynological results which demonstrate evidence for agriculture and abandonment in contemporary horizons and radiocarbon age-depth reversals. Multiple working hypotheses are developed to explicitly demonstrate the equally plausible, but starkly different, interpretations that are possible from these data. To refine our interpretations we apply pollen preservation analysis and multivariate statistical analysis of this dataset with a large well dated fossil dataset from the same region. In so doing, this paper highlights the value of ordination as a chronological tool and the importance of pollen preservation analysis in interpreting taphonomically-complex depositional environments.

1. Introduction

Over the past decade, the environmental impact of the 10th century colonisation of Greenland by Norse settlers from Iceland has been subject to renewed and extensive palynological study (Edwards et al., 2004a, 2009). Integral to this work has been a methodological focus on palaeovegetational reconstructions from small depositional contexts – typically mires, but also ponds and peaty hollows – that are closely associated with Norse archaeology (Edwards et al., 2008, 2011b; Schofield et al., 2008; Ledger et al., 2013). These have been favoured over larger basins (although see Gauthier et al., 2010 for an exception) in order to maximise the responsiveness of the palynological signal for individual farm units, as the impacts arising from human activity appear reduced at the landscape-scale (Ledger et al., 2014a). Following this strategy, it has been possible to not only confirm patterns established in the pioneering work of Johannes Iversen (1934) and Bent Fredskild (1973), but also to investigate resource usage and landscape change around individual farms alongside the provision of settlement chronologies independent of the archaeology (Edwards et al., 2008; Schofield et al., 2008; Schofield and Edwards, 2011; Ledger et al., 2013; Ledger et al., 2014b).

This approach is not without risk, as the taphonomy of mires and peaty hollows can often be complex. Sedimentary hiatuses are common (Schofield et al., 2008; Schofield and Edwards, 2011) and the highly dynamic nature of the Greenlandic landscape (Kuijpers and Mikkelsen, 2009) provides ample opportunity for the re-working and deposition of old microfossils through erosion (Ledger et al., 2015a). This is compounded by the fact that Norse *landnám* triggered localised periods of soil erosion as settlers introduced grazing herbivores into a previously 'pristine' landscape and stripped turf for the construction of dwellings (Dugmore et al., 2005).

To gain meaningful insights into human impacts from palaeoecological archives, it is necessary to appreciate and overcome such difficulties. This is not always readily achieved. Used alone, palynological data can frequently suggest multiple interpretations; as additional lines of evidence are introduced (lithostratigraphic data, ^{14}C dates etc.), the number of plausible interpretations may increase further. For this reason the use of multiple working hypotheses (MWH), whereby numerous hypotheses are formulated, tested and consecutively eliminated, could be considered a tenet of palaeoecology (Birks and Birks, 1980; Edwards, 1983; Edwards et al., 2004b, 2005a), although the method is seldom implemented in a systematic manner. Even when the MWH method is adopted formally, it does not necessarily lead to an adequate resolution as it is not always possible to espouse a preferred hypothesis (cf. Ledger et al., 2015a).

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http://dx.doi.org/10.1016/j.revpalbo.2016.10.007
0034-6667/

This paper uses the MWH approach to explore palaeoevegetational and radiocarbon data from a taphonomically complicated sedimentary sequence from the Vatnahverfi region of the former Norse Eastern Settlement of Greenland. Rather than resisting the potential contradictions posed by the existence of MWH, this paper embraces them to explore what is a problematic sequence. We present equally intricate, and starkly different, perspectives on the same data in order to highlight the dangers and complexities of explaining palynological data from such contexts. We then apply pollen preservation data – an underutilised form of analysis (Tipping, 2000; Tweddle and Edwards, 2010) – and ordination in an attempt to help resolve some interpretational conundrums. In so doing, we aim to offer meaningful insights on the impacts of Norse settlers from a deposit which may otherwise be considered unsuitable for palynological study.

2. Background

2.1. Vatnahverfi

Vatnahverfi is a predominantly-inland region within the former Eastern Settlement of Greenland (Fig. 1) containing approximately 50 groups of Norse ruins. The area is dominated by a series of long valleys and lakes, with topography ranging from sea level to 1000 m asl. The geology comprises a suite of granites (Allaart, 1976) with a drift cover of glacial and glaciofluvial deposits of Quaternary age (Feilberg, 1984). Soils in this region are typically podzols (Jacobsen, 1987). Thick deposits of fine windblown sand (loess) are present, particularly in eastern areas (cf. Jakobsen, 1991; Kuijpers and Mikkelsen, 2009), and the mires of the region exhibit a relatively high minerogenic (aeolian and slopewash) component (Ledger, 2013). Climatically the region is within the subarctic/sub-oceanic climate belt of southern Greenland with the nearest observational data (for Narsarsuaq [Fig. 1] over the period 1961–90) indicating a mean summer (July) temperature of 10.3 °C and annual precipitation of 615 mm (Cappelin et al., 2001).

2.2. The study site

Tasilikulooq (Ø171) is a medium-sized group of eleven Norse ruins located in a small valley (c. 200 × 500 m) near the centre of Vatnahverfi between Lake Saqqaata Tasia and Tasersuaq (Figs. 1 and 2). The eleven ruins were first recorded by Christian Vebæk (1992) and are dispersed throughout the area, with the largest concentration located on a low mound to the east of the valley (Fig. 2). A modern sheep farm was established on the site in 1986 and is situated c. 50 m northeast of the ruins. The valley floor slopes gently from northeast to southwest and is dominated by hayfields associated with the farm. To the east, the relief rises sharply to a rocky outcrop c. 50 m asl on which the slopes are covered by *Salix glauca-Betula glandulosa* scrub (plant nomenclature follows Böcher et al., 1968). The land to the west rises more gently and is covered with a mix of scrub and improved grassland.

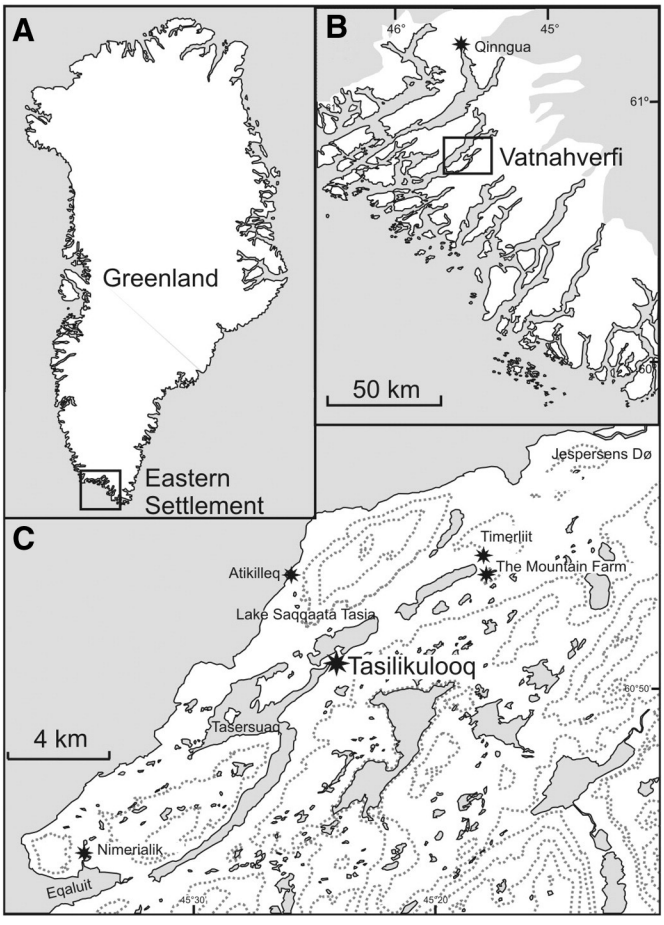

Fig. 1. Location maps: (A) Greenland (B) Vatnahverfi within the Eastern Settlement; (C) Tasilikulloq and other locations mentioned in the text.

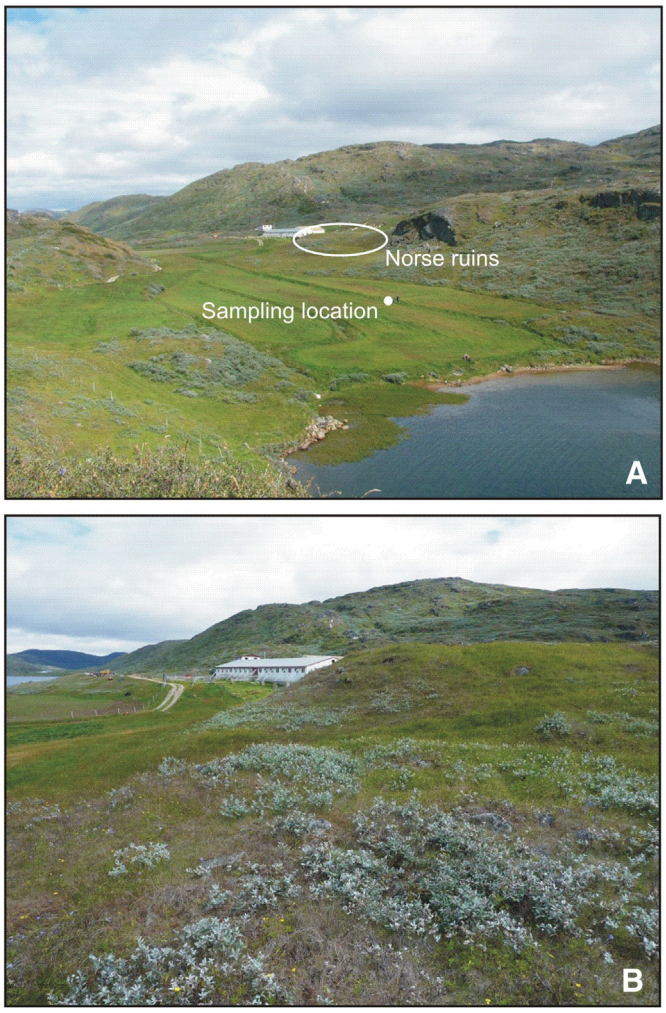

Fig. 2. Photographs of the study site: (A) view northeast across Tasersuaq and the modern hayfield towards ruin group Ø171 (Photo: P. M. Ledger, July 2010); (B) looking northeast over ruin group Ø171 towards the modern farm (Photo: K. J. Edwards, July 2010).