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Changes in mid- and far-field human landscape use following the Laacher See eruption (c. 13,000 BP)

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ABSTRACT

Around 13,000 years ago, the Laacher See volcano (East Eifel volcanic field, Rhenish Shield) erupted cataclysmically. The thick tephra blanket in the eruption's near field covered and thereby preserved a large number of archaeological sites, ranging from very small to some of the largest and richest sites known from the Late Glacial. In this proximal region, there is a striking contrast in the number of sites prior to the eruption and the almost complete lack of sites dating to the period after the event, i.e. to Greenland Interstadial 1a. The preservative function of the tephra cover itself may explain this near-field pattern, but it is shown here that similar stratigraphic observations can also be made in the Laacher See eruption's mid field towards the west and, in particular, to the north-east. The aim of this paper is to review the stratigraphic relations of known archaeological sites outside the near field of the Laacher See event with a particular focus on the German Federal State of Hesse and adjacent areas of Lower Saxony and the Thuringian Basin. Here, a number of archaeological sites are known, where strata of Laacher See tephra cap human occupation. Most often, these sites are not reoccupied until much later in prehistory, suggesting that the eruption may have led either to a complete or a near-complete abandonment of the affected regions or, at the very least, to a major reorganisation of landscape-use.

1. Introduction

There is little doubt that volcanic eruptions can be powerful geological agents that can affect human communities in a variety of complex ways (Grattan, 2006; Grattan and Torrence, 2007; Cashman and Giordano, 2008; Oppenheimer, 2011). The association of humans with volcanic landscapes goes far back into the Pleistocene (King and Bailey, 2006) and numerous claims have been made for the impact or otherwise of volcanic eruptions during critical phases of human evolution and dispersal. These episodes include the very first hominid ventures to the gates of Europe at Dmanisi just under two million years ago (de Lumley et al., 2008), the much debated global or regional effects of the Toba eruption at c. 74,000 years ago (see Williams, 2012), and the no less controversial effects of the Campanian Ignimbrite Y5 eruption on Neanderthals and anatomically modern humans across Europe (see d'Errico and Banks, in press). In relation to more recent human communities, the effects of volcanic eruptions include the total devastation of settlements as exemplified above all by the city of Pompeii buried by the AD 79 eruption of Vesuvius (Beard, 2008), but seen equally well at earlier Bronze Age settlements in the area (Mastrolorenzo et al., 2006), at the 6th-century AD settlement of Cerén, El Salvador (Sheets, 2002), and at the Bronze Age island town of Akrotiri on Thera in the Mediterranean Sea (Friedrich, 2009). In addition, volcanic eruptions have, arguably, left their mark on the religious world-views and mythologies of the affected people (Barber and Barber, 2006; Chester and Duncan, 2007; Vitaliano, 2007; Cashman and Cronin, 2008).

In recent years, methodological improvements in tephrochronology have made it possible to more routinely detect and securely identify otherwise invisible traces of volcanic ash (tephra) in different kinds of stratigraphic sequences (Alloway et al., 2007; Swindles et al., 2010; Lowe, 2011; Dugmore and Newton, 2012). These methodological developments not only enable an extension of known tephra distributions far beyond previously known plume reconstructions based on macroscopically visible occurrences alone, but they also allow a better integration of tephrochronology with specifically archaeological investigations (Riede and Thastrup, 2013; Lane et al., 2014b).

One such archaeological application of tephrochronology concerns the eruption of the Laacher See volcano (Germany) located at 50.411502° N, 7.269952° E and its impact on contemporaneous groups of highly mobile Final Palaeolithic hunter–gatherers of the

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so-called Federmessergruppen in the near-, mid- and far-fields of this cataclysmic event. These distance distinctions are defined, following Thorarinsson (1979), as areas <50 km, 50–500 km, and >500 km from the vent respectively. The Laacher See eruption (LSE) occurred just under 13,000 years ago and has been studied extensively from a geological perspective. Owing to numerous detailed petrological and volcanological investigations, the sequence of events surrounding this eruption is known in great detail (e.g. van den Bogaard and Schmincke, 1984; van den Bogaard and Schmincke, 1985; van den Bogaard et al., 1990; Schmincke et al., 1999; Schmincke, 2006). Furthermore, commercial exploitation of the eruptive products has led to the uncovering of pre-event landscapes replete with evidence of plants as well as of animal and human activity (see Baales, 2002 for a general summary). Using the widespread Laacher See tephra (LST) marker horizon as a dating reference, Riede (2008) has argued that the eruption also affected contemporaneous human communities outside the proximal area via a range of combined ecological/economic and demographic mechanisms that changed in parallel with the changing hazard dynamics from proximal to distal (Table 1). This hypothesis took its starting point in the observation that the period immediately following the LSE is characterised by a remarkable episode of culture change in S Scandinavia. In this region – itself wholly or almost wholly unaffected by the LST [for possible cryptotephra traces of LST in Denmark other than the island of Bornholm see Larsen and Noe-Nygaard (in press) and Noe-Nygaard et al. (2006)] – an archaeological culture emerged, the so-called Bromme culture, that first and foremost is set apart by its technological simplicity as well as its tight geographic circumscription. The Bromme culture is at the same time associated with an increase of on- and off-site material in the region. With reference to formal demographic models that link technological complexity in traditional societies to group size and connectedness (cf. Henrich, 2004; Derex et al., 2013; Kempe and Mesoudi, 2014; Muthukrishna et al., 2014), it has been suggested that the emergence of the Bromme culture in S Scandinavia signifies:

(i) The more permanent migration of forager groups from central N Europe into S Scandinavia (Riede, 2012) and the corresponding abandonment or near-abandonment of the former area. This desertion of Germany N of the Main River and E of the River Rhine is thought to have been stimulated by the negative respiratory health impacts of the fine-ash deposition and its continued remobilisation in so-called ash-storms (Riede and Bazely, 2009), the steeply increased tooth wear (and its effects on mortality and morbidity) amongst prey animals caused by ingested tephra (Riede and Wheeler, 2009), acute/chronic human and/or animal fluoride poisoning also due to ingestion of chemically-loaded particles (cf. Cronin et al., 2000; D'Alessandro, 2006; Flueck and Smith-Flueck, 2013), as well as perhaps the culturally specified restrictions on the use of the affected landscapes (Blong, 1982; Lowe et al., 2002).

(ii) The subsequent loss of complex technologies (bow-and-arrow technology) in favour of simpler ones (the dart/spear-thrower; see Dev and Riede, 2012; Riede, 2009) as the result of reduced connectedness of this small and isolated population (Riede, 2014a).

This hypothesis has not gone unchallenged. Sørensen (2010) has argued that the emergence of the Bromme culture cannot be related to the LSE chronologically, demographically, or culture-historically. Whilst a range of source-critical issues that go beyond the scope this paper complicate the resolution of these competing claims (Riede, 2013), accurately dating the pre-eruption human occupation in areas affected by the LSE as well as the Bromme culture itself are of primary importance in this debate. In a previous attempt to better resolve the chronological position of the Bromme culture in relation to the LSE, a systematic evaluation and subsequent Bayesian modelling of the available radiocarbon dates was conducted. This exercise strongly suggests a clear temporal correlation between the LSE and the emergence of the Bromme culture immediately thereafter (Riede and Edinborough, 2012). Notably, newly obtained dates support the placement of the Bromme culture into the very late Allerød and the beginning of the Younger Dryas (Fischer et al., 2013), which is also fully consistent with the few additional non-radiometric age indicators available from some Brommean sites (Eriksen, 2002). Yet, due to the inherent rarity of preserved organic materials from this period in the generally acidic soils of the North European Plain the current database of relevant radiometric and non-radiometric dates remains small. Independently of the issues of numerical dating, the suggestion that the emergence of the Bromme culture relates causally to a population movement into S Scandinavia from elsewhere requires that a source population for this immigration be identified.

Table 1
Potential hazards from near-field (proximal) to very far-field (ultra-distal) of explosive volcanic activity and those documented for the Laacher See eruption. The number of Xs indicates acuteness of the hazard. Modified from Thorarinsson (1979).

Distance from vent (km)	Hazard agent									
	Lava	Tephra	Ash storms	Gases	Pyroclastic flows	Base surges	Lahar/mudflows	Secondary lahar/flooding	Earthquakes	Tsunamis
<50 (near-field/proximal)		**XX**	**XXX**	**XXX**	**XXXX**	**XXXXX**	**XXXX**	**XX**	**XXX**	**XX**
50–500 (mid-field/medial)		XXXX	XXX	XXX	XX		XX	XXXX	XX	XXX
500–1000 (far-field/distal)		**XX**	**X**	**X**				**X**		**XX**
>1000 (very far-field/ultra-distal)		**X**								
Relevant for the LSE	**no**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**yes**	**no**

In a further effort to clarify the chronological and demographic source-sink dynamics in the wake of the LSE, this paper thus queries the stratigraphic sequences of Late Glacial archaeological sites in Belgium and in the German Federal State of Hesse and adjacent areas of Lower Saxony and the Thuringian Basin. Together these regions span the mid-field of the LSE to the W and the NE of the Laacher See and the River Rhine respectively. Beginning with a brief summary of the general parameters of the LSE, this paper then presents an updated distribution map of the LST with particular focus on assessing the chronostratigraphic information value of this tephra marker in relation to mid-field archaeological deposits. While it is conceivable that factors promoting the preservation of archaeological material are also germane to the preservation of LST