

Kuwae, Epi and Tongoa Islands: Transformations of a volcanic landscape in central Vanuatu

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ABSTRACT

This paper presents a detailed overview of archaeological research undertaken on Epi and Tongoa, in central Vanuatu. These islands were previously connected to one another and respectively formed the western and eastern portions of Kuwae, one of the largest islands in the Vanuatu archipelago, until the catastrophic Tombuk volcanic eruption separated them in the mid-fifteenth century AD. Oral traditions and insights drawn from previous ethnographic, linguistic and genetic research provide context for the archaeological data. We begin to address questions about the extent to which impacts of the major Tombuk eruption were experienced across the entirety of the former Kuwae landmass, and the role of this and other volcanic events in the complex transformations of the physical and cultural landscapes of central Vanuatu.

Keywords: Vanuatu, Kuwae, Epi, Tongoa, volcanic eruptions, Tombuk

RÉSUMÉ

Cet article présente un résumé détaillé des recherches archéologiques conduites sur Epi et Tongoa, deux îles situées dans le centre du Vanuatu. Ces îles étaient autrefois reliées l'une à l'autre, formant les parties occidentale et orientale de Kuwae, l'une des plus grandes îles de l'archipel de Vanuatu, jusqu'à ce que l'éruption volcanique dite de Tombuk les sépare, au milieu du XV^e siècle après J.-C. Les traditions orales et les données issues de recherches ethnographiques, linguistiques et génétiques antérieures permettent de contextualiser ces données archéologiques. Nous nous interrogeons en particulier sur l'étendue de l'impact de cette éruption sur l'ancienne masse terrestre de Kuwae et sur l'influence qu'a eu cette éruption ainsi que d'autres événements volcaniques sur les transformations complexes des paysages physiques et culturels du centre de Vanuatu.

Mots-clés: Vanuatu, Kuwae, Epi, Tongoa, éruptions volcaniques, Tombuk

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INTRODUCTION

For more than a decade, the Republic of Vanuatu, an archipelago of 83 islands located in the southwest Pacific, has topped global indexes of countries assessed as most at risk from natural disasters (Aleksandrova et al., 2021; Birkman et al., 2011). The range of threats includes tropical cyclones, tsunamis, floods, landslides, earthquakes and volcanic activity. Here we focus on the latter; volcanic eruptions, often dominate headlines and pose a very real

threat to many communities. Various authors have emphasised the potential for archaeological studies, and studies of oral traditions, related to past volcanic eruptions to add texture to understandings of a range of aspects of past societies, as well as to inform contemporary disaster management strategies (Cronin & Cashman, 2007; Franks et al., 2024; Grattan & Torrence, 2002, 2007; Nunn et al., 2022; Torrence & Doelman, 2007; Torrence, 2008, 2016, 2019). In Vanuatu, where there are currently 12 active volcanoes¹ located from the south to the north of the

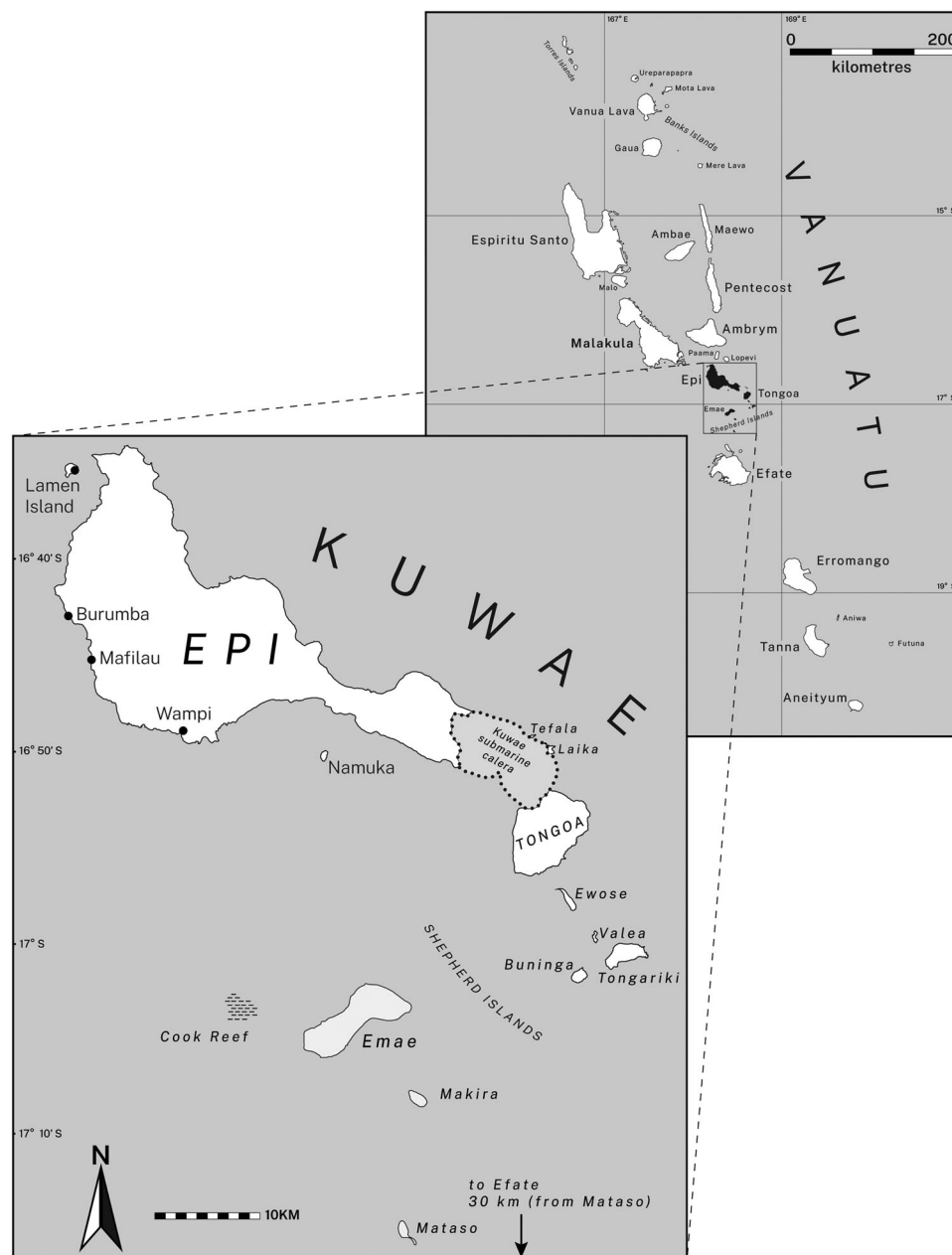
archipelago, archaeological and volcanological research indicates an extensive eruptive history relating to these as well as now dormant volcanic sources encompassing the last 3000 years of human habitation (Bedford, 2019a; Bedford et al., 2006: 817; Garanger, 1972; Horrocks et al., 2009; McCall et al., 1970; Nemeth et al., 2009; Quantin, 1973; Shreve et al., 2021; Warden, 1967). Studying the volcanic histories of the islands is crucial to understanding how communities in Vanuatu have been affected by and adapted to such hazards over thousands of years and presents an opportunity to explore the relationship between adaptation and the formation and maintenance of traditional social networks. Across much of the archipelago, eruptions or ongoing volcanic activity have been relatively benign and, in the majority of cases, have contributed to enriching the soils of most islands, providing the base for abundant horticultural production to sustain large populations (Weightman, 1989). However, volcanic eruptions have also forced movements of entire communities and evacuations of whole islands. In the twentieth and twenty-first centuries, numerous temporary and long-term displacements have occurred and are well-documented (Frater, 1922; Rovins et al., 2020; Tonkinson, 1968, 1977, 1979). In this paper we consider one of the more sensational documented events, the massive eruption of a volcano located in the southeast of an island known as Kuwae in central Vanuatu, dated to c. AD 1452, which had profound local, regional and as some have argued, possibly even global consequences (Ballard, 2020: 105–106; Ballard et al., 2023; Cole-Dai et al., 2013; Gao et al., 2006; McCarroll et al., 2013; Monzier et al., 1994; Nunn et al., 2006; Robin et al., 1994; Strandberg et al., 2023; Wang et al., 2012). This event, now known as the Tombuk eruption,² split the island of Kuwae, producing a massive submarine caldera that separated its major remnants, the extant islands of Epi and Tongoa (Figure 1).

This paper works towards addressing several goals of a current multi-disciplinary study being undertaken by the authors and collaborators investigating aspects of the Tombuk eruption and the resulting transformations of the physical and social landscapes of central Vanuatu.³ Its first aim is to provide an outline of data previously generated from Epi and Tongoa Islands from the 1960s to the mid-2000s (Bedford & Spriggs, 2008; Garanger, 1972; Hoffman, 2006), spanning both the pre- and post-Tombuk eruption periods. In addition to providing a summary of previously published research, we also present new data from the last program of fieldwork carried out on Epi between 2005 and 2008, including insights from analyses of pottery and worked shell. The overview of archaeological data included is necessarily detailed given that it represents the first attempt to synthesise this material in relation to historical developments in central Vanuatu. Taken into consideration with a summary of ethnographic, linguistic and genetic data, these insights advance a view that, within the last millennium, central Vanuatu and the Kuwae area more specifically, was the setting for a major disjuncture between northern and southern populations in terms of cultural, political, linguistic and genetic affinities.

Exactly what role the Tombuk eruption played in the transformations of central Vanuatu's social landscape is a question which the project seeks to address. Doing so will require an understanding of how the eruption impacted the physical landscape of this region. Certainly, the creation of the submarine caldera between Epi and Tongoa is indicative of a major reorganisation of space in this part of the archipelago, but it remains unclear how widespread the effects of the eruption were, particularly on Epi, which (as this review highlights) has received limited attention (Ballard et al., 2023; Hoffman, 2006). This leaves open additional questions about how much of Kuwae's original population could have survived the eruption, the extent of the landscape which became available for resettlement in its aftermath, which groups were involved in undertaking this, and how they may have engaged with newly configured spaces and impressed upon them the meanings they hold as places today. As will be detailed below, oral traditions from the Shepherd Islands describe the resettlement of Tongoa by groups which had previously resided on southeast Kuwae (Ballard, 2020). These traditions provide partial insights into some of these matters, but they do not reflect the whole picture as it relates to very different human elements of other parts of the former Kuwae landmass, namely northern and western regions of Epi. Are these areas so distinct because they were resettled from the opposite direction, or as Hoffman (2006) has suggested, was a population able to persist in the sheltered valleys of north and west Epi? Apart from this last point regarding the likelihood of surviving groups on Epi, which is strengthened by the addition of evidence presented here, this paper does not yet specifically aim to test hypotheses which may answer these questions – rather, several hypotheses emerge from our review and are outlined in the discussion. These will be assessed through future research and additional fieldwork. The ultimate goal of this paper therefore is to establish the current picture ahead of the commencement of this new program.

Another aspect that this paper aims to introduce is that beyond the Tombuk eruption, Kuwae and its remnants are situated within a broader volcanic context which encompasses the surrounding marine and insular environments. The north-western portion of Epi comprises a range of heavily eroded ancient volcanic features while in the east several prominent and well-preserved cones, including Mount Pomare and Tavani Ruro, reflect more recent volcanism, as do corresponding features on Tongoa. These cones are now dormant but some may well have been active during the last 3000 years of human settlement (Quantin, 1973; Warden, 1967). This broader setting also includes the active volcanoes on Lopevi and Ambrym, as well as the submarine Karua and East Epi volcanic systems; all have erupted numerous times during the last century, including the East Epi submarine volcano, which erupted most recently in February 2023. The regularity of such events in recent history, as well as the obvious influence of volcanism on the present landscape demonstrate its ongoing force in the archipelago as a major process in island formation and as a persistent challenge to be dealt with by

FIGURE 1. (a) Map of the Vanuatu archipelago highlighting the location of Epi and the Shepherd Islands in the centre of the archipelago. (b) Map of Epi and Tongoa, major remnants of Kuwae, and neighbouring islands in the Shepherd group.



human communities. While the Tombuk eruption may have been the most spectacular and impactful single volcanic event during Vanuatu's human history, for communities on Kuwae it occurred within a context where systems must have developed to allow them to adapt and cope with the effects of volcanic hazards (not to mention the range of other extreme events noted above which regularly impact this part of the world). There is an opportunity here to explore the question of cultural resilience in relation to the capacity of traditional networks to adapt to abrupt physical and social changes brought about by environmental disturbances. This is an area which may offer as many insights about developments in the past as it does potential

solutions for dealing with current challenges. We will broach the topic of resilience in the discussion at the end of this paper, but this is a conversation which will be developed more fully over the course of the current project and in future publications.

THE TOMBUK ERUPTION AND ITS LEGACY

Oral traditions recounting the Tombuk eruption on Kuwae Island have been passed down through generations of Shepherd Islands⁴ communities and are now well known throughout Vanuatu and beyond. They relate in detail events

immediately preceding and precipitating the eruption, contextualising it within a worldview in which disasters can occur as consequence of a human act of cultural transgression, and describe the dramatic flight of populations from the area and finally the resettlement of the Shepherd Islands by named chiefs and their respective canoes (Ballard, 2020; Ballard et al., 2023; Calandra, 2020; Galipaud, 2002; Guiart, 1973; Hoffman, 2006; Luders, 1996, 2001; Michelsen, 1893, 1906, 1934). This body constitutes an invaluable cultural resource related to events that were initially triggered more than 500 years ago and have always figured strongly in matters relating to the region's complex system of chiefly titles and contestation over land tenure. The oral traditions were also fundamental in launching the initial volcanological and archaeological research activities related to the eruption in the 1960s (Espirat et al., 1973; Garanger, 1972; Guiart, 1973). However, it is striking how little these oral traditions appear to relate to Epi (445 km²), although it represents the vast bulk of the former Kuwae landmass being ten times the size of Tongoa (45 km²). Apart from certain chiefly title claims to areas in the extreme southeast of the island (Hoffman, 2004: 12), there appear to be few or no narratives which make explicit reference to the eruption or any resettlement.

The stark contrast between the vast corpus of oral histories held by Shepherd Islands (and particularly Tongoan) communities and the conspicuous absence of narratives deriving from or relating to Epi may reflect a range of factors. These include primarily the massive depopulation and land alienation experienced by communities on Epi beginning in the nineteenth century amidst which the import of labourers from other islands was encouraged (Bedford & Shlomowitz, 1988: 65; Smith, 2017). This trend progressed throughout the twentieth century, and the movement of populations from other islands to southeast Epi has continued into the post-Independence period (1980–present). Today, many residents of eastern Epi trace their origins to other islands in relation to this period of migration. Another potential factor originally canvassed by Hoffman (2006) is the real possibility that much of Epi's population survived or found sanctuary on the western half of the island, and stories relating to resettlement are not as vivid as on Tongoa where survivors had to flee and seek refuge on other islands further south (primarily Efate) for at least a generation or two before the environment had recovered to a level suitable for human habitation. Resettlement in the latter case was likely to have been much more challenging, involving small groups over several generations which had to reclaim and establish ownership of territory that was in many respects unrecognisable.

KUWAE AND ITS REMNANTS

The drama of the massive mid-fifteenth century Tombuk eruption, its drastic impact on surrounding landscapes resulting in the emergence of the islands of Epi and Tongoa

and its climactic role in various narratives have been central aspects of research relating to Kuwae. However, this focus tends to eclipse the reality that for more than 80% of the human history of central Vanuatu, Kuwae constituted a single landmass spanning a surface area which was probably the fifth largest in the archipelago. In order to avoid confusion, we must draw an important practical distinction between the terms we will use to refer to three locations throughout this paper. These of course are Kuwae, Epi and Tongoa; entities which exist in particular spaces and at particular points in time. Here, when we discuss aspects relating to Epi or Tongoa, we refer to the islands which have been separate from one another since the Tombuk eruption dated to c. 1452 AD, and which have been the settings of very distinctive social and cultural developments since that event. We use Kuwae to refer to the significantly larger island which, until the eruption, encompassed both Epi and Tongoa, as well as the terrain which once connected them.

This connective landscape is now defunct physically, but as Ballard (2020: 100–101) notes, it remains animate socially through oral traditions which relay a kind of “crypto-geography” of Kuwae. This situation reflects important notions of time and space, two dimensions which through cultural activity and knowledge contribute to the making of place (Basso, 1996; Rodning, 2010: 180; Tilley & Cameron-Daum, 2017). Concepts of place more broadly have figured prominently in ethnographies of Vanuatu (e.g. Bolton, 1999; Bonnemaïson, 1994: 113–145; Jolly, 1994a; McDonnell, 2023; Patterson, 2002; Rodman, 1992, 1998, 2001) and warrant some reflection. For example, mobility and mutability are salient aspects of ni-Vanuatu conceptualisations of place, which have been identified by Bolton (1999: 44–45) and are particularly relevant here. These characteristics are enabled by a range of phenomena both natural and supernatural. Places are made as much through processes such as tectonic uplift and volcanic eruption as they are through the actions of culture heroes or the tendencies of stones, and even entire islands, to uproot themselves and move to new locations; as we must contend with in our study of Kuwae, Epi and Tongoa, places are not static (Bolton, 1999: 44–45; see also, Ballard, 2023).

Unsurprisingly, individuals do not necessarily interact with places in the same ways, either. In her work with primarily colonial spaces, Rodman (1992, 1998) has explored how the concepts of multilocality and multivocality can be variously identified in relation to place in Vanuatu. In many ways these are terms which also resonate with Kuwae and its remnants which, through the Tombuk eruption, are fragmented across space and time and rendered multilocal. Furthermore, narratives of Kuwae comprise a range of voices for whom the eruption and places associated with it hold a multitude of meanings, whether they are told by members of local communities or by outsider missionaries, anthropologists, volcanologists or climate historians.

These voices speak with a volume and authority which afford them a level of power relative to place (Rodman,

1992). As we have highlighted above regarding the lack of oral historical sources from Epi, there are many voices which have not been heard in the articulation of places related to Kuwae and the Tombuk eruption. Archaeological evidence may provide opportunities for traces of those perspectives to come forward from the past and contribute to understandings of Kuwae and its remnants.

THE ARCHAEOLOGY OF KUWAE

Archaeological research in relation to Kuwae and its primary remnants, Epi and Tongoa began in 1964, with research led by José Garanger in collaboration with local communities that focused on confirming oral traditions in relation to both a massive eruption and the resettlement of Tongoa Island (Garanger, 1972; Guiart, 1973; Hébert, 1966). Garanger undertook extensive excavations on Tongoa and further south on Makira Island and Efate and the offshore islands of Lelepa, Retoka and Mele, many of which connected with oral traditions. The research on Tongoa confirmed the stories of a massive eruption and at the same time uncovered deposits related to the pre- and post-Tombuk occupation. Garanger did not undertake fieldwork on Epi, largely due to the fact that oral traditions relating to the Tombuk eruption or other aspects of his research focus had not been collected there.

Evidence on Tongoa relating to the pre-Tombuk period centred around the pottery recovered from a number of sites. Garanger defined the various pottery traditions that were found between Efate and Tongoa, which showed remarkable similarity and synchronous change across the region over thousands of years, indicating high levels of interconnectivity for at least the first 1600 years of settlement (3000–1200 BP). The chronology and definition of the pottery sequence for this same region has been greatly refined over the last 60 years but the basic building blocks of Garanger's original framework remain relevant. Lapita sites have now been identified throughout Vanuatu, including on Efate, and are confirmed as being associated with the first settlement (Bedford et al., 2009; Petchey et al., 2014). The other pottery traditions defined by Garanger for the Shepherds and Efate, namely Erueti, Mangaasi and Aknau, have been further augmented, with larger well-preserved collections in the case of the Erueti style, and have all now been placed in a more robust chronological sequence. This begins with Lapita (3000–2800); followed by Arapus (2900–2800 BP); Early Erueti (2800–2600 BP); Late Erueti (2600–2200 BP); Early Mangaasi (2200–1600 BP); Late Mangaasi (1600–1200 BP); and Aknau (1200–550 BP) (Bedford, 2006: 157–173, 2009; Garanger, 1972).

On Tongoa, a remnant of the easternmost part of Kuwae, the recovered pottery was dominated by Early Mangaasi- and Aknau-style sherds. There was no record of any definitive Erueti sherds or any dates that indicated sites that dated to that period. Several important aspects of Garanger's research on Tongoa should be highlighted. The

Early Mangaasi pottery that was recovered from the excavations had direct parallels with the same style of pottery he had recovered on Efate, an aspect which many subsequent excavations have confirmed (Bedford, 2006, 2009). The cultural deposits were clearly visible only on the south part of the island at Mangarisu, where the sea is rapidly eroding the exposed cliff face. The earliest occupation found on Tongoa (then eastern Kuwae) is associated with Early Mangaasi deposits (2200–1600 BP) which were situated directly on top of earlier volcanic deposits, emphasising the perilous nature of the wider Kuwae landscape. The Aknau-style pottery with its very distinctive internal markings, first defined from recovered sherds on Tongoa (Garanger, 1972: 96–97, figs. 272–278), was found above the Mangaasi deposits and directly below a thick eruptive layer interpreted as being associated with the Tombuk eruption. Aknau pottery was also found on Makira Island further south but not on Efate or any of its outer islands.⁵ This remains the case today with many more excavations having been carried out on Efate and on the offshore islands of Lelepa and Nguna (Bedford, 2009). This distribution indicates that there are the beginnings of local cultural diversification between Efate and the Shepherds from 1200 BP. Pottery production, in the form of Aknau ware, continued on eastern Kuwae and Makira for another five or six hundred years longer than on Efate. Production ceased following the Tombuk eruption. Groups that returned to settle Tongoa did not make pottery; this change almost certainly reflects the influence of sheltering on Efate, potentially for several generations, where pottery had been long abandoned.

Archaeological investigations on Epi Island only began in 2004. This comprised preliminary heritage surveys that were carried out by Andrew Hoffman and Salkon Yona, which resulted in the first serious archaeological consideration of Epi and its relationship to the Tombuk eruption (Hoffman, 2006). The results of that survey relate primarily to the post-Tombuk cultural landscape and are further discussed below. Excavations and survey in 2005, 2006 and 2008 directed by Bedford and Spriggs targeted sites that pre-dated the Tombuk eruption and provided the first data for the island related to that period, offering insights into Epi's deeper history dating back to as early as the immediately post-Lapita period. Various selected aspects of these excavations have been published elsewhere (Bedford & Spriggs, 2008; Horrocks et al., 2009; Valentin et al., 2011) but here we summarise the data which provides an opportunity to assess them against the earlier insights from Hoffman regarding Epi's past (Hoffman, 2006). Three excavations in different locations and site surveys in general provide data related to the pre-Tombuk period on Epi. The excavations included extensive sampling of a massive 80 m × 40 m midden mound in the centre of the village of Mafilau on the south-central west coast of Epi, a series of burials on the wide coastal terrace at Burumba and investigations on Lamén Island located immediately off the northwest coast of the main island.

Archaeological deposits were first noted at the mound at Mafilau village by one of the authors (SY) during construction of a church building on top of the mound. Burials, pottery sherds, marine shell and cooking stones were identified near the surface and at a depth of some 50 cm when the church foundations were being dug. Initial excavations in 2005 confirmed the artificial nature of the mound and provided details regarding its extent, stratigraphy and depth. At its high point it rises some three metres above current ground surface which presented logistical challenges in relation to obtaining a full stratigraphic profile. More extensive excavations in 2006 and 2008 provided the full depth, stratigraphic definition and composition of the mound. Excavations reached sterile beach deposits at 5.5 m below the top of the mound. The top 50 cm comprised largely natural accumulation that post-dated the midden dumping period and the bottom 50 cm consisted largely of beach sand with only occasional midden material. The total depth of concentrated midden then was 4.5 m, comprising primarily pottery, marine shell, shell artefacts and associated debitage and cooking stones in a tephra-rich matrix (Figure 2). Fine layering and thicker lenses, along with patches and concentrations seen in the sections suggested it represented secondary dumping where baskets of midden collected elsewhere had been regularly dumped across the mound. Radiocarbon dates from Mafilau demonstrate that the feature accumulated relatively rapidly. Five dates on nut charcoal and/or coconut shell recovered from throughout four and a half metres of the deposit returned overlapping calibrated ages at 2 SD between 2767 and 2432 calBP (Bedford & Spriggs, 2008: 104, Appendix 1). An updated summary of ^{14}C dates from Epi sites is presented in Table 1.

The Mafilau mound is the earliest site yet identified from Kuwae. The dates fall in a flat section of the calibration curve⁶ but there are a number of aspects which suggest that the bulk of the mound and midden deposits date to the immediately post-Lapita period. The consistency throughout of the pottery style and shell artefactual material suggests a very rapid accumulation. The pottery-bearing contexts of the Mafilau mound overlap in age with the Early and Late Erueti phases of the central Vanuatu ceramic sequence for Efate and the Shepherd Islands (Bedford, 2006, 2009). Stylistically the pottery bears various similarities to assemblages from south-central Vanuatu, with an initial assessment suggesting it could represent a “diluted form” of the Erueti style (Spriggs & Bedford, 2008: 106). A recent analysis of the entire assemblage generally supports this view. It was possible partially to reconstruct several pots from large sherds originating in a single cache within the mound; these are relatively small, plain globular-bodied vessels with outcurving rims. They would not be out of place among Early Erueti assemblages from Efate, with the exception that they lack the widened flat rim that characterises those assemblages to a large extent. This discrepancy extends to the entirety of the Mafilau assemblage, which is instead dominated by outcurving rims with round notched lips, such as those

favoured during the earlier transitional (Lapita to Erueti) Arapus phase on Efate. In fact, several sherds from the mound resemble Arapus examples in decoration and form more than Early Erueti, suggesting that potting communities around Mafilau conserved elements from the earlier phase over innovations that are seen further south where the distinctive widened flat lip is dominant. The assemblage of 232 sherds consists overwhelmingly of plain vessels, another feature associated with the Arapus and Early Erueti phases on Efate. With the exception of notching on the lip, decorated sherds are rare (sherds with visible decoration, $n = 24$) but also appear to conform to techniques and motifs utilised in other Early Erueti assemblages, mostly utilising linear incision. In some instances, this is combined with oblique incised gashes to create more complex patterns; there are examples where oblique incised lines have been used to produce a rough chevron pattern (Figure 3a). The Late Erueti phase pottery (2600–2200 BP) found on Efate is dominated by vessels with incurving rims, notching on the lip and with body decoration a standard feature, techniques and many motifs continuing from the earlier phase. However, neither these vessel forms nor such a high frequency of vessel decoration are evident from the Mafilau assemblage. Other surface-collected pottery from the area around Mafilau confirms continued connections with the Shepherd Islands and Efate up to c. 1600 BP, as distinctive sherds associated with the Early Mangaasi phase were found at both Mafilau and Atunga (Figure 3b,c).

Shell artefacts recovered from the mound provide further evidence of connections to the Early Erueti phase on Efate and confirm the interconnected nature of the region at this time (Bedford & Spriggs, 2008: 106; Harvey, 2021). These include numerous *Tridacna*, *Conus* and *Rochia* shell rings consistent with types found during the Lapita and immediately post-Lapita periods across Vanuatu and the wider southwest Pacific (Bedford, 2006: 203–218; Harvey, 2021: 94–97; Kirch, 2021: 428–438; Langley et al., 2019). More definitively associated with the Early Erueti phase and restricted to contexts from central Vanuatu are distinctive cut and drilled units of *Spondylus* shell and *Chama* shell drilled units. These represent a new form of personal adornment developed during this period and specific to this region. The *Spondylus* shell units are finely made elongated rectangular units of varying length, cut from the rib of the shell utilising the contrasting orange/red and white surfaces of the exterior and interior of the shell. At each end of the unit a fine hole has been drilled suggesting that they may have been sewn onto some form of belt (Figure 4a, also a variation shown, 4b). The *Chama* shell units have holes drilled at each end and are generally less modified (Figure 4c). Rectangular units of both types produced using these taxa have been identified from the Erueti and Arapus sites on Efate (authors unpublished data), the long type utilising *Spondylus* being the more numerous. Grooved sea urchin (Echinoidea) spines also occur relatively frequently within the assemblage from Mafilau (Figure 4d). Similar specimens have been identified dating to c. 2900 BP from

FIGURE 2. (a) View of Mafilau mound with excavation team assembled around Test Pit 1 on top of the feature. (b) Richard Shing points towards the top of the dense midden and tephra-rich deposits that constitute the mound. (c) The highly stratified section of the mound is revealed to a depth approaching 5 m. (d) Stratigraphic profile illustration, originally published in Horrocks et al. (2009) with levels of dated samples indicated (left); plot of ^{14}C dates from the mound (right). All photographs: Stuart Bedford 2008.

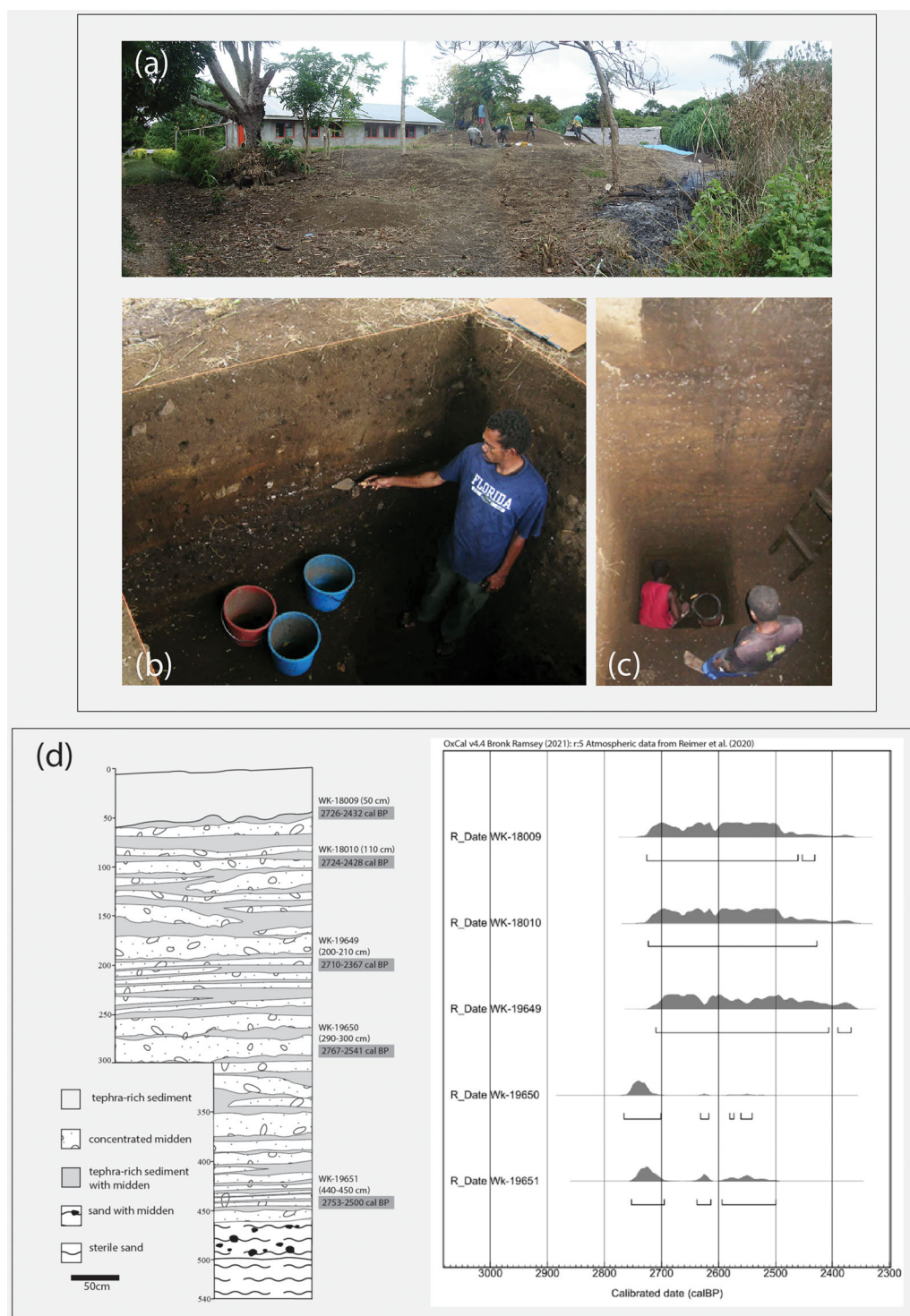


Table 1. Summary table of ^{14}C dates from Epi archaeological sites.

Sample number	Site	Depth	Material	Uncalibrated date	Calibrated date (95.4% unless otherwise indicated)	Reference	Notes
WK-18009	Mafilau mound	50 cm	Coconut shell	2493 $\pm$ 33	2726–2432 calBP	Bedford and Spriggs (2008): 104, Table 1	†
WK-18010	Mafilau mound	100 cm	Charcoal	2486 $\pm$ 32	2724–2428 calBP	Bedford and Spriggs (2008): 104, Table 1	†
WK-19649	Mafilau mound	200–210 cm	Nut shell	2465 $\pm$ 31	2710–2407 calBP	Bedford and Spriggs (2008): 104, Table 1	†
WK-19650	Mafilau mound	290–300 cm	Nut shell	2592 $\pm$ 32	2767–2541 calBP; 2767–2702 calBP (89.7%)	Bedford and Spriggs (2008): 104, Table 1	†
WK-22304	Lamen Island, TP3	110–120 cm	Charcoal	405 $\pm$ 30	515–327 calBP; 515–429 calBP (77.6%)	This study	†
WK-22305	Lamen Island, TP4	170–190 cm	Shell (<i>Lambis lambis</i>)	1296 $\pm$ 31	919–663 calBP	This study	†
WK-22306	Lamen Island, TP4	210–230 cm	Shell (<i>Turbo chrysostomus</i>)	1857 $\pm$ 30	1508–1243 calBP	This study	†
WK-22307	Lamen Island, TP4	230–250 cm	Shell (<i>Periglypta puerpera</i>)	2014 $\pm$ 36	1691–1377 calBP	This study	†
WK-19850	Burumba, TP1	Upper cultural deposit	Shell	465 $\pm$ 35	199 calBP–modern	Valentin et al. (2011): 54	†
WK-25769	Burumba, burial 5		Human bone (skull fragment)	1464 $\pm$ 30	1350–1180 calBP	Valentin et al. (2011): 54, Lipson et al. (2018), Table 1	†
PSUAMS-2460	Burumba, burial 5		Human bone	1490 $\pm$ 15	1380–1240 calBP	Lipson et al. (2018), Table 1	†
PSUAMS-1841	Burumba, burial 5		Human bone	1530 $\pm$ 20	1340–1180 calBP [1410–1280 calBP]	Lipson et al. (2018), Table 1	†
PSUAMS-2428	Burumba, burial 5		Human bone	1395 $\pm$ 15	1300–1170 calBP	Lipson et al. (2018), Table 1	†
WK-25770	Burumba, burial 3		Human bone (femur fragment)	1189 $\pm$ 33	1230–1005 calBP; 1173–1051 calBP (88.5%)	Valentin et al. (2011): 54	†
WK-19644	Burumba, burial 3		Charcoal	1467 $\pm$ 33	1374–1177 calBP	Valentin et al. (2011): 54	†, ‡
WK-56111	Wampi, burial 4		Human bone	213 $\pm$ 21	220–140 calBP	This study	†
PSUAMS-1922	Wampi		Human bone	255 $\pm$ 20	300 calBP–modern	Lipson et al. (2018), Table 1	†
PSUAMS-1923	Wampi		Human bone	225 $\pm$ 20	280 calBP–modern	Lipson et al. (2018), Table 1	†

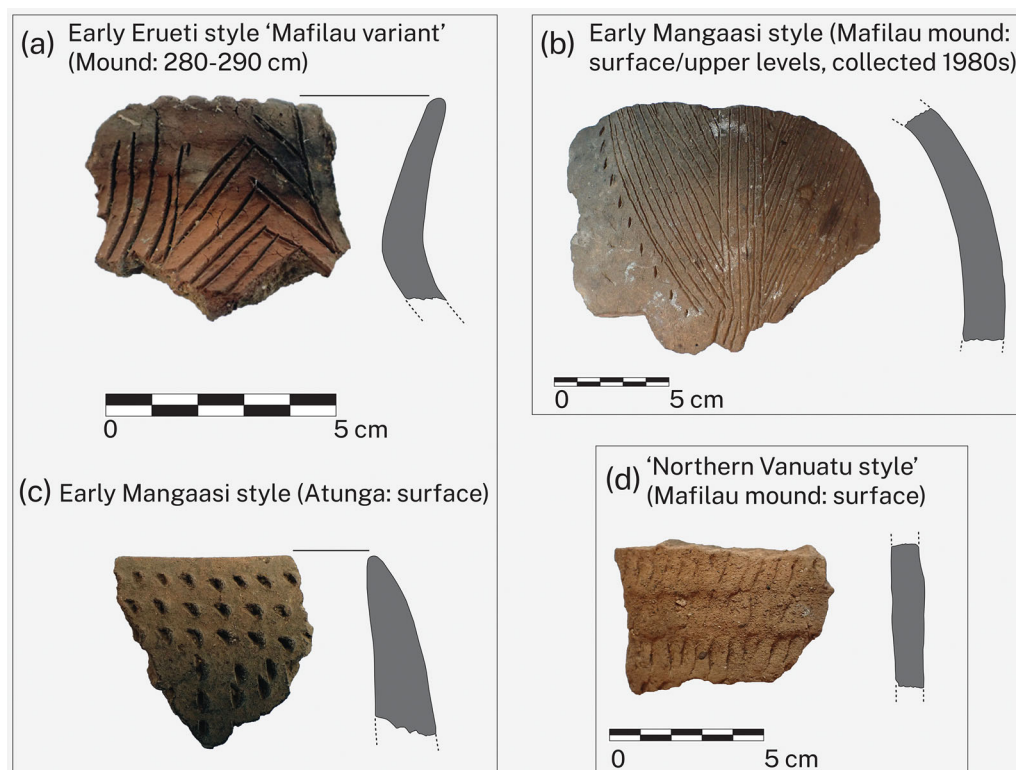
† Terrestrial charcoal and marine shell dates have been recalibrated for this publication using OxCal v4.4 (Bronk Ramsey, 2021) and the IntCal20 atmospheric curve (Reimer et al., 2020) or the Marine 20 calibration curve, with a Delta R value of -109 ± 10 (Heaton et al., 2020).

‡ Dates derived from human bone samples are presented as they appear in Lipson et al. (2018): (Table 1).

§ Valentín et al. (2011); Wampi burial 4 (WK-56111) previously unpublished but calibrated using the same corrections as Valentín et al. (2011); see those publications for calibration details.

¶ Inconsistent with direct date for skeleton and presumed to represent either previous activity at site or inbuilt age (Valentin et al., 2011: 54)

FIGURE 3. (a) Rim sherd from Mafilau mound featuring outcurving rim, notched lip and a rough linear incised pattern reminiscent of Early Erueti examples from Efate (the rounded lip presents a contrast with examples from Efate, which typically employ a widened flat lip). (b) Decorated body sherd collected on or near the surface of the mound feature during construction of a church house—the motif is typical of Early Mangaasi examples from Efate and Tongoa. (c) Decorated rim sherd collected from the surface at Atunga, near Mafilau village, featuring form and decoration typical of Early Mangaasi examples. (d) Body sherd collected from surface of Mafilau mound featuring a coil-built form and fingernail impression typical of pottery from northern Vanuatu, such as the Chachara Ware vessels produced on Malakula during the last 1000 years (Bedford, 2006).



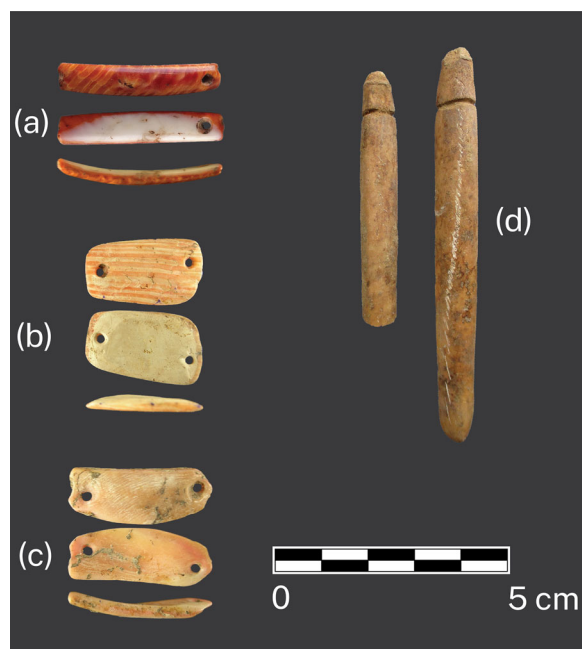
the Arapus site on Efate (Bedford, 2006: 208), demonstrating further evidence of interconnectivity between communities in central Vanuatu, but they have also been described from Lapita and immediately post-Lapita sites throughout Vanuatu and the southwest Pacific more broadly (Best, 1981: 15, 1984: 461; Janetski, 1976: 72-73; Kirch & Yen, 1982: 271; Spriggs, 1984: 217). However, as Bedford (2006: 208) notes, sea urchin spines exhibiting this form of modification are relatively rare overall and are infrequent among the assemblages in which they have been identified. The seven specimens from the Mafilau mound therefore comprise a comparatively large collection.

Marine midden shell dominated the recovered material from Mafilau. Vertebrate remains were also recovered and are under analysis at present and will be reported in detail together with the shell data in a forthcoming publication. Substantial midden deposits are often associated with early phases of settlement and may reflect an initial reliance on locally abundant marine and terrestrial faunal resources as a central aspect of subsistence strategies prior to gardens becoming fully established (Kinaston et al., 2014; Valentin et al., 2010). Evidence for the establishment of horticultural

activities during this period was identified by the presence of banana (*Musa*) phytoliths throughout the mound (Horrocks et al., 2009).

The only other substantial pre-Tombuk excavations undertaken on Epi Island itself were carried out at Burumba, a locality situated on a wide, flat terrace between the sea and steep hills of central west Epi. This location is known to have been an area of substantial settlement during the early historic period, when it was selected as the site for the island's first mission station around 1880 (Miller, 1987). Local people identified human skeletal remains while digging a rubbish pit at the Kalala plantation and gave permission for the burials to be excavated. Ultimately a 5 m × 2 m area was excavated to a depth of 150 cm at which depth sterile beach deposits were identified. In total the remains of nine individuals were identified in five burials which had been interred within the layer immediately overlying the sterile beach sand (one burial consisted of the crania of five individuals). ¹⁴C ages for these burials cluster in the late second millennium calBP (Valentin et al., 2011: 54; Lipson et al., 2018: Table 1) (see Table 1). Details related to mortuary aspects of the burials

FIGURE 4. Worked shell artefacts from Mafilau mound. (a) Elongated drilled unit in *Spondylus* sp. shell (note the artefact has broken at the perforation on the left side). (b) A variation of the rectangular drilled unit in *Spondylus* sp. Shell. (c) A similar example in *Chama* sp. Shell. (d) Grooved sea urchin spines. Photographs: Iarawai Phillip and Richard Shing.



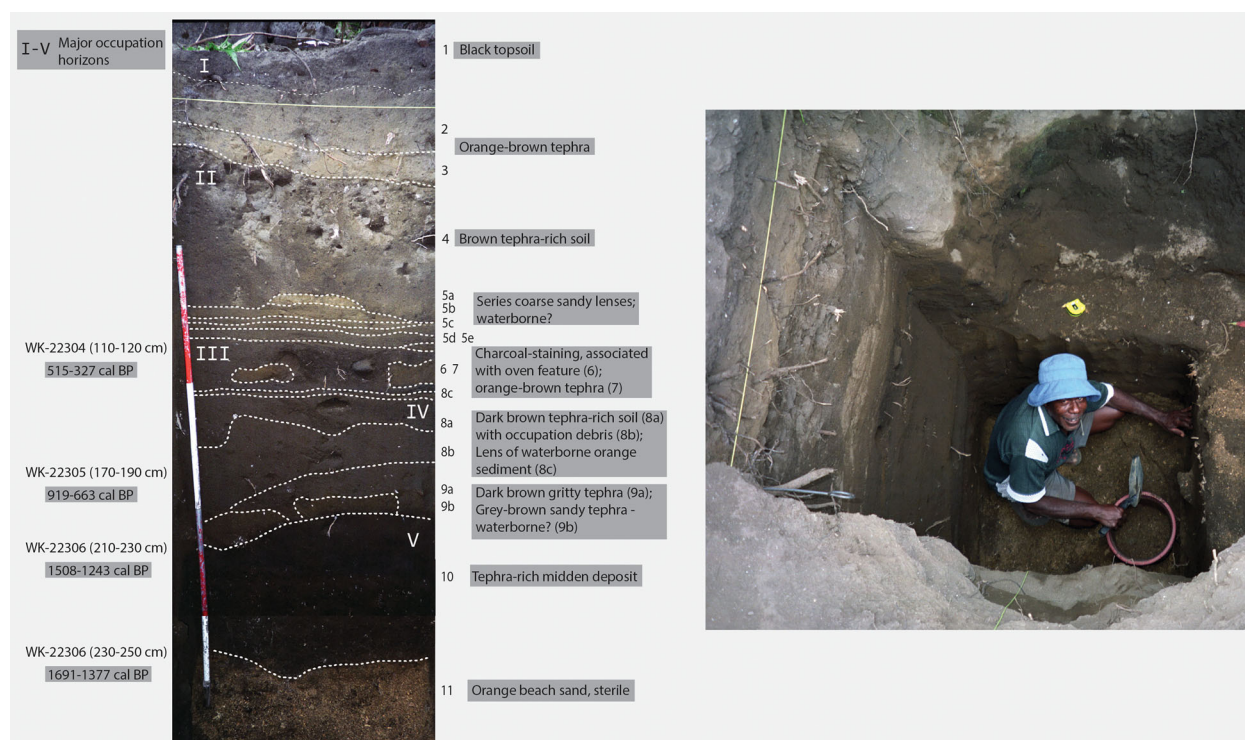
are reported elsewhere (Valentin et al., 2011). What is relevant here is the composition of the five distinct layers built up over a relatively rapid period (1400 years at most) along with the recovered pottery. Deposition of these layers appears to be primarily related to slopewash associated with cyclonic events which were interspersed with evidence of occupation. Two layers appear to consist primarily of very similar tephra-rich deposits. An upper layer consisting of a 20- to 30-cm-thick deposit of yellow-brown (tephra-rich) sediment was attributed by locals to having been deposited during a heavy rainfall event in 1951, and we interpret the much thicker earlier layer as being associated with a similar event. Any obvious primary tephra that might have been associated with the Tombuk eruption does not seem apparent. The pottery recovered from the excavations comprised 30 sherds. Of those which display decoration ($n = 7$) or evidence of vessel form, none could be assigned to any known style such as Mangaasi or Aknau, suggesting pottery production continued in the Burumba area post-Tombuk and adopted formal and decorative aspects which are to be investigated via future research.

Further excavations relating to the pre-Tombuk period were undertaken in 2006 on Lamén Island, a small coral islet immediately off northwest Epi. Four 1 m × 1 m test pits were excavated on the south of the island, behind a sheltered beach where evidence of early settlement seemed likely. The stratigraphy revealed thick deposits consisting of interspersed tephra-rich and cultural layers (Figure 5); these

would have accumulated rapidly as a result of frequent volcanic ashfall events, evidently the major driver of landscape formation on this small island.⁷ Test pits were excavated to a maximum depth of 300 cm, exposing sterile beach deposits. A date obtained from the beach level at the base of the deposit of 1691–1367 calBP highlights the rapid nature of accumulation and suggests that it is from this period that the island became habitable, as apart from a small ancient core in the southwest, the bulk of the island is a large flat terrace (see Table 1). The densest deposits of pottery relate to contexts which correspond in age to the Late Mangaasi and Aknau phases of the central Vanuatu sequence (1600–550 BP). No clear relationship is apparent, however, between the Lamén Island assemblage and the former, and certainly no examples of the distinctive Aknau style were identified. This assemblage is instead characterised by a more diverse range of decorative elements and forms, some of which appear to present parallels with pottery found further north on Malakula. The excavations on Lamén Island confirm that pottery production continued in the northern region of Epi, possibly through to the early period of European contact. There is no evidence for an abrupt discontinuity in ceramic use and production such as has been observed on Tongoa and Makira Islands following the Tombuk eruption. While there is clear evidence of major volcanic activity on northwestern Epi and Lamén over the last 2000 years, this seems most likely to relate to nearby Ambrym and Lopevi which feature prominently in the historic record of eruptions affecting the area. No distinctive tephra deposits were identified which would align with proposed dates for the Tombuk eruption. Questions relating to the identification of tephra deposits from Lamén Island will be addressed through chemical profiling which is currently being undertaken.

In summary, the massive midden mound located at Mafilau on Epi represents the earliest archaeological evidence relating to Kuwae Island generated to date. It consists largely of midden associated with the immediately post-Lapita period on the island. The rapid accumulation of the mound appears to represent the dumping of midden over a relatively short period by a large, nucleated community living near the sea during a colonising phase involving the establishment of garden systems in the area. The recovered pottery and shell artefacts have direct parallels to materials which have been recovered from sites dating to the same period on Efate, namely the Early Erueti phase, indicating high levels of interconnectedness. This period of interconnectedness linking Kuwae with islands as far south as Efate evidently remained active until around 1600 BP; surface collected sherds clearly associated with the Early Mangaasi phase (2200–1600 BP) are present on Epi and have been excavated on Tongoa where the phase represents the earliest evidence for occupation. However, innovations in pottery associated with the development of Late Mangaasi (1600–1200 BP) do not appear to have extended to northwest Kuwae based on current evidence from Epi, and the distribution of the subsequent and very distinctive Aknau-style pottery remains unclear across the Kuwae

FIGURE 5. Left: Stratigraphic profile of Lamén Island Test Pit 3 demonstrating interstratified cultural and tephra deposits with levels indicated from which ^{14}C dates have been obtained. Photographed by Matthew Spriggs in 2006 and stratigraphic details adapted from a field recording produced by Spriggs; Right: Salkon Yona at the base of the deposits. Photograph: Matthew Spriggs 2006.



landmass. Of course, Late Mangaasi and Aknau represent the terminal phases in the pottery sequences of Efate and southeast Kuwae (Tongoa) respectively. As the pottery evidence related to later periods from Burumba and Lamén Island indicates, production and/or use of pottery obviously continued until much more recently on Epi but appears to have adopted a very different trajectory even prior to the abandonment of pottery on Efate and the Tombuk eruption. The current albeit somewhat unclear picture of this transitional period highlights major chronological gaps in archaeological evidence relating to the occupation of Kuwae, a problem which may be resolved through future field work and analysis.

POST-TOMBUK: THE ARCHAEOLOGY OF EPI AND TONGOA ISLANDS

The Tombuk eruption resulted in a vastly different physical and cultural landscape across the area which once comprised the island of Kuwae. The collapse of a substantial portion of Kuwae during the eruption produced a large submarine caldera which today separates the two primary remnant landmasses of Tongoa and Epi. On Tongoa, a stratigraphic horizon consisting of Tombuk deposits is present across much of the island and is in places many metres thick. Except for the somewhat miraculous

escape of several canoes recounted in the oral traditions (Ballard et al., 2023: 4), it is highly improbable that any of the population occupying this region of Kuwae could have survived the eruption. On the other side of the caldera, Epi is ten times larger and orientated in a north-westerly alignment, and in contrast to Tongoa, it seems that there was indeed the potential for survival across much of the western half of the island. The archaeological record generally appears to support such a scenario although much more extensive survey and volcanological investigation are required to establish the extent of associated pyroclastic and ashfall deposits across Epi's landscape.

On Tongoa, the post-Tombuk archaeological picture, with associated oral traditions, is relatively straightforward. The research that Garanger (1972) carried out in collaboration with Tongan communities confirmed the massive eruption through the identification of pyroclastic deposits at numerous sites on the island. A total physical transformation would have ensued as much of the landscape was engulfed by these pyroclastic flows, producing devastating impacts which would not have been survivable. For the most part, Garanger's excavations relating to the re-settlement of the island focused on a series of chiefly and other graves (Garanger, 1972: 83-100). Many featured burial characteristics and associated grave goods very similar to those in burials associated with the Chief Roi Mata cemetery site excavated on Retoka Island, off Efate,

which date to around 400 BP (Bedford et al., 1998; Lipson et al., 2020).⁸ The Tongan burials likely date to a similar period or later.⁹ The excavations also confirmed the complete absence of any pottery associated with the communities who re-settled the island.

On Epi, the surveys of heritage sites by Hoffman and Yona (Hoffman, 2004, 2006) are key to understanding the cultural landscape of Kuwae's largest remnant. Although they did not carry out any excavations, among the sites they recorded were numerous megalithic features distributed from the north to the centre of Epi that are associated with customary dancing grounds, or *nasara*, and which reflect continuing connections between Epi communities and adjacent regions to the north in the post-Tombuk period. Many of these ceremonial complexes, such as a series of stone enclosures at Lumbil *nasara* in the interior of the island behind Mafilau and the structures at Purvanua,¹⁰ inland from Ponkovio, present obvious parallels with sites on Malakula. The stone dolmens on Lamén Island, immediately off the northern tip of Epi, are especially reminiscent of those found on Malakula and its offshore islands (e.g. Layard, 1942: 34-37). These similarities are consistent with ethnographic observations made regarding Epi social structure in the early twentieth century where ranks associated with a local variant of the *nimangki* system were recorded on the island (Deacon & Wedgwood, 1929: 498-506).

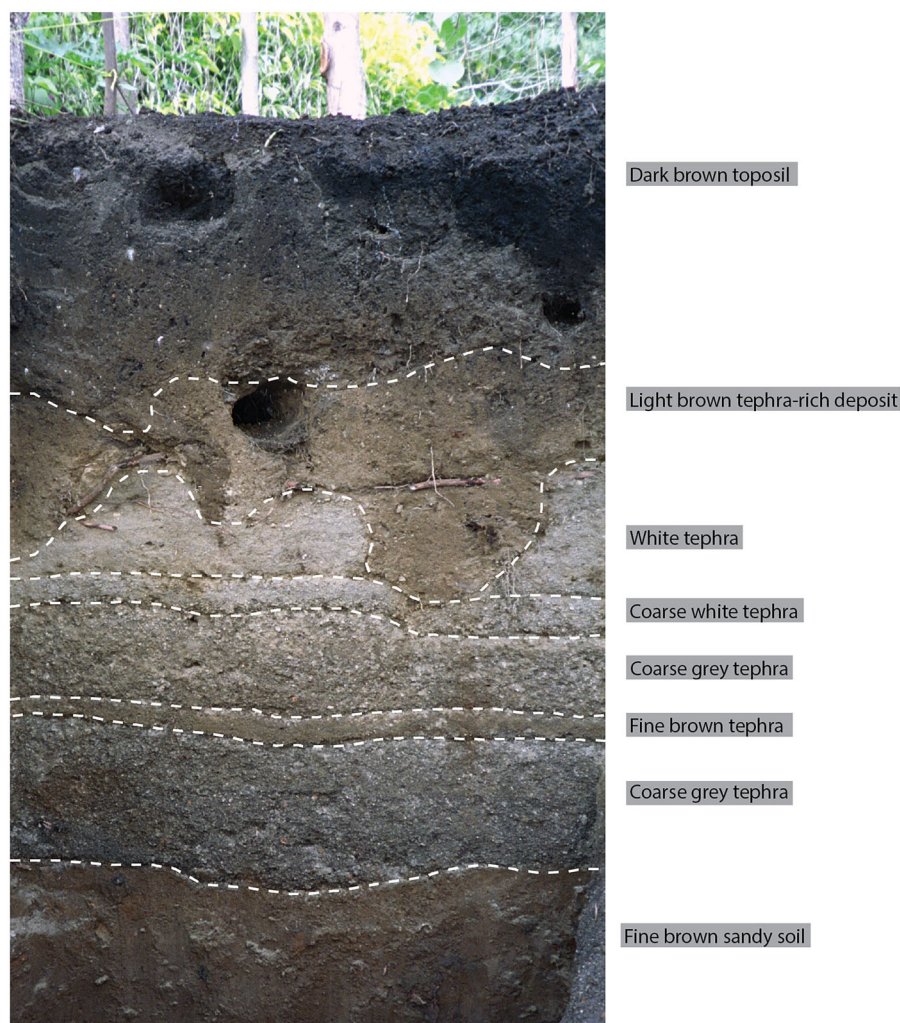
The *nimangki* system, generally synonymous with "graded societies" (known also by various names including *maki*, *namaki*, *mage*, *suque*, etc.), is a social institution of varying forms prevalent across northern and north-central Vanuatu in which participants acquire power by ascending a hierarchy of ranks, each accompanied by progressively more levels of control over aspects of both the physical and spiritual worlds (Bonnemaison, 1996a: 200-216; Deacon, 1934; Deacon & Wedgwood, 1929; Jolly, 2012; Layard, 1942; Speiser, 1996 [1923]: 342-344). Historically, rituals associated with the *nimangki* were carried out in ceremonial settings similar to those found on Epi and on many of the islands in northern Vanuatu. Central Epi can be seen as marking the southern limit of the distribution of *nimangki* practices, and as the location where they border the distinctive hereditary chiefly title systems of south-central Vanuatu, with which they are often contrasted in discussions regarding power and status in the archipelago (Bonnemaison, 1996a). Another quite different stone arrangement was also recorded by Hoffman and Yona towards the extreme southeastern end of Epi at Filakara and consists of a modest "headstone" around which smaller stones have been positioned in an oval layout. This arrangement is more similar to the surface features associated with chiefly burials excavated by Garanger on Efate and Tongoa than it is to the "megalithic" structures related to *nimangki* practices to the north, which include dolmens and standing stones (often tubular or otherwise modified to a lesser extent) (Bedford, 2019b: 69-72). Furthermore, the Filakara site is said to mark the grave of Chief Roi Muri, a brother of the more famous Roi Mata of

Efate, whose burial complex is located on Retoka (Hoffman, 2006).

Excavated contexts relating to the last 550 years on Epi are relatively few although, as discussed, the Lamén Island and Burumba excavations indicate that pottery continued to be produced and/or used in these areas post-Tombuk. Furthermore, a number of surface-collected sherds from various locations are clearly fragments of coil-built vessels similar to examples made by potting communities of Malakula and other northern islands in recent centuries (see Figure 3d, above). Whether this pottery was imported or produced locally on Epi is unclear and presents a question to be addressed by the current project.¹¹ The only other excavation dating to the post-Tombuk period on Epi was of burials at Wampi. Radiocarbon dates obtained from these returned calibrated age ranges in the last 300 years to modern (see Table 1). The burials were oriented East-West and appear to be Historic in age, associated with a nearby Christian missionary outstation at Botnembau which was occupied from around the turn of the twentieth century until it was moved to Taliko in 1910 due to depopulation (Miller, 1987: 343, 374, 426). Interestingly, one of the individuals displayed a loss of incisors, possibly related to deliberate extraction, a practice reported from Malakula and Santo during the nineteenth and early twentieth centuries, where it was performed on girls undergoing various rites (Deacon, 1934: 480; Jolly, 1994b: 141; Speiser, 1996 [1923]: 162). The Wampi burials were cut from the current ground surface into a series of layered tephra deposits, approximately 80 cm thick in total (Figure 6). Based on the age of the burials and the extent of the deposit, the Tombuk eruption is the most likely source for these tephra deposits. Wampi is the eastern-most site on Epi to have been excavated, and the closest to the presumed eruptive centre, at some 30 km distant. If Tombuk can be confirmed as the source for these tephra deposits, this would suggest that severe impacts of the eruption extended across much of the eastern portion of what is now Epi.

In summary, the post-Tombuk landscape across Epi and Tongoa indicates a range of both similarities and differences although it also must be emphasised that archaeological investigations focusing on this period remain fairly limited. On Tongoa, research primarily focused on identifying and confirming a whole series of burials that post-dated the massive eruption. It also confirmed the widespread effects of the eruption and that there is no sign of pottery production post-Tombuk. On Epi, surveys have confirmed the widespread nature of megalithic features at least as far southeast as Mafilau that indicate connections with cultural practices to islands in the north. Another stone arrangement in the very southeast at Filakara suggests connections with the resettlement of Tongoa and this area of Epi. Surface-collected pottery and excavations on Lamén Island and Burumba indicate that production and use continued across much of Epi post-Tombuk. Excavations at Wampi provide indications of the potential destructive nature and extent of the Tombuk eruption on Epi.

FIGURE 6. Stratigraphic profile of excavation carried out at Wampi demonstrating numerous layers of volcanic tephra. Photograph: Matthew Spriggs 2006.



LINGUISTIC AND GENETIC CONTRIBUTIONS

The linguistic record and regional distribution of languages provide further important details with regards to understanding the pre- and post-Tombuk social landscapes of Kuwae and its remnants. As summarised by Hoffman, work on Epi languages (Clark, 1985, 1996; Early, 1994; Tryon, 1976a, 1976b, 1979, 1986, 1999) demonstrates that five languages spoken on Epi today form a linguistic unit which is sufficiently isolated from others in the archipelago to preclude significant recent influence, such as might be expected had a complete resettlement or replacement of the population occurred involving groups from either south-central Vanuatu, or from islands to the north, such as Malakula or Ambrym. This is contrasted with the two languages spoken on Tongoa which have connections to islands further south, these being Namakir (also known as Namakura), which is also spoken on islands of the southern Shepherds, and Nakanamanga which is spoken on northern Efate. In a more recent update on the distribution and

spread of Nakanamanga in the region, the extreme southeast tip of Epi is also now included (Hermann & Walworth, 2020). This may relate mainly to more recent settlement of this area by Tongoans as Epi's population collapsed in the early Historic period but is also likely to have some historical depth given the gravesite at Filakara associated with the Efate-associated chief Roi Muri. Also suggestive of (presumably post-Tombuk) movements from the Shepherd Islands are records of the Livara language spoken by communities in east Epi, which is now extinct but was related to the Sasake dialect of Emae of the Nakanamanga language (Miller, 1987: 343; Ray 1893, 1926: 230).

Based primarily on linguistic data, Hoffman argued that migration from the north was not the primary factor in the repopulation of Epi following the Tombuk eruption, although he noted considerable cultural influence from that direction was clearly evident. In his assessment of whether Epi was resettled primarily as an internal process or was driven by migration from surrounding islands (as according to the oral traditions occurred on Tongoa, regardless of

whether migrant populations included descendants of Kuwae's original population), he advocated that significant areas of the island were sheltered enough from the most destructive impacts of the eruption that some of the population survived.

As noted, there are no existing recorded oral traditions from Epi which make explicit reference to the Tombuk eruption, contrasting strongly with the situation on Tongoa and the other islands of the Shepherd group further south. However, Hoffman (2006: 66–67) suggests that two oral traditions from the island may relate to the event, if somewhat obliquely. The first is a narrative which describes how all people living on Epi share a common ancestral village called Purvanua or Ruete (associated with a *nasara* mentioned earlier), located inland, and how the population spread from this village across the island. Hoffman suggests this scenario could allude to a resettlement of parts of Epi by a population which survived in a sheltered area following the eruption. The second narrative is perhaps more compelling; it recounts activities of two women, presumably amidst the aftermath of some catastrophic event. As they foraged in the bush for edible wild tubers (of a particular yam-like variety called *bao*, commonly regarded as a reliable food source in times of famine), they encountered a freshwater spring blocked by debris. In the process of uncovering the spring, they rescued a live man who had been buried in the rubble. For Hoffman, this is a clear allusion to events immediately following the Kuwae eruption (Hoffman, 2006).

Genetic studies drawing upon data obtained from both ancient and modern populations provide further detail relating to the human history of the region (Arauna et al., 2022; Bedford et al., 2018; Lipson et al., 2018, 2020; Posth et al., 2018, 2019; Spriggs & Reich, 2019). The ancient data for Epi is limited with the only samples being the burials from Burumba and Wampi, which conform with an overall trend towards high levels of “Papuan ancestry” among individuals associated with the post-Lapita period in Vanuatu; by comparison, most Lapita-age burials are characterised as being “East Asian” or “First Remote Oceanian” in terms of their genetic ancestry (Lipson et al., 2018; Lipson et al., 2020). This pattern is argued to reflect an influx of groups from Near Oceania, probably from New Britain, shortly after the original settlement of Vanuatu by peoples associated with Lapita, resulting in a significant genetic turnover in the archipelago after around 2500 BP (Lipson et al., 2020: 4853).¹² The four Epi burials included in the study, dating to well after Lapita, possess high levels of “Papuan ancestry” ranging from 90.6% ± 1.1% to 92.2% ± 1.2% (Lipson et al., 2018: 1159, Table 1).

The picture presented in a recent modern genomic study (Arauna et al., 2022) is also instructive, although we suggest much more complex than what has been summarised particularly for Epi with its history of migration from other islands dating from the late nineteenth century to work on plantations (Bedford & Shlomowitz, 1988). Using data obtained from 1433 living individuals from throughout Vanuatu, Arauna and colleagues attempt to reconcile the

modern genomic structure of the archipelago with a range of models reflecting 3000 years of settlement and migration history, the nature of admixture, marriage practices and relationships between language and genetic ancestry. Most relevant to discussions about Kuwae is the apparent break indicated by the modern data between northern and southern ni-Vanuatu genetic populations; these groups are delineated by a line running through the submarine caldera separating Epi and Tongoa (Arauna et al., 2022: 5, 8). In many respects, this rupture aligns with the archaeological data and oral traditions. However, while Arauna et al. (2022: 8) claim that “[...] oral traditions and linguistic evidence suggest that after this eruption, Tongoa and Epi were repopulated by distant populations,” the evidence presented here instead suggests that Epi was “repopulated” primarily via internal processes involving surviving groups from north and west Kuwae, with some influences from further north. The pre-Tombuk population across Kuwae may have been genetically similar, with diversification leading to the present situation taking place after the eruption, as Tongoa was resettled primarily by populations from the southern Shepherds and Efate. Alternatively, as Arauna et al. (2022: 5) suggest, ongoing volcanism on eastern Kuwae may have served as a barrier to gene flow between communities on either side, although this would contradict the rapid onset of the eruption implied by the Tombuk oral tradition and other narratives. The distribution of Early Mangaasi pottery as far as the Mafilau area also indicates that any level of volcanic activity on Kuwae prior to about 1600 BP did not impede the maintenance of social affiliations suggested by the presence of common decorative and formal characteristics within the pottery assemblages of communities across this zone (or the direct exchange of pots between them, as may have occurred). Such an obstacle was perhaps easily circumvented by the adept seafaring capabilities of these communities.

DISCUSSION

A thorough review of the evidence gleaned from several decades' worth of research on Tongoa and Epi allows us now to address some of the aims introduced at the beginning of this paper. Based on the integration of available archaeological evidence with the broader view from linguistic, genetic and ethnographic data, we develop an outline below of the social phenomena in which communities on these islands and their predecessor, Kuwae, appear to have been engaged at various points in the past, and suggest ways in which the Tombuk eruption and subsequent events may have been influential. We conclude by discussing some of the ways in which aspects of resilience thinking might be applied to the long-term volcanic history of Kuwae and central Vanuatu, stressing the importance of interactive networks and their various functions in allowing communities to persist in this environment. Lastly, we also consider briefly a range of potential positive aspects and opportunities presented to

groups inhabiting landscapes which are continuously being renewed and redefined by volcanic forces.

Patterns of connectivity

Similarities in material culture indicate high levels of connectivity between Kuwae, the Shepherd Islands, and Efate for some 1200 years following Lapita. During this period, communities across central Vanuatu produced broadly similar pottery and shell artefacts. Around 1600 BP, material culture links between Efate and Kuwae may have been in decline, as no evidence of Late Mangaasi has been obtained from parts of northwest Kuwae which correspond with present-day Epi, although this view may change as further field research is carried out. Certainly, from around 1200 BP there is no possibility of any shared pottery traditions, as it is abandoned by communities on Efate. At approximately the same time, the highly distinctive Aknau-style material appeared among pottery assemblages from southeast Kuwae and the Shepherds. It is unclear how widely Aknau was distributed across Kuwae as it has yet to be identified from contexts on Epi. Again, this is a question which may be resolved through additional archaeological research on Epi in the near future. As Aknau pre-dates the Tombuk eruption, however, it is unlikely that its distribution would be restricted to spaces which only took on their present form after the event. It can be stated more definitively that neither Late Mangaasi nor Aknau appear to have had significant influence on the roughly contemporary assemblage excavated on Lamén Island, at the distant northwest end of Kuwae.

The distinctive developments in the pottery sequence of northern Kuwae from around 1600 BP may reflect that connections were already in place with communities on Malakula and other islands to the north prior to the Tombuk eruption. Post-Tombuk, these links are clear and based on multiple lines of evidence, including the presence of northern-style pottery in surface collections, as well as the numerous megalithic features recorded by Hoffman and Yona (Hoffman, 2004, 2006) which likely functioned in localised expressions of the *nimangki* system observed by ethnographers in the late nineteenth and early twentieth centuries (Deacon & Wedgwood, 1929; Speiser, 1996 [1923]). Epi is also implicated in the expansive ethnographically recorded exchange networks which have linked communities across much of northern Vanuatu (Bedford & Spriggs, 2008; Huffman, 1996). The northern orientation of Epi's post-Tombuk cultural outlook opposes that of the other major Kuwae remnant, Tongoa, which is integrated into the network of hereditary chiefly titles extending through the Shepherd Islands south to Efate. Communities within this network are also linked through language and oral traditions (e.g. Guiart, 1973), and archaeologically by broadly similar burial practices and the absence of pottery (Bedford, 2006; Valentin et al., 2011). The striking cultural and interactive disjuncture between Epi and Tongoa has been highlighted by various authors previously (Bedford & Spriggs, 2008; Bonnemaïson, 1996a; Huffman, 1996: 184, Fig. 213) and has been further

emphasised more recently in an overview of modern genetic data (Arauna et al., 2022). Although Kuwae may not have been a culturally homogeneous island for the entirety of its human history up until its destruction, we suggest that the sharp divide between its remnant islands occurred only within the last half-millennium and was primarily the outcome of resettlement of Tongoa following the Tombuk eruption by groups deriving largely from Efate, with a component from the Shepherd Islands.

During this period of resettlement, aspects associated with cultural transformations which had been ongoing further south were extended to Tongoa, and clearly at some stage to southeast Epi with the distribution of the Livara language, evidently a dialect of Nakanamanga (Ray, 1893), to the far eastern end of the island. These developments relate to the proliferation of the more “Polynesian-style” chiefly power structures across south-central and south Vanuatu, and the abandonment of pottery – phenomena which may have been influenced by contacts with western Polynesia or Polynesian communities established within the archipelago (Flexner et al., 2019; Zinger et al., 2020). Likewise, the emergence of the *nimangki* system on Epi, the monumental sites associated with them, and the presence of coil-built pottery fitting into a northern regional style all probably relate to relatively recent developments in the human history of the archipelago. These also reflect complex movements, interactions, and exchanges linking communities across the vast breadth of western Melanesia from New Guinea through the Bismarck and Solomon archipelagos to central Vanuatu over the last thousand years (e.g. Bedford & Spriggs, 2018; Specht, 2024). Whereas we have argued that resettlement from the south was the primary mechanism in the cultural transformation of Tongoa following the Tombuk eruption, we propose that the post-Tombuk cultural landscape on much of Epi may have developed in situ through relationships between communities which survived the eruption and islands to the north.

It is important to emphasise that the social worlds of communities inhabiting the remnants of Kuwae did not fracture into totally discrete northern and southern cultural and interactive spheres. As Bonnemaïson (1996b: 174–175) notes, “shared linguistic features and trading relations recorded by oral tradition [reveal] that there are no really abrupt breaks in the archipelago's system of internal communication.” The Shepherd Islands, especially Tongoa and Emae, dominate the view from almost any point along Epi's south coast, and contact between these regions would have continued in the post-Tombuk period, as the linguistic picture demonstrates. In many ways east Epi communities may have been more integrated into the social environment of the Efate-Shepherds region – the apparent absence of recent pottery across much of east Epi would further support this – but language and other connections were paralleled by exchange relationships (Tryon, 1996: 178), which in instances spanned the divide between the seemingly contrasting social systems bisecting the remnants of Kuwae. For example, at the turn of the twentieth century

the missionary on Lamén recorded that pigs had been traded to that island from Sasake village on Emae (Miller, 1987: 399); these were perhaps then traded on to southeast Malakula (Huffman, 1996: 184–185). Epi can therefore be seen as an important link in a chain of connection and a crossroads between diverse cultural and linguistic entities. We might also imagine how this situation could give rise to the emergence of complex, hybridised and highly localised expressions of social and political systems (Bonnemaïson, 1996a: 200) and must keep such considerations in mind as we attempt to reconstruct aspects of this island's past.

As Hoffman (2006) suggested there is evidence to suggest that a portion of Kuwae's population could have survived the event on Epi, including the relative independence of its languages and possible allusions to survival in oral tradition. One question which must be addressed in order to assess the validity of this hypothesis is whether the Tombuk eruption really could have been survivable for any of Kuwae's population. In contrast to Tongoa, which has been a focus of volcanological and archaeological research for decades, the extent of confirmed Tombuk deposits on Epi is virtually unknown. Based on the radiocarbon ages of the burials at Wampi, the major Kuwae eruption would be a highly probable candidate for the source of the distinctive tephra into which the remains were interred. This site is situated more than 30 km from the presumed eruptive centre, and if Tombuk can be confirmed as the source of this deposit, its considerable thickness at this distance would suggest that the impact across most of the eastern portion of Epi was severe. At this stage, we tentatively suggest that Wampi may represent a western limit for the extent of the destructive impacts which rendered eastern Kuwae uninhabitable for a period spanning multiple human generations; this must be confirmed through further survey and targeted investigation seeking evidence for Tombuk eruptive deposits on Epi. Pottery was obviously in use on Epi in the post-Tombuk period, but the nature of this sequence is ambiguous at this stage – another issue which we will seek to clarify through the current project. If the apparently late pottery identified from surface collections on Epi and from excavated contexts at Burumba represents a continuation of the earlier sequence, this would provide additional support to the argument that a population survived on northwest Epi participated in the development of the island's distinctive post-Tombuk character, as we have suggested above.

Long-term persistence, resilience and opportunity in a volcanic environment

Communities in this region have clearly experienced exposure to regular volcanic events of varying intensity throughout their history, as the tephra-rich, densely stratified Mafilau and Lamén Island excavations demonstrate. The most likely sources for these deposits are Ambrym and Lopevi, but an active volcano on Kuwae is also a potential candidate. Although this history is somewhat overshadowed by the catastrophic Tombuk eruption, it presents an opportunity to explore how volcanic

events at a range of scales impacted communities and the degrees to which they were able to cope. Clearly, based on the continuous deposition of cultural materials at these sites, these events did not typically result in disruption to occupation – at least not to the extent that any hiatuses are evident in the archaeological record. This does not preclude that regular volcanic events presented considerable challenges for communities living in this region in the past. Ash falls have the potential to destroy food crops, damage structures, and pollute or inhibit access to potable water sources (Blong, 1984, 2017; Cronin & Neal, 2000). Rather, evidence for continuous occupation supports a view of a highly resilient society in which strong social connections within and between communities supported them to withstand moderate levels of disturbance caused by volcanic eruptions and other natural hazards, such as cyclones.

Events on the scale of the major Kuwae eruption would certainly have tested the resilience of connections between groups and required that they were extensive enough to provide access to relatively unaffected areas. As the oral traditions recount, groups from southeastern Kuwae (i.e. Tongoa) fled the eruption in canoes bound for the Shepherd Islands and Efate where they took residence until conditions on Tongoa allowed for the new island to be resettled (Ballard, 2020). This arrangement is suggestive of a relationship in the mode described by Torrence and colleagues in which one role of social exchange networks was to facilitate a level of residential flexibility, allowing groups from an impacted region to take “temporary refuge” in another during a crisis (Torrence & Doelman, 2007; Grattan & Torrence, 2007: 10). Yet, curiously, whatever social exchange network existed, it defied a major gap in terms of material culture by connecting pottery-using communities on southeastern Kuwae with groups on Efate which had long abandoned pottery. On northwest Kuwae (areas corresponding with present-day Epi), even based on the rather limited evidence available from pottery surface finds, it is clear that following the Tombuk eruption links were in place with pottery-producing communities in regions to the north. These connections may have emerged as surviving groups sought to establish new networks after the destruction of a large portion of the former Kuwae landmass, but it seems probable that they were already active and took on greater significance amidst the period of social upheaval which must have followed the eruption. Further work on northwest Epi will provide greater insight into its position in the social exchange networks operating in north-central Vanuatu during this crucial period, as well as a more comprehensive record of its long-term exposure to volcanic activity. Considered in combination, these aspects will present opportunities to explore the intersection of a range of social and environmental processes as one dimension of cultural transformation in Vanuatu.

Finally, it must also be recognised that the destructive impacts of volcanic eruptions are to some extent matched by their extraordinary creative powers. Indeed, were it not for the intense volcanic activity associated with the

subduction of the Australian plate along the New Hebrides trench (a section of the Pacific “Ring of Fire”) there would be no habitable land where the Vanuatu archipelago presently exists. These processes are active to a significant extent even on a human timescale. For instance, within less than two thousand years Lamén Island appears to have emerged as a suitable place to live largely through the accumulation of volcanic ash on top of a low coral islet, providing enough space to accommodate a considerable population and potentially offering numerous residential benefits over the environment on large islands¹³. On larger islands such as Epi and Tongoa, as well as the numerous others in the archipelago which receive regular exposure to volcanic ashfalls, tephra-enriched soils would have provided fertile ground in which the earliest human inhabitants of Remote Oceania were able to establish horticultural activities, and they have continued to support the production of various crops critical to the subsistence and market economies of Vanuatu. Lastly, the potential for volcanic activity to create empty landscapes may not be perceived as particularly benign, but nonetheless presents opportunities to at least some groups living in proximity to volcanic environments. Coming full circle with our earlier reflections on place-making, as Torrence (2008: 334–335, 339–340) notes, the groups which re-occupy these landscapes are empowered to recreate space, ascribe it with new meanings, and develop new conceptions of place. As Tongoa and parts of Epi emerged from the devastation of the Tombuk eruption, communities occupying this transformed landscape for the first time must have engaged in similar acts of place-making, endowing its features with narrative significance, reinstating existing familial entitlements or conjuring new ones, and asserting claims to knowledge and power with respect to land.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

NOTES

1. Eight active sub-aerial volcanoes, four active sub-marine volcanoes. This includes the actively volcanic Matthew and Hunter Islands, which are subject to territorial claims by both Vanuatu and France.
2. This name derives from Shepherd Islands traditions and has been adopted by Ballard and colleagues (Ballard, 2023; Ballard et al., 2023) in order to refer specifically to the c. 1452 AD eruption and differentiate from potentially a whole series of eruptions emanating from across Kuwae and adjacent islands.
3. ARC funded Discovery Project DP200102320 *Kuwae 1452 AD: multi-disciplinary perspectives on a Pacific super eruption*.
4. The Shepherd group comprises six inhabited islands between Epi and Efate: Mataso, Makira, Emae, Buninga, Tongariki, and Tongoa, the latter being a major remnant of southeast Kuwae. Several uninhabited smaller islands and islets are also included, Tefala and Laika being fragments of the former Kuwae landmass situated along the northeastern perimeter of the Kuwae submarine caldera.
5. A single piece was identified on Retoka although it appears to be associated with fingertip impressions which can be found in other traditions rather than the more distinctive internal slashing impressions so distinctive of Aknau (Garanger, 1972: 59). It remains an anomaly.
6. A flat section of the calibration curve at c. 2500 BP remains a challenging aspect of refining the chronological sequence of pottery sequences throughout Vanuatu and the wider Pacific associated with this period (Bedford, 2024: 128; Petchey et al., 2014: 239; Petchey & Kirch, 2019: 14; Petchey et al., 2023).
7. During the August 2006 field season the excavation team on Lamén Island witnessed the active eruption of the Lopevi volcano as it showered the neighbouring island of Paama with ash; locals on Lamén Island confirmed that they also received ashfall when the wind blew in their direction.
8. It should be noted, however, that grave goods are particularly rich in the Retoka burials and comparatively limited on Tongoa (Garanger 1972).
9. Many excavations were undertaken but only a single ¹⁴C date was obtained from a burial said to be associated with Ti Tongoa Liseiriki, one of the earliest chiefs said to have resettled the island. The 1475 AD date is rejected on the grounds of the unreliability of bone dates of the 1960s, prior to development of reliable dating protocols for Pacific burials (Petchey et al., 2011).
10. Also known as Ruete; a now defunct village located in the interior of north Epi associated with an oral tradition which claims Epi’s present population originates from this location (Hoffman, 2004, 2006).
11. Tryon (1996: 179–180) states that pottery was transported via traditional exchange routes from west Santo (the only area in Vanuatu where traditional pottery production has persisted into the contemporary period) through Malo, Vao, and Malakula to Epi. This obviously relates to a very recent

period, and the surface-collected sherds from Epi do not resemble Santo pottery.

12. A third migratory phase associated with more recent Polynesian influences is proposed and supported by genetic affinities with Polynesians among individuals sampled from the Roi Mata site on Retoka and the Mangaasi site on the adjacent Efate mainland (Lipson et al., 2020).
13. Supposed advantages of small offshore islands have frequently been cited as having a role in the settlement strategies of peoples associated with Lapita; these are suggested to include lower populations of malaria-transmitting mosquitoes (or other nuisance insects) on small islands exposed to offshore breezes (Kirch, 1997, 110–113; Sallares, 2011; cf. Specht, 2007: 58), as well as providing additional space to accommodate incoming or expanding populations, potentially mitigating competition or conflict with groups on the opposing “mainland” (Kirch, 1997: 166; Spriggs, 1997: 88; cf. Specht, 2007: 58).

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