



Research Article

Early architecture in Tonga: implications for the development of Polynesian chiefdoms

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Durable architecture is a hallmark of Polynesian chiefdoms, associated with centralised control of residential and agricultural land. Previous work in West Polynesia has indicated a relatively late date for the onset of such construction activity—after AD 1000—suggesting that political development was influenced by events such as post-colonisation migration. The authors report new dating evidence from the excavation of a large earth mound on the island of Tongatapu. Its construction 1500 years ago indicates that, in contrast to previous findings, well-developed chiefdoms and field monuments probably dominated the landscapes of West Polynesia substantially prior to the colonisation of more easterly island nations.

Keywords: Polynesia, first millennium AD, AMS radiocarbon dating, LiDAR, stratigraphy, chiefdoms, social complexity

Introduction

The archaeological record of the first millennium AD in West Polynesia is central to our understanding of the *in situ* development of chiefly polities and the nature of political systems that were carried by colonists from West to East Polynesia (Burley & Clark 2003; Harris *et al.* 2020). West Polynesia—defined here as Tonga and Samoa, along with the smaller islands of Futuna and 'Uvea—was colonised by Lapita groups around 2850 years ago (Burley *et al.* 2015). Traditional Polynesian culture developed later in this region (Kirch & Green 2001; Addison & Matisoo-Smith 2010) before an expansive phase of migration in the period, AD 700–1100 (Wilmshurst *et al.* 2011; Sear *et al.* 2020), to the islands within the three archipelagos—the Hawaiian Islands, Rapa Nui/Easter Island and Aotearoa/New Zealand—that delineate Triangle Polynesia (Figure 1).

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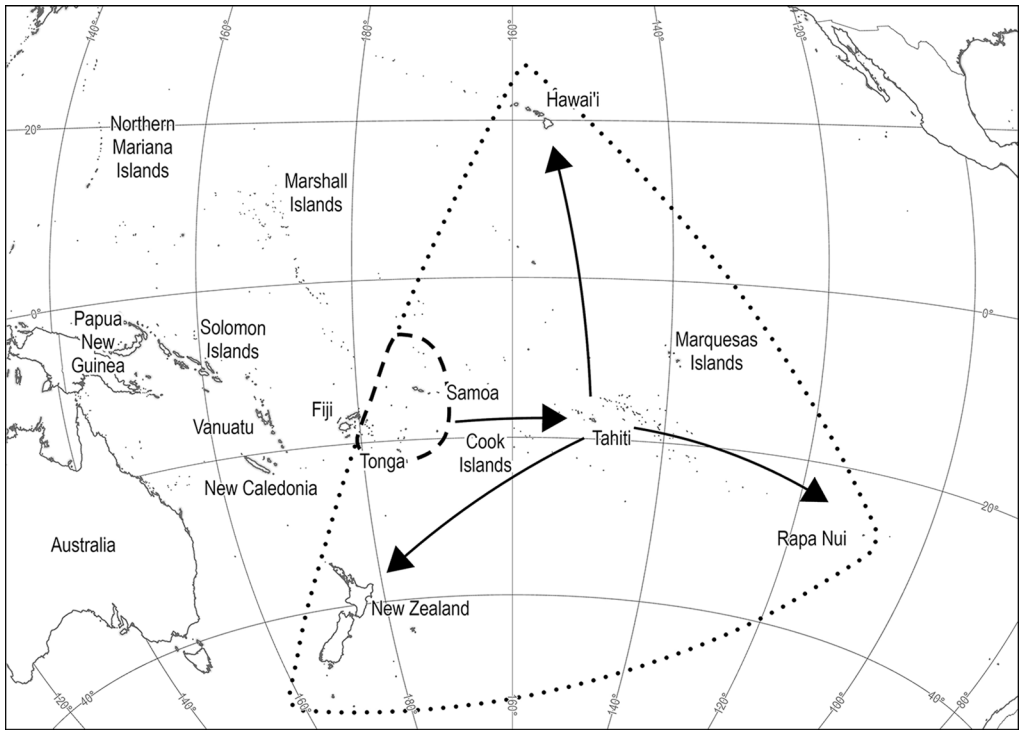


Figure 1. Map of the Pacific Ocean showing Triangle Polynesia (dotted line) and colonisation movements (arrows) from West Polynesia (dashed line) to East Polynesia c. AD 700–1100 (figure by authors).

There is a post-colonisation research lacuna within the records of the first millennium AD for Tonga and Samoa, a period that is termed the ‘Dark Ages’ or ‘Formative Development’ stage (Burley 1998; Green 2002). This knowledge gap bridges the interval between the abandonment of ceramics and the appearance of vernacular and monumental architecture associated with traditional Polynesian societies, chiefdoms and titles (Martinsson-Wallin 2016). The Formative Development stage in Tonga spanned AD 400–1200, during which time it is hypothesised that the population on the main island of Tongatapu grew to a point where all available arable land was in use (Kirch 1984: 222; Burley 2007). The implications of demographic expansion during the Formative Development stage include competition for land and the appearance of hierarchical political groups led by elites. Yet archaeological correlates of emergent complexity, particularly the creation of raised structures such as large mounds and earth fortifications, have only been dated to the second millennium AD (Burley & Clark 2003: 240–41; Clark & Reepmeyer 2014).

The expansion of durable architecture in the region after 1000 AD has been linked with external migration, sustained population growth and the rapid development of traditional Polynesian leadership systems that organised and managed agricultural and residential space (Harris *et al.* 2020; Quintus *et al.* 2020). Researchers have long noted, however, that dating Pacific field monuments is difficult (Davidson 1979; Wallin *et al.* 2007), raising the possibility that their construction began earlier, and therefore that population growth rates and Polynesian social complexity developed *in situ* over a longer interval.

This article reports on the excavation of Mala'e Vakapuna, a large earth mound on the main island of Tongatapu that was built around 1500 years ago, making it the oldest known example of Polynesian architecture. The size and prominent location of the mound is consistent with construction for the control of land and demonstrates the existence of formative political structures, as proposed by Burley and Clark (2003), centuries before the advent of the Tongan maritime state (Clark & Reepmeyer 2014). Age determinations from Mala'e Vakapuna reported here are the first to confirm a substantial time depth for the intensively modified landscapes of West Polynesia (Freeland *et al.* 2016; Frimagacci 2016; Jackmond *et al.* 2018). Results also suggest that the colonists who settled East Polynesia came from societies that had experienced centuries of social and political stratification.

Location and stratigraphy

The mound identified as 39-Mala'e Vakapuna (Tongan 'airport') is located to the east of Fua'amotu International Airport on the summit of a small hill (53m elevation) that overlooks central Tongatapu and the Fanga 'Uta Lagoon (Figure 2). The site is covered by a dense growth of *Hibiscus tiliaceus* (*fau*) (Figure 3) and lies 6km from the lagoon and 2.8km from the limestone south coast. The composite and fertile soils of the area belong to the Vaini and Lapaha series consisting of a shallow and younger tephra soil that has developed over an older weathered tephra clay (Cowie 1980). The mound is a rounded rectangle with base dimensions of 38 × 41m, a top area of 16 × 21m and a height of approximately 2–3m, depending on the hill slope (Figure 4).

The mound has previously been recorded as part of a fortification complex (Spennemann 1989a: 483; Burley *et al.* 2016; Parton *et al.* 2018). Surrounding the mound is a shallow ditch, the excavated earth from which was used to make a low rampart (see Figure 3 & 4). Many Tongan fortifications were built in the nineteenth century (Parton *et al.* 2018) and charcoal found beneath the rampart returned accelerator mass spectrometry (AMS) radiocarbon dates from the Civil War era (AD 1790s–1852) confirming that the defensive earthworks were built during the nineteenth century AD.

A 1.3m × 0.7m trench was opened at the centre of the mound, along an east-west orientation, and excavated to a depth of 2.43m. Access steps made to reach deeper layers reduced the excavated surface area with increasing depth (Figure 5). Consideration of the stratigraphy of the trench shows that the mound consists of around 2m of earth deposited in alternating layers of fill. Red layers and lenses are apparent and represent *in situ* combustion features made on fill surfaces that oxidised and hardened the underlying clay, leaving concentrations of charcoal and ash. Fill deposits are composed of mixed clay and topsoil and have a mottled appearance. The unmodified tephra clay (7.5YR 4/6) found above limestone bedrock is weakly developed with moderate stickiness and plasticity while the 'A' horizon soil (5YR 2.5/1) that the mound was built on is strongly developed and friable. Initial mound layers (5c + d, see Figure 5) are clay and humic soil with increasing amounts of dark humic soil in layers 5a and 4. Upper layers (1a, 2a & 2b) have less humic soil and more clay. The buried topsoil (layer 6) beneath the mound is a dark, compact and well-structured loam with occasional charcoal. Below this, at a depth of 2.25–2.35m, layer 7 is a compact dark-brown soil containing scattered cultural material, including six plain pot sherds, abundant charcoal,

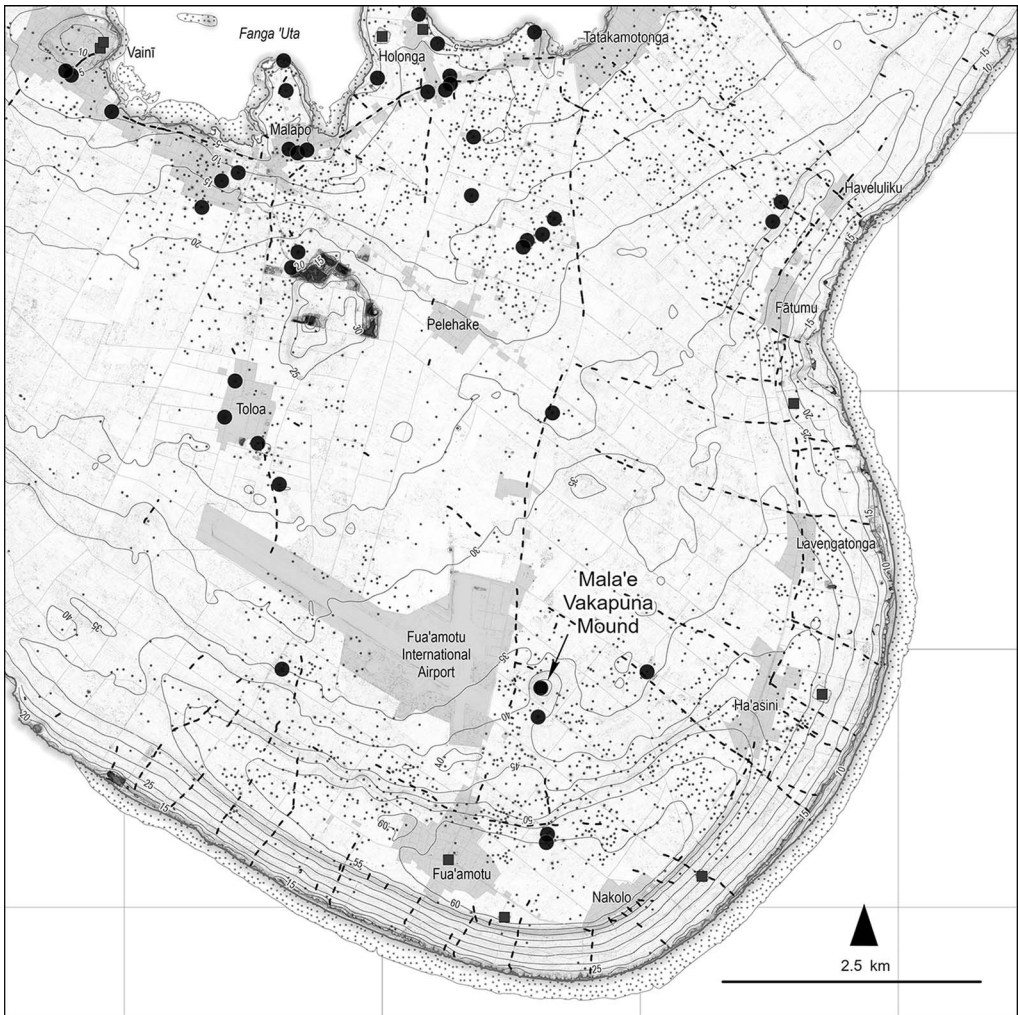


Figure 2. LiDAR image showing Mala'e Vakapūnia and the location of earth mounds (dots), sunken roads (dashed lines) and forts (squares) in central Tongatapu (figure by authors).

more than 30 limestone oven stones, a few shellfish and bones from small fish and mammals, probably representing a midden deposit. Layer 8 is a weathered tephra clay with fragments of pumice and limestone devoid of cultural material.

Radiocarbon dating

A series of 15 charcoal and marine shell samples were dated with AMS at the Australian National University (ANU; Table 1). A fragment of mammal/human bone recovered from Layer 7 was submitted for dating, but failed pre-treatment. Charcoal samples from *in situ* combustion features and the midden deposit and oven in layer 7 were examined under high magnification and compared with tropical reference material. Two samples



Figure 3. LiDAR perspective view of Mala'e Vakapuna mound (left), aerial view showing dense vegetation (*Hibiscus tiliaceus*) covering the mound site (right) (figure by authors).

were identified as coconut endocarp (SANU-59938, SANU-57831) and two samples with a narrow diameter appeared to be from twigs/small branches (SANU-59931, SANU-57839). Radiocarbon determinations were obtained using a NEC Single Stage AMS at the ANU Radiocarbon Laboratory (Fallon *et al.* 2010). Charcoal samples were cleaned using a standard acid-base-acid protocol to remove exogenous carbonates, humic acids and degraded charcoal. Two bivalve shells from layer 7 were also sent for analysis; the outer layers of the shells were removed with a drill and the remainder washed in dilute acid. Charcoal dates were calibrated with Calib Rev8.2 using the SHCal20 data set (Hogg *et al.* 2020). Shell ages from Tongatapu can be influenced by hardwater making them appear older so the marine shell results were calibrated with the Marine13 calibration curve (Reimer *et al.* 2013) using the *Gafrarium* age (SANU-59410) adjusted with a ΔR of 273 ± 34 years and the *Anadara* age with a ΔR of 187 ± 76 years following Petchey and Clark (2011).

Bayesian modelling

Bayesian analysis (OxCal 4.2, Bronk Ramsey 2017) was used to model four sequential events in the main excavation sequence: 1) pre-mound (oven use); 2) pre-mound (age of buried topsoil—layer 6 top); 3) mound construction; and 4) fortification (see online supplementary material (OSM) section 1 for more details). Activity in the sequence was divided by uniform boundary priors with the model span constrained by the end of the Civil War period in AD

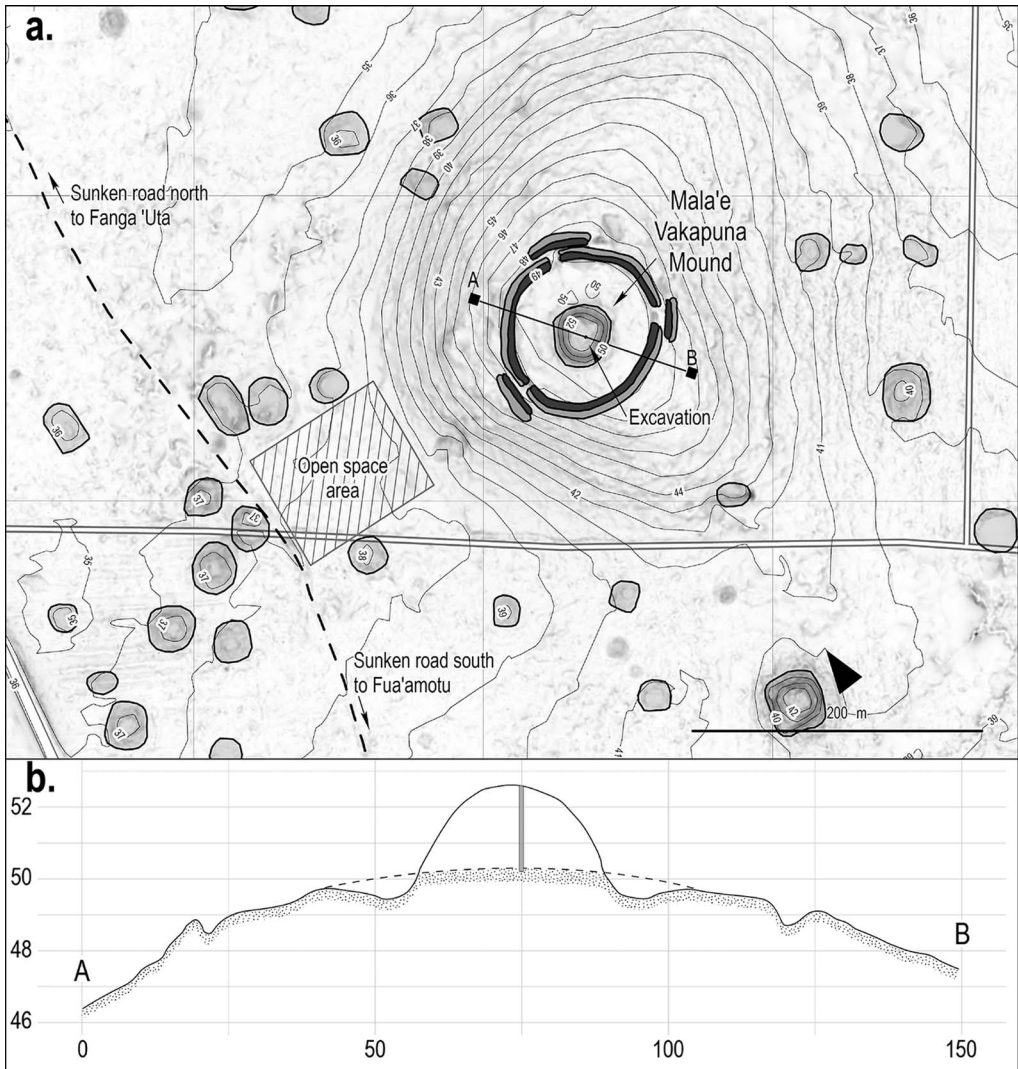


Figure 4. Plan (a) and cross-section (b) of the Mala'e Vakapuna site. Also seen in plan are smaller mounds around the site, including a western cluster that appears to demarcate an open space in front of the hill on which Mala'e Vakapuna was constructed (figure by authors).

1852 when fortifications ceased to be made (Figure 6). The estimate for oven use is broad (440–40 BC, 95.4% of the highest posterior density interval (HPDI)) due to multiple age intercepts on the SH20 calibration curve (Hogg *et al.* 2020). Radiocarbon samples at the interface of the buried topsoil (layer 6 top) and an early stage of mound building (B6 burn event, see Figure 5) demonstrate that mound building had commenced by AD 350–500 (95.4% HPDI). The large age difference between the final burn event (see Figure 6: B1 End) and nineteenth-century posthole age associated with site fortification prevents us from precisely dating mound completion. However, the mound was likely completed shortly

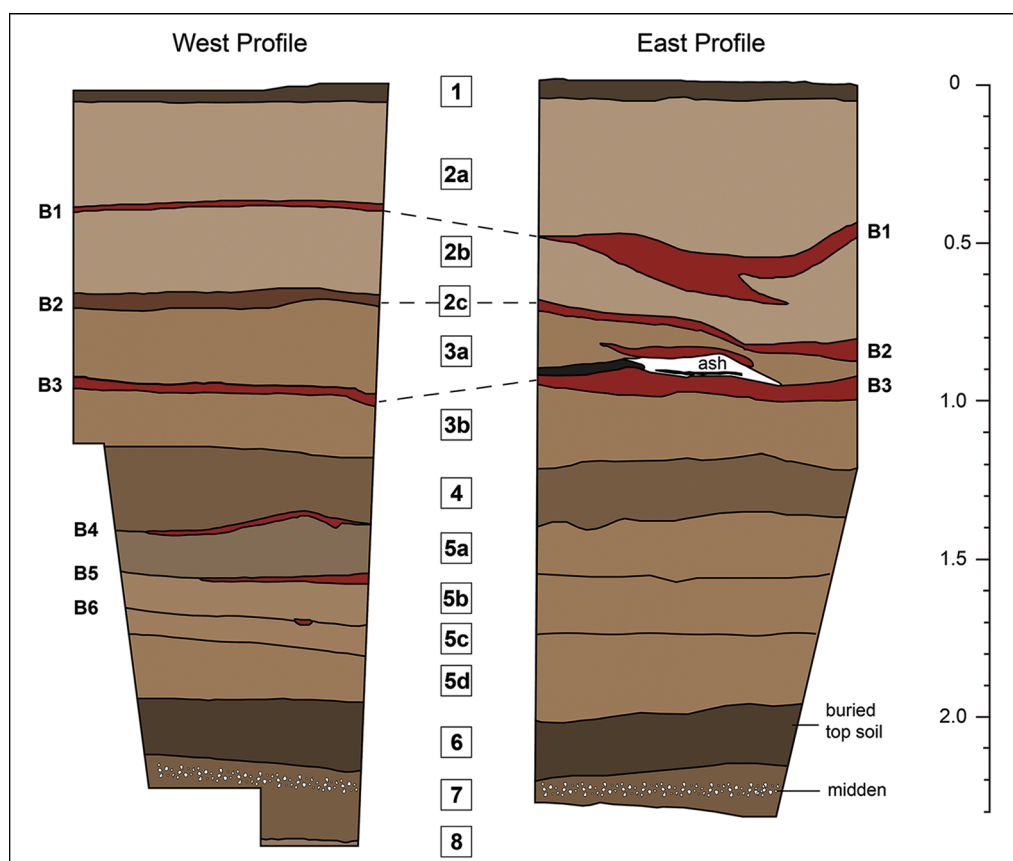


Figure 5. Stratigraphy at Mala'e Vakapuna as illustrated by the west and east profiles of the trench, with B1–B6 dated burn events highlighted (figure by authors).

after burn event B1 (see below) and the Bayesian model based on the burn event sequence indicates completion by AD 530–670 (95.4% HPDI), with modelling of the mound-building phase indicating a conservative construction span between 25 and 250 years (95.4% HPDI). A charcoal sample taken to date the onset of topsoil formation on the south side of the mound gave an age of 1472 ± 22 BP (see OSM section 2) with a calibrated range of AD 590–650 (95.4% confidence) consistent with mound completion in the first millennium AD. A recent age returned on charcoal from a posthole cut from the mound surface (186 ± 22 BP) is consistent with dates obtained from beneath the fortification bank, indicating the addition of defences to the site during the nineteenth-century Civil War era.

Construction sequence

LiDAR imagery indicates that the hill surface around Mala'e Vakapuna provided the fill used to construct the mound. The stratigraphy shows that basal fill layers were composed of a mixed topsoil-clay sediment (layers 4 & 5) with upper layers predominantly of clay (layers 1 & 2).

Table 1. AMS ages from the Mala'e Vakapuna main excavation (see Figure 5).

Depth & context	Material	Sample number (SANU)	Calibrated radiocarbon age (BP)	$\delta^{13}\text{C}$	cal. BC/AD (95.4%)
0.45m, posthole from surface into layer 2	Charcoal	57903	186 ± 22	-24.85	1670–1950 AD
0.46m, burn layer B1	Charcoal, narrow diameter	59931	1541 ± 31	-23.85	480–640 AD
0.85m, burn event B2	Charcoal, narrow diameter	57839	1517 ± 25	-27.36	540–640 AD
1.00m, burn event B3	Charcoal	57838	1637 ± 24	-24.67	410–540 AD
1.38m, burn event B4	Charcoal	57605	1672 ± 24	-24.63	370–520 AD
1.49m, burn event B5	Charcoal	57837	1627 ± 24	-26.86	420–540 AD
1.78m, burn event B6	Charcoal	57836	1669 ± 25	-28.25	370–520 AD
2.04m, top of buried topsoil, layer 6	Charcoal	57835	1698 ± 24	-26.61	260–520 AD
2.25m, earth oven, layer 7	Charcoal	57833	2235 ± 25	-24.82	380–160 BC
2.27m, earth oven, layer 7	Charcoal, coconut endocarp	59938	2199 ± 28	-24.55	360–70 BC
2.32m, earth oven, layer 7	Charcoal	59937	2262 ± 27	-26.33	380–190 BC
2.35m, earth oven, layer 7	Charcoal, coconut endocarp	57831	2179 ± 25	-23.74	350–70 BC
2.35m, earth oven, layer 7	Charcoal	57832	2230 ± 24	-26.24	370–150 BC
2.35m, midden deposit, layer 7	Shell, <i>Anadara antiquata</i>	60218*	2881 ± 25	-0.23	590–110 BC
2.35m, midden deposit, layer 7	Shell, <i>Gafrarium tumidum</i>	59410*	3297 ± 25	-0.79	1080–700 BC

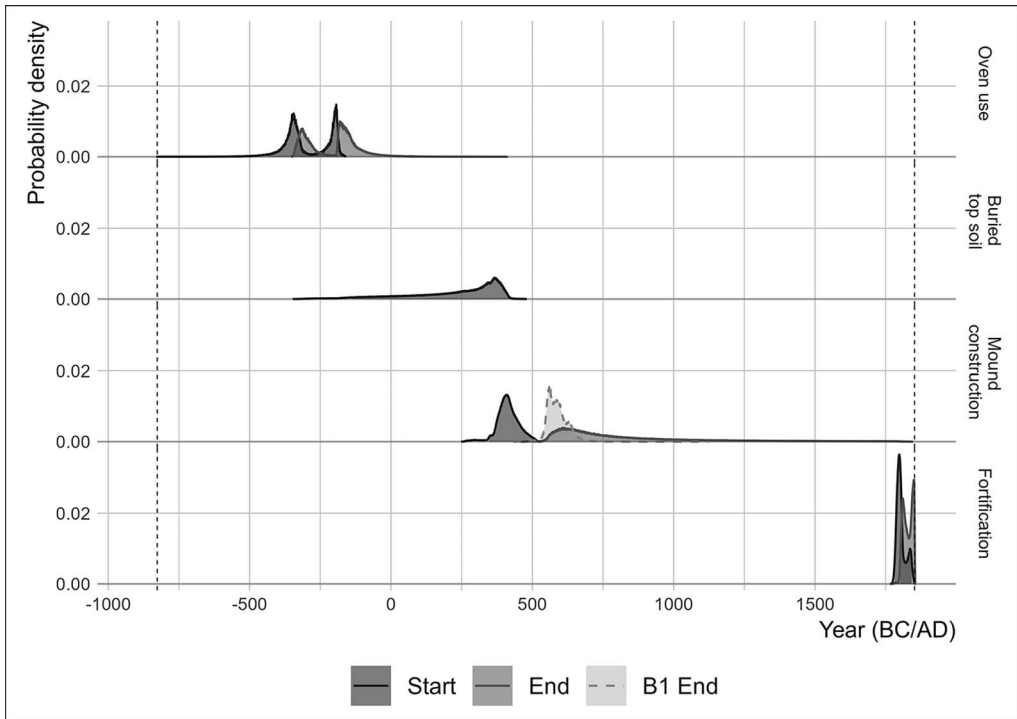


Figure 6. Bayesian analysis of activity at Mala'e Vakapuna (figure by authors).

An inverted sediment sequence is common in Tongan earthworks and is caused by removal of the organic topsoil and subsoil to create an initial foundation with deeper substratum clays excavated to increase volume and height. The burn layers are evidence of sequential construction events when vegetation, presumably growing on the mound, was collected and burned before additional deposits of earth fill were added. It is possible that significant burn layers (B1–B3) were made during the refurbishment or replacement of a structure made on the mound but there are no artefacts or layers of sand/gravel suggestive of a significant construction hiatus, as observed in several earth mounds excavated by Spennemann (1989b: 160, 326–29), and no topsoil development above fill layers. We suspect, therefore, that the mound was constructed over a span of 3–5 generations. The overlapping radiocarbon ages support this hypothesis, as does a volume analysis of the recent fortification ditch and embankment which demonstrates that these earthworks did not contribute additional material to the mound (see OSM sections 2 & 3). If the upper part of the mound—particularly the upper 0.46m of clay sediment above B1—was deposited centuries later, then these layers should contain substantial amounts of organic-rich soil from the removal of topsoil horizons that formed after AD 500. Layers 2a and 2b are, however, predominantly clay indicating the excavation of deeper sediments before thick organic soils had been able to form. A test excavation on the southern edge of the mound disclosed stratigraphy equivalent to layers 4 and 5 in the main trench, indicating that the horizontal and vertical dimensions of Mala'e Vakapuna were attained in the first millennium AD.

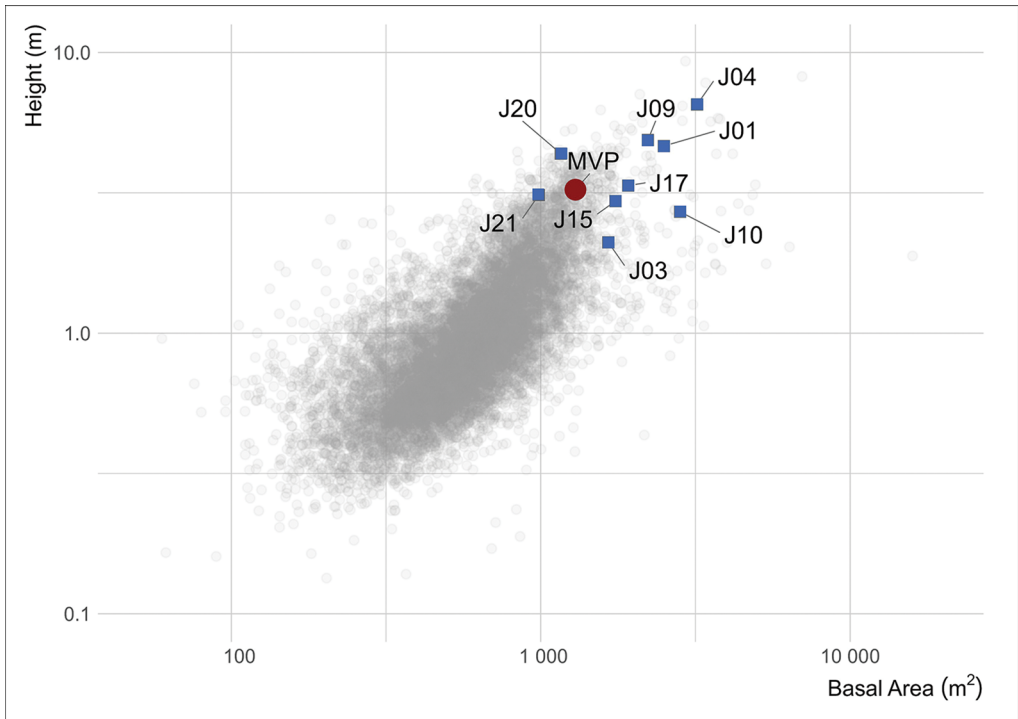


Figure 7. Plot of Tongatapu mound dimensions (light grey circles) showing Mala'e Vakapuna (red circle) and monumental tombs (blue squares) of the paramount Tu'i Tonga dynasty (AD 1200–1800, see Clark et al. 2008) (figure by authors).

Mound dimensions

The Mala'e Vakapuna mound was made on a small hill (Figure 3) and was a prominent structure with a base area of 1290m² and a volume of roughly 1700m³. Figure 7 shows the dimensions of the mound compared with over 10 000 mounds in the Tongatapu LiDAR dataset (Freeland et al. 2016), with the monumental burial structures of the paramount Tu'i Tonga at Lapaha labelled for comparison (Clark et al. 2008). In the Tongatapu dataset, Mala'e Vakapuna is in the top 97th and 98th percentile for height and volume and in the top 95th percentile for basal area. These values highlight the 'substantial' size of Mala'e Vakapuna relative to other earth mounds. Nonetheless, labour estimates indicate a modest workforce could have been used to build Mala'e Vakapuna with a total of 1008 person/days required or just over a month with a work crew of 30 people (see earthwork labour calculations in Parton et al. 2022).

Mound context

Near Mala'e Vakapuna there is a western cluster of 14 mounds distributed on either side of a sunken road (Figure 4). An open space is demarcated by this cluster at the base of the hill and may correspond with ethnographic examples of a village green (*mala'e*). We interpret the road

that runs through the mound cluster as an early route that ran from the Fanga 'Uta Lagoon to the exposed south coast. Close to Mala'e Vakapuna is the remnant of a road junction that connected to the southwest-to-southeast arc of a high-density settlement spread across a 60m ridgeline (Figures 2 & 4). Together these roads indicate that the southern part of the island was an early and important area of occupation that interacted with lagoon-based communities. Previous research has shown an almost continuous band of ceramic and shellfish debris along Tongatapu's sheltered northern lagoon coast (Groube 1971; Spennemann 1989a) that may have supported 'one of the densest Lapita populations in the ancient Pacific world' (Dickinson 2007: 184). That people were travelling inland from settlements along the north coast of Tongatapu using an informal track that eventually developed into a throughfare is suggested by the presence of pottery and marine shellfish below the Mala'e Vakapuna mound dated to c. 900–400 BC and oven use around 300–200 BC.

The mounds in the surrounding landscape have yet to be investigated and radiocarbon dated. Nonetheless, we draw attention to the potential association of Mala'e Vakapuna with nearby residential structures and roads as they are features of the built landscape observed in later chiefdom-era settlements that have a deep history based on linguistic reconstructions in Proto-Polynesian. The location of large mounds with a volume greater than 1500m³ in central Tongatapu and in the vicinity of Mala'e Vakapuna is shown in Figure 2. Like Mala'e Vakapuna, large mounds are frequently associated with a road; this pattern remains apparent despite the fact that many sunken roads have been destroyed by development. For example, the nine largest structures of the Tu'i Tonga at Lapaha (Clark *et al.* 2008) were recorded as adjacent to a large road which no longer exists (Clark 2014). Large mounds are also commonly located close to other mounds/residential structures that surround an open community area (*mala'e*) adjacent to a road (see OSM section 4). Historical linguistics identifies mound foundations (**qafu*) made for residential and communal buildings, roads (**hala*), an open meeting/ceremonial area (**malaqe*) and cultivated fields (**maqala*) as elements of a Polynesian settlement pattern that emerged in West Polynesia sometime after 2500 years ago (Kirch & Green 2001; Pawley 2001). Although built landscapes are palimpsests, we believe that large mounds like Mala'e Vakapuna were not isolated constructions and were likely associated with transport, residential and agricultural structures that comprised an ancient form of Tongan settlement.

Discussion

Numerous studies have investigated and attempted to date different types of durable architecture in West Polynesia, including monumental mounds (Wallin *et al.* 2007; Clark *et al.* 2008), fortifications (Best 1984; Frimagacci 2016; Clark *et al.* 2017), stone terraces (Pearl 2004), linear mounds (Quintus *et al.* 2020), circular mounds (Spennemann 1989a) and pigeon-snaring mounds (Burley 1996; Sand *et al.* 2018; Quintus & Clark 2019). Two indicators frequently used to examine the onset of social complexity in West Polynesia are significant landscape change, as an indicator of agricultural intensification, and the construction of durable architecture. The age of built structures is particularly important as the development of specialised architecture is linked with the presence of complex chiefdoms, growing populations and intensified forms of food production. Corollaries of chiefdom societies include

increasing inequality and conflict, population aggregation and declining habitat suitability. These conditions are associated with hierarchical subjugation and despotic control of land that may have stimulated population dispersal from West Polynesia to East Polynesia (Kennett & Winterhalder 2008).

There are no detailed palaeoenvironmental records from Tongatapu to identify when agricultural intensification, environmental infilling and expansion to marginal zones occurred, but research in Fiji, Samoa and Futuna suggests significant landscape change between AD 100 and 1000 (e.g. Dickinson *et al.* 1998; Roos *et al.* 2016; Kirch 2017: 244; Gosling *et al.* 2020).

In contrast, all substantial architecture in West Polynesia has been dated to after the first millennium AD. Monumental mounds faced with carbonate stone in Tonga are no older than AD 1250 (Clark & Reepmeyer 2014) and the first phase of the Pulemelei mound on Savai'i was constructed in either AD 1000–1400 or AD 1050–1250 (Rieth & Hunt 2008; Martinsson-Wallin 2016: 112). Genealogical reckoning indicates that large earth mounds on the island of Upolu date to the seventeenth century AD, while Samoan pigeon mounds were probably built in the seventeenth–eighteenth century AD (Sand *et al.* 2018). Oral traditions suggest that Tongan pigeon mounds may be older, and some could date to the fifteenth century AD (Burley 1996). Built fortifications and defences also appear after AD 1000 in Tonga, Fiji and Samoa (Field & Lape 2010; Martinsson-Wallin 2016; Clark *et al.* 2017).

Dating of the construction of Mala'e Vakapuna to AD 500 corresponds with the palaeoenvironmental evidence for increased land alteration that suggests the existence of other early structures in Fiji-West Polynesia. Although there are potential examples of structures built in the first millennium AD (see OSM section 5) it is notable that the dating of field monuments in Fiji-West Polynesia is problematic and this has contributed to conservative estimates for the onset of earth and stone architecture. New dating of field monuments is now needed, especially multiple radiocarbon analyses from mound stratigraphies and dating of material collected from ground surfaces buried beneath structures. Such programmes of study might initially focus on built sites that are large and potentially old such as the Vaialele mounds in Samoa and other large mounds on Tongatapu (Figure 2).

Turning to the interpretation of Mala'e Vakapuna, the Tongan archaeological sequence is marked by continuity and is potentially different to Samoa where the arrival of a new population has been linked with the late production of architecture (Harris *et al.* 2020). The complex chiefdom of the Tu'i Tonga dynasty arose in AD 1100–1200 by incorporating regional chiefdoms across the archipelago under a paramount authority. The existence of simple chiefdoms centuries before the advent of the Tongan state is indicated by Proto-Polynesian terms including **kainanga*, a social group consisting of smaller residential groups (**kaainga*) that held residential and agricultural land and led by a **qariki*—the male leader of a senior landholding group who inherited his position patrilineally (Kirch & Green 2001: 214, 217, 231). It is currently unclear what type of structure was built on Mala'e Vakapuna, but ethnographic, genealogical and traditional history repeatedly identify large mounds and the structures on them (i.e. high-status residences, burial sites, religious and communal buildings) as the property of chiefs (e.g. Davidson 1974; Gifford 1985; Barnes & Green 2008: 27, 36; Martinsson-Wallin 2016). A parsimonious reading of Mala'e Vakapuna is that it marks a

simple chiefdom, possibly a single community in which power was held by a senior kin-group or hereditary leader.

Conclusion

The ancestral cultures of West Polynesia gave rise to diverse Polynesian societies that encompassed archaic states and chiefdoms with different levels of stratification (Kirch 2017). As our results demonstrate, the next phase in understanding Pacific landscapes requires the critical addition of chronological data to the spatial architecture record (e.g. Quintus *et al.* 2020) to examine Polynesian settlements and chiefdoms from the poorly understood first millennium AD through to the early European contact era. Due to the presence of fires on construction surfaces that were subsequently sealed by layers of earth fill, Mala'e Vakapuna is currently the best dated prehistoric structure in West Polynesia. Whether early architecture was made in other island groups is uncertain but appears likely given the difficulty in accurately dating earth and stone structures.

The relatively late and rapid development of traditional Polynesian chiefdoms seen in the chronological record of durable architecture has given rise to the implication that their formation was catalysed by particular events such as the intensification of food production systems, increased inter-group competition as a result of the Little Ice Age (around AD 1400–1800), or demographic expansion connected with migration in the past 1000 years (Addison & Matisoo-Smith 2010; Field & Lape 2010; Harris *et al.* 2020). A longer trajectory for Polynesian social complexity is indicated by Mala'e Vakapuna, particularly the existence of population aggregations 1500 years ago focused on territorial units that were marked with landesque capital, referring to the repeated construction of permanent social and economic structures on a landscape. In West Polynesia, monumental and substantial structures used in late prehistory were clearly linked to high-status leaders (Martinsson-Wallin 2016), and Mala'e Vakapuna suggests this association is an ancient Polynesian trait. The age and size of Mala'e Vakapuna has implications for understanding socio-political conditions prior to the formation of the ancient Tongan state, including the likelihood that early population agglomeration propelled settlement inequality and inter-group competition in the first millennium AD. The age of Mala'e Vakapuna also indicates that by the time that East Polynesia was colonised, approximately 1000 years ago, well-developed chiefdoms and field monuments were already extant in West Polynesia.

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Supplementary material

To view supplementary material for this article, please visit <https://doi.org/10.15184/aqy.2023.200>.

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