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Recovering a legend: The Wara Liang pottery assemblage and the origin story of Lamalera, Lembata, Indonesia

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ABSTRACT

Wara Liang is a shoreline rockshelter on Lembata island, Indonesia, where excavation in 2017 revealed a deep stratigraphy preserving evidence of forager habitation from ca. 1200 years ago. At around 600 BP, the nature of the occupation changes with a range of new zooarchaeological remains appearing, including domesticated animals as well as a substantial assemblage of earthenware pottery with some exotic tradeware. The deposition of the Wara Liang pottery at this time seemingly represents a strikingly late arrival of pottery technology at this site. Here we discuss the Wara Liang ceramics assemblage and consider a range of scenarios that may account for this apparent late technology transfer. The historical context of the time and the intensification of exogenous contact and influence in Nusa Tenggara Timur, along with the essential environmental nature of the region with its history of natural disasters and displacement of populations, are discussed in terms of effects on local communities. We also highlight the oral history and origin legend of Lamalera, a village close by the Wara Liang rockshelter and famous for its tradition of hunting whales. This origin legend intriguingly sheds light on the first use of pottery in the Wara Liang locale and provides information that credibly supplements the pottery record.

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Introduction

Throughout Island Southeast Asia (ISEA), including Nusa Tenggara Timur (NTT), earthenware pottery is found in Neolithic contexts dating from approximately 3500 BP (e.g., in NTT, Beaumont et al. 2023; Glover 1986; Handini et al. 2023), with a much-increased number of sites showing the first occurrence of pottery in the Metal Age

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after 2500 BP (Bulbeck 2008). The emergence of pottery-using communities varies significantly across time and space in ISEA (O'Connor 2015, 22), resulting in a patchy and diverse record of pottery adoption. The variations in the timing of pottery introductions, exhibited in a multitude of geographically dispersed sites, prompt questions about the technological transfer of ceramics and its use by different island communities.

Wara Liang is a coastal rockshelter on Labala Bay in the south of Lembata,¹ excavated in 2017 by a team from the Australian National University and Universitas Gadjah Mada, Indonesia. It presents a deep stratigraphy preserving clear evidence of aceramic foraging occupation layers from ca. 1200 years ago. However, from around 600 years ago, the nature of the habitation changes and an extensive ceramics assemblage was deposited, overwhelmingly comprising earthenware pots, along with a small number of glazed tradeware ceramics. The introduction of pottery as late as pre-Historic Era times at Wara Liang is *prima facie* an unusual occurrence, especially in light of the apparent availability of pottery technology across the region. In this paper we present the findings from the excavation of Wara Liang, with a particular focus on the ceramic assemblage, and discuss a range of scenarios and localized circumstances that may account for the transmission and adoption of pottery technologies in the Labala Bay area and its surrounding communities.

The appearance of pottery at Wara Liang ca. 600 years ago coincides with a period of dramatically increasing trade and exogenous influence in the region. This extension of mercantile activity across ISEA likely brought new contact to peripheral locations and island communities along with novel technologies and practices, occasionally with radical and devastating effects. While such factors may explain this late adoption of pottery at Wara Liang, we also consider the geomorphology and environment of Lembata and the nature of the rockshelter itself. The geo-environmental record points to a history of natural calamity and population displacement, as well as temporal limitations to the habitability of this rockshelter that have a bearing on the evidence of pottery use at Wara Liang.

Of particular significance is a connection drawn between the Wara Liang pottery and the nearby villages of Lamalera. Lamalera is widely known for its traditional practice of hunting whales and other large marine quarry (Dwyer and Akerman 1998), and is comparatively well studied among the many distinct communities of NTT. Consequently, details of the Lamaleran's oral history and origin legend are well documented (Barnes 1984, 1996; Lundberg 2000), and provide an intriguingly local explanation regarding the introduction of pottery to the Wara Liang vicinity. In recent studies, indigenous oral traditions have been used to build deep histories, which inform and supplement archaeological finds (see Gaffney et al. 2018; Hägerdal et al. 2017; Hardy et al. 2024; Urwin 2022). Indigenous knowledge and interpretations have enabled a greater insight into both archaeological and historical data producing a "braided," richer understanding of the past (e.g., Roberts et al. 2023). We assess the details of the Lamaleran origin legend in conjunction with the Wara Liang archaeological record to assess its credibility in explaining the arrival of pottery at this

¹Lembata is also known by other appellations historically including Lomblen.

location. In doing so, we aim to contribute to broader discussions on the dynamic patterns of pottery dispersal across ISEA.

Historical background

Rise of archipelagic trade

Indian and Chinese seafaring merchants were among the first to seek the endemic produce and merchandise obtainable in particular “spice islands” (Sutherland 2021), most prominently in Maluku, Timor, and other locations in NTT. The site of Sembiran-Pacung on the north coast of Bali has produced artifacts including rouletted ware of south Indian manufacture, establishing Indian influence and presence from the first century BC (Calo et al. 2015). This apparent entrepôt site was primarily positioned for trans-regional exchange and early commerce with the spice islands. The pattern of archipelagic trade saw the rise of a number of Indic inspired, Hindu-Buddhist entrepôt centers and maritime empires. Srivijaya (seventh–twelfth centuries AD) was a thalassocratic series of overlapping spheres of influence (Sutherland 2021) based in southern Sumatra, commanding the Sunda and Malacca Straits. It facilitated exchange with indigenous shippers gathering in regional ports and provided access for merchants when the locations of the spice islands remained a fiercely guarded secret (Lapian 1985). In the thirteenth century, the Majapahit rajahdom in east Java was emerging as the pre-eminent maritime power (Ricklefs 2008). At its zenith, Majapahit claimed authority over large parts of Southeast Asia through direct conquest and vassal rulers. The fourteenth century Javanese text *Nagara-Kertagama* details some 98 tributaries under the control of Majapahit including several islands throughout eastern Indonesia (Aritonang and Steenbrink 2008; Lapian 1985).

Islamic influence and European intrusions

Circa AD 1400, Majapahit was declining in the face of Islamic competition for regional trade. The establishment of Malacca as a center for Muslim traders and religious figures, and the concomitant development of Islamic communities and ports along the north coast of Java, presaged an acceleration in mercantile activity throughout eastern Indonesia driven by new external powers. The original port-state of Malacca was based entirely on providing an advantageous location and facilities for an international community of traders (Ricklefs 2008). Javanese harbors prospered because of their role as staging ports and conduits for these traders operating in the spice islands further east (Thomson Zainu'ddin 1980).

Islam had been brought to Indonesia by the globalizing network of commerce and it became most firmly established in the locations of greatest importance in trade, such as Malacca, north-coast Java, and Maluku (Ricklefs 2008). For local rulers, frequently involved in trade, the incentive to adopt Islam and join religiously with the most dynamic merchants of the time was strong. The ongoing spread of Islam, without large-scale military conquest, demonstrates the adeptness of Muslim emissary traders to build sophisticated relationships with local polities and the networks that underpinned access to the prized commodities of various spice islands.

In 1511, the Portuguese conquered Malacca through a combination of superior firepower and religious zealotry and immediately set out to “discover” the spice islands (Reid 2015). The arrival of European powers ultimately disrupted the extant trading systems and instigated a period of intense competition and rivalry. Whereas the thalassocratic systems of the past had relied on open trading relations with a range of participants, the European powers sought to monopolize and secure direct access to the sources of the most precious commodities.

Portuguese attempts to establish a presence at the Sultanates of Ternate and Tidore were largely unsuccessful, instead opting in 1522 to consolidate at Ambon where through alliances they sought to exert control over Maluku (Thomson Zainu'ddin 1980). The effect was a deep intensification in the quasi-religious and trade conflict between the Christian Europeans and Muslims. From the mid-sixteenth century, Ternate became a fiercely Islamic and anti-Portuguese state (Ricklefs 2008). Similarly Makassar, which had risen to head a confederation of trading states, formally adopted Islam (Ricklefs 2008). The maritime power and influence of Makassar increased as it maintained its status as an independent emporium in defiance of Dutch actions to monopolize the spice trade (Bulbeck and Caldwell 2020). Ternate, and the ethnic alliances of South Sulawesi, exercised suzerainty and extensive economic connections with multiple islands in Maluku, NTT, and elsewhere (McWilliam 2020).

Effects on local communities

The arrival of European powers and the oppositional rise of assertive Islamic polities created the circumstances where uncertainty and violence were pervasive. In NTT, various communities experienced effects depending largely on the ecological qualities of particular locations and the natural products that could be extracted. Expansionary trading interests and intense competition for supremacy often played out in violent struggles for access among coastal communities (McWilliam, O'Connor, and Brockwell 2020). The constellation of petty rulers, diverse economies, and communities negotiated and adapted opportunistically to exchange networks that promised imported goods, and cultural and technological superiority (Sutherland 2021). Local enmities were created or exacerbated, resulting in a state of almost constant warfare, where slave raiding was rife. Although outside traders had come to NTT primarily seeking sandalwood, for some locations, slaves were the most desirable commodity available to the wider trade network. The coercive strategies employed by European and Islamic powers left communities vulnerable to the avarice of those scouring the region for salable merchandise or plunder. The expansion of mercantile networks into peripheral locations brought a range of threats, where the most viable option for securing community safety may have been relocation or withdrawal to fortified refuges (Andaya 2023).

Lamalera origin legend

The clans of Lamalera are most famous for their inherited practice of hunting sperm whales using hand-harpoons and traditional *peledang* seacraft (Dwyer and Akerman 1998). They are also specialist weavers of *ikat* textiles (Barnes 1984). The people of

Lamalera maintain an oral account of their origin outside of Lembata and their subsequent arrival and settlement. While such “origin legends” are not uncommon in the region (see Pradjoko 2017; Ramenzoni 2023), the Lamalerans specifically detail an introduction of pottery-making technology close-by the Wara Liang site.

The Lamalerans’ ceremonial origin song (Lundberg 2000) describes a succession of supernatural events, voyages, and sojourns that trace their ancestors’ departure from a homeland in southern Sulawesi and eventual arrival in Lembata. It contains historical references as well as toponyms, which set broad timeframes and confirm a notional progression through geographically sequential islands. Specifically, the odyssey begins in Luwuk (variously Luwuk-Belu or Luwu), South Sulawesi, which according to the *Nagara-Kertagama*, was a dependency of Majapahit (Barnes 1984). The ancestors are compelled to leave Luwuk at the command of the Majapahit military leader Gajah Mada (Lundberg 2000; Pradjoko 2017). Gajah Mada led a campaign through eastern Indonesia in 1357 and, according to the legend, presented a *kris* to the ancestors, said to still be in the possession of the Lamalerans (Barnes 1984). From Sulawesi the ancestors sail a circuitous route through central Maluku then south to NTT and westerly to the island of Lapan Batan (Barnes 1996; Lundberg 2000; Pradjoko 2017). At Lapan Batan the ancestors settled for several generations, welcoming traders and prospering, until disaster strikes when a magical eel is killed causing the land to be inundated (Barnes 1984; Lundberg 2000). Although the whereabouts of Lapan Batan is somewhat obscure, it is highly credible that the existing twin islands of Lapang and Batang, immediately east of Lembata and to the north of Pantar, is the location of the legendary homeland (Figure 1).

The surviving ancestors flee Lapan Batan and sail the nearby coasts of Lembata (Figure 2). After many attempts to make landfall, hostility from locals, and supernatural encounters, the refugees round the AtaDei Peninsula and enter Labala Bay. They anchor at Luki Point² (Barnes 1996, 58) and are permitted to settle at Doni-Nusa Lela, or the village of Nualela and the marketplace of Wulandoni³ (Barnes 1984, 1996; Bataona 2021; Lundberg 2000). Here they live harmoniously with the local people and, subsequently, a significant exchange of craft skills and transfer of technologies is initiated. The ancestors are taught iron forging skills, in return giving the people of Nualela the technology for making clay pots in the form of *fato faka* (paddle and anvil) (Barnes 1996, 59; Lundberg 2000, 172). The ancestors live well at Doni-Nusa Lela but find their boats are frequently taken further westward to Bata Bala Mai beach (Bataona 2021). They seek the landowners’ permission to settle here, who agree on the basis that the “brave seafarers” could protect them from pirates (Bataona 2021). This place subsequently became the location of Lamalera.

Lembata environment and Wara Liang

Lembata lies within NTT or the eastern sector of the Lesser Sunda Island chain (Figure 1). This is a highly active geological region shaped principally by the collision of three

²Luki Point may be the current Tanjung Watokleta, adjacent to the modern village of Pantai Harapan and the site of Wara Liang.

³Nualela and Wulandoni (variously Wulan Doni, Fulan Doni or Fulandoni) are encompassed by the contemporary Pantai Harapan settlement.

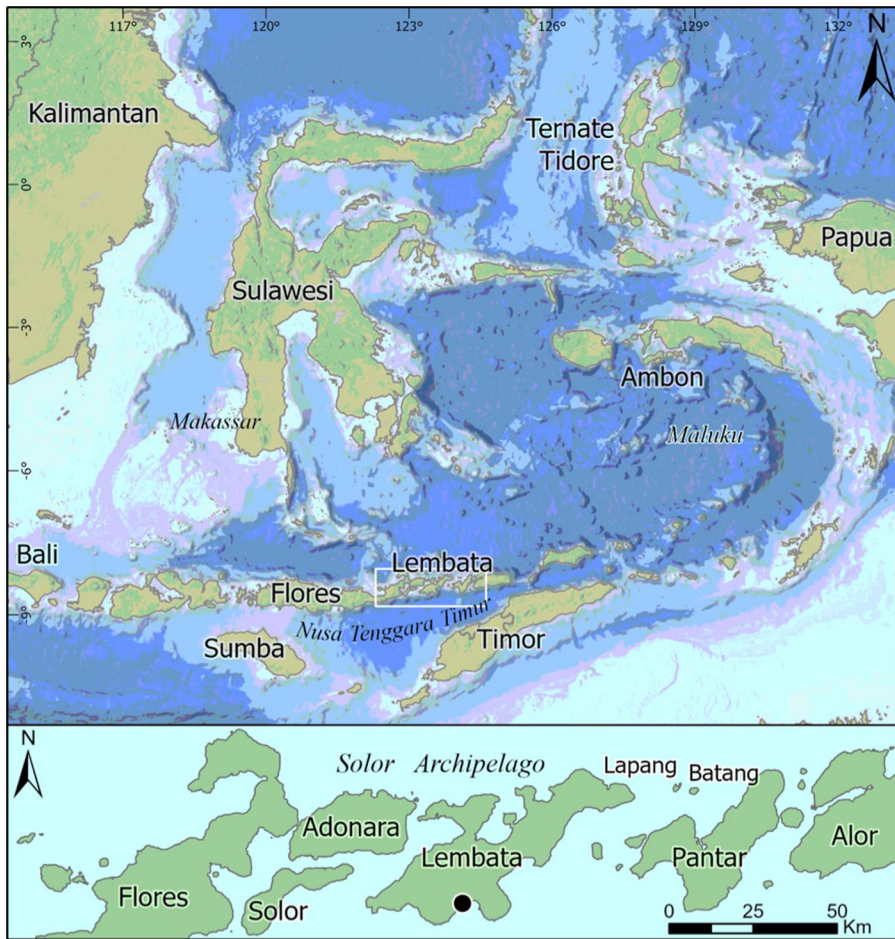


Figure 1. Map of the region discussed showing Lembata and Wara Liang (black dot). Upper map: DEM basemap sourced from General Bathymetric Chart of the Oceans (GEBCO) and NOAA National Centers for Environmental Information (NCEI) through ArcGIS Online (ESRI).



Figure 2. Map of Labala Bay and the Wara Liang vicinity. Satellite imagery sourced from Earthstar Geographics through ArcGIS Online (ESRI).

major tectonic plates within Wallacea: the Eurasian Plate, the India–Australian Plate, and the Pacific–Philippine Sea Plate (Hall 2009). The formation of NTT is the outcome of collision between the Australian and Banda Sea plates, and the subduction of the

Table 1. Radiocarbon age determinations produced by the University of Waikato, Radiocarbon Dating Laboratory.

Sample ID	Spit	Layer	Sample type (species)	¹⁴ C date ± error	Cal BP			Cal AD		
					68.3%	95.4%	Median	68.3%	95.4%	Median
Wk-45560	12	3	Charcoal	370 ± 15	472–332	491–325	434	1478–1619	1459–1625	1517
Wk-45559	18	5	Charcoal	336 ± 15	441–319	451–313	386	1510–1632	1500–1637	1565
Wk-45555	37	7	Charcoal	569 ± 15	622–538	625–531	550	1329–1413	1325–1420	1400
Wk-45556	43	9	Charcoal	614 ± 15	631–555	645–550	606	1320–1396	1306–1400	1345
Wk-45561	48	9	Charcoal **	659 ± 15	652–565	659–560	590	1299–1386	1292–1390	1361
Wk-45552	51	11	Charcoal	956 ± 15	907–799	915–794	847	1044–1152	1035–1156	1104
Wk-45558	53	12	Charcoal	1246 ± 15	1243–1120	1248–1074	1147	708–830	703–877	803
Wk-45557	59	12	Charcoal	1251 ± 16	1244–1124	1263–1076	1157	707–826	688–874	793
Wk-45553	63	12	Charcoal	1353 ± 17	1295–1274	1300–1181	1283	655–677	651–770	668
Wk-45554*	61	*14	Coral	1860 ± 18	1310–1188	1369–1128	1255	641–762	581–823	695
Wk-45551*	64	*14	Marine shell (<i>Muricidae</i>)	1833 ± 15	1287–1174	1342–1102	1229	663–776	608–848	721

All dates were calibrated in OxCal v4.4 (Bronk Ramsey 2009) using a mixed U(0,50) curve, combining the IntCal20 (Reimer et al. 2020) and SHCal20 (Hogg et al. 2020) curves, with the exception of the marine shell and coral samples that were calibrated using the Marine20 curve (Heaton et al. 2020). Calibrations presented in both “years before present” (BP) and calendar years (AD). * Indicates dates from non-cultural layers. ** Sample recovered from hearth in direct proximity to *in situ* rim sherd. See [Supplementary Table S1.1](#) and [Data S2.1](#) for further details.

Australian plate resulting in a combination of volcanic arcs and areas of coralline uplift (Major et al. 2013). Although there are segments of the volcanic Sunda and Banda Islands Arc that are dormant or extinct, Lembata is characterized by recent and ongoing volcanism (Zhang, Miller, and Schulte-Pelkum 2022).

Lembata has numerous massive volcanic edifices, three of which are active (Yudhicara, Bani, and Darmawan 2015). This pronounced volcanism has resulted in several incidents of eruption, earthquake, landslide, and tsunami, which have created a dynamic landscape of island extensions and land uplift or subsidence. There are many historical accounts in traditional narratives and among European records of volcanic and seismological events in the area (Barnes 1996, 8; Ramenzoni 2023). In 1979, a landslide and resultant tsunami on the eastern side of the AtaDei Peninsula caused major destruction and death (Yudhicara, Bani, and Darmawan 2015, 91).

The Wara Liang rockshelter is situated on the easterly side of the Watokleta headland projecting into Labala Bay (Figure 2). It is adjacent to the township of Pantai Harapan, which encompasses the long-established Nualela village and marketplace of Wulandoni, and 7 km from the twin villages of Lamalera Atas and Lamalera Bawah. The rockshelter sits within an igneous formation of tuffaceous breccia (Ili Lebakelang Old Volcanic Formation; Koesoemadinata and Noya 1989), which has been uplifted, exposing a rock platform below that continues into the sea. Basal level sampling on non-cultural coral and shell specimens from within the excavation pit (Table 1) produced dates around 1300–1200 BP, indicating the cave was subject to tidal incursion during that time and unsuitable for human occupation prior to its subsequent uplift (see [Supplementary Data S2.1](#) for additional exploration of possible uplift rate).

Wara Liang excavation

In 2017 a 1 × 1 m test pit (Square A) in the front center of the Wara Liang rockshelter was excavated (Figure 3, [Supplementary Figures S2.1 and S2.2](#)). The excavation was

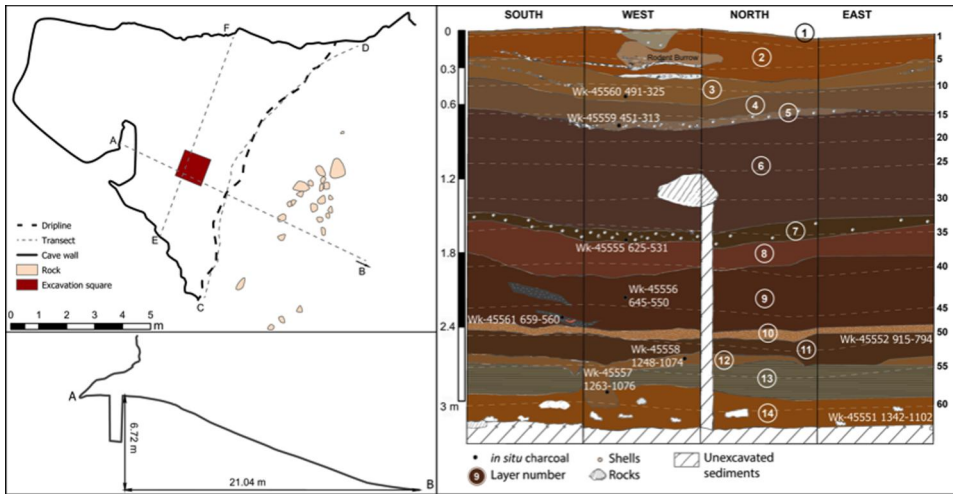


Figure 3. Wara Liang excavation details. Left, top: site plan showing the excavation location (red square) and cross-sections for profiles. Left, bottom: site profile (cross-section A–B) and transect down to sea-level. Right: stratigraphic excavation drawing. Radiocarbon dates are shown with lab code and 95.4% cal BP date range. Layers are numbered down the north wall. Spits indicated down the right side.

carried out in 5 cm spits with all deposit dry and wet screened through 1.5 mm sieves. The test pit was excavated to a depth of around 3.5 m with significant sediment accumulation over a relatively short period evident. With the exception of the lowest two layers (Layers 14 and 13), which were determined to be culturally sterile, the overlying layers recovered archaeological materials indicating two phases of occupation; an initial aceramic occupation (Layers 12 and 11) followed by pottery-rich layers (Layers 9–1).

Stratigraphic chronology

Eleven radiocarbon dates were obtained for Wara Liang, calibrated using OxCal v.4.4 (Bronk Ramsey 2009) and a mixed U(0,50) curve, combining the IntCal20 (Reimer et al. 2020) and SHCal20 (Hogg et al. 2020) curves for terrestrial (i.e., charcoal) samples, as recommended for the Inter-Tropical Convergence Zone (Hogg et al. 2020), and the Marine20 curve (Heaton et al. 2020) for marine shell and coral samples (see [Supplementary S2.3](#) for detailed methodology). The radiocarbon chronology shows that site occupation commenced around 1200 years ago (Figure 4; Table 1; [Supplementary Table S1.1](#)).

Stratigraphic interpretation, excavation findings, and radiocarbon dates suggest the following sequence of events at Wara Liang (see [Supplementary Data S2.2](#) for detailed interpretation of the stratigraphic layers). Initial uplift above sea level ca. 1300 years ago allowed some terrestrial sediments to accumulate upon the underlying beach deposit, but was not yet impervious to inundation as demonstrated by the overlying storm surge deposit of Layer 13. Around 1200 years ago the site was occupied for the first time (Layer 12) with these early inhabitants excavating a substantial pit (extending into Layers 13 and 14) with a distinctive hearth at the base (spit 63). Sometime later this pit

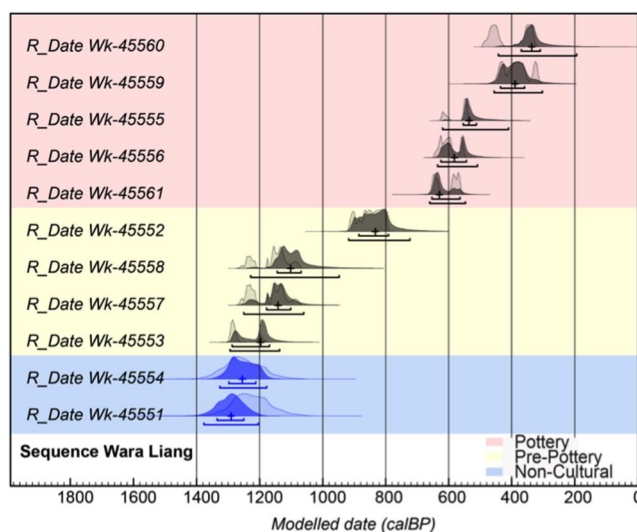


Figure 4. Bayesian date model for the Wara Liang archaeological sequence. Pale probability distributions represent the calibrated, unmodelled date, whilst dark distributions represent the modeled date. Gray = charcoal samples, blue = marine shell/coral. The brackets beneath the distributions represent the 68.3% and 95.4% probability ranges, respectively. The + indicates the median. Dates are displayed in years cal BP. See [Supplementary Data S2.3](#) for model methods and [Table S1.1](#) for detailed results. Colored shading corresponds with the same three phases highlighted in [Figure 5](#).

was used again for a second hearth (spit 61) with associated shell artifact manufacture as evidenced by worked *Turbo* sp. recovered in conjunction with this hearth. The presence of an anthropogenic pit and fireplaces, along with shell artifacts, provides clear evidence of human occupation at this time. We consider the small proportion of zooarchaeological materials from the lower spits (below spit 55) to originate from this Layer 12 pit and are thus assigned to Layer 12 and the associated Wk-45557 and Wk-45553 dates ([Figures 3](#) and [5](#)). Layers 12 and 11 recovered the highest proportion of rodent, fruit bat, and crab remains, as well as barnacle, shellfish, and some fish, alongside a few cobble pounders ([Figure 5](#)). However, the relatively limited amount of these cultural materials suggests low intensity, periodic use of the cave by foraging groups from initial use ca. 1200 years ago until around 800 years ago. This cultural sequence is then interrupted by the deposition of a thin sterile layer of very well sorted sand (Layer 10), perhaps deposited under similar conditions to Layer 13. It is after this that we see a sudden increase in the intensity of site use (Layer 9), corresponding with the first appearance of pottery in the assemblage around 600 years ago. Later in Layer 6 (ca. 500 years ago) we see the arrival of glazed ceramics and metal artifacts (S2.4).

With the introduction of pottery a broader range of zooarchaeological remains is present and in greater quantity, including sea mammals, deer, terrestrial domesticates (e.g., pig and goat), abundant fish, as well as shellfish, crab, urchin, and barnacles ([Figure 5](#)). In addition, flaked lithic artifacts, glass beads, and metal artifacts were also recovered from these pottery-bearing layers ([Supplementary Tables S1.2-4](#) and [S2.4](#)). This shift from forager-focused inhabitants to pottery users with domesticated animals indicates a change in local subsistence strategies and lifeways at this site.

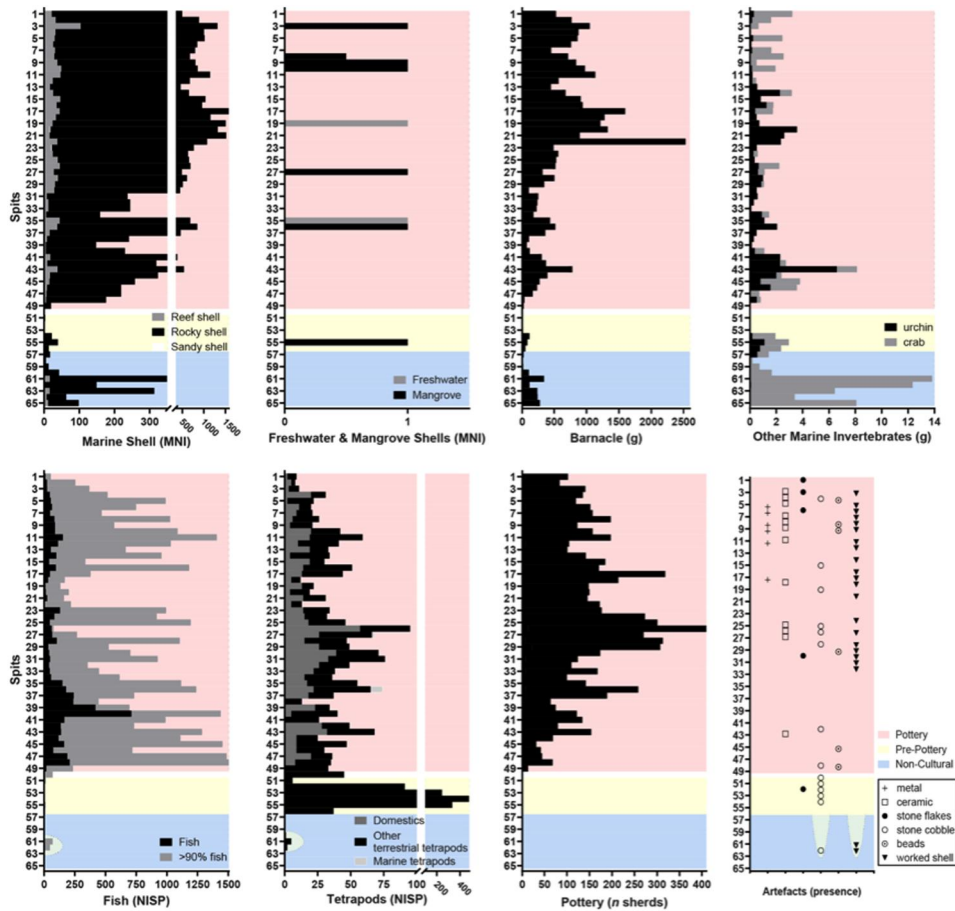


Figure 5. Graphs of cultural materials recovered from the Wara Liang excavation by spit from left to right. Top: marine shell MNI (gray = reef species, black = rocky, and white = sandy); freshwater (gray) and mangrove (black) shell MNI; barnacles (g); urchin (black) and crab (gray) (g); Bottom: fish NISP (black = identifiable specimens, and gray = unidentifiable but >90% likely fish bone); tetrapod (aka. non-fish vertebrates), NISP (gray = domesticate species; black = other terrestrial species; light gray = marine species); pottery (number of sherds); other artifacts symbolized as presence/absence per spit from left to right: cross = metal, square = glazed ceramics, filled circle = stone flakes, open circle = cobbles, circle with dot = beads, triangle = worked shell. All graphs are shaded to indicate the three main phases of the deposit: pottery-bearing upper phase (pink), lower pre-pottery (yellow), and the culturally sterile bottom layers (blue). Yellow shading within the blue phase is used to indicate materials associated with the pit dug down from Layer 12. See [Supplementary Table S1.2](#) for raw data.

Wara Liang pottery assemblage

The Wara Liang pottery assemblage consists of highly fragmented pieces of low-fired earthenware although there are some relatively large sherds. There is also a slight number of high-fired, glazed ceramic pieces. [Table 2](#) details the number and weight of ceramic finds by spit alongside the available calibrated radiocarbon age determinations.

Pottery occurs consistently throughout layers 1–9 with most spits between 3 and 43 recording more than 100 sherds ([Table 2](#)). Sherd numbers decline from spit 44 to 49 at the base of Layer 9. Two fragments of pottery were recovered below Layer 9 (spits 50

Table 2. Occurrence of pottery at Wara Liang by spit and age determinations.

Spit	Layer*	Number of sherds	Weight (g)	Median date (cal. AD)
1	1	95	87	1517
2		83	124	
3		141	121	
4	2	133	124	
5		118	112	
6		150	175	
7	3	155	190	
8		197	202	
9		121	152	
10	4	155	204	
11		197	213	
12		103	119	
13	5	100	87	1565
14		141	105	
15		184	151	
16	6	171	285	
17		318	312	
18		214	247	
19	7	148	254	
20		150	187	
21		146	104	
22	8	173	141	
23		177	157	
24		272	414	
25	9	299	404	1400
26		412	553	
27		270	282	
28	10	312	278	
29		293	338	
30		172	140	
31	11	123	173	
32		111	344	
33		168	266	
34	12	100	99	
35		142	224	
36		256	364	
37	13	189	249	1345
38		64	63	
39		75	118	
40	14	122	150	
41		138	260	
42		78	153	
43	15	151	486	
44		67	188	
45		32	43	
46	16	40	64	
47		41	88	
48		63	95	
49	17	12	13	1361
50		1	1	
51		0	0	
52	18	1	1	
53		0	0	
54		0	0	
55	19	0	0	
56		0	0	
57		0	0	
58	20	0	0	
59		0	0	
60		0	0	
Total		7574	9702	

*Layer associations are approximations.

and 52) and are considered intrusive to these lower layers. This overall pattern is generally mirrored by the weight of pottery (Table 2). It may be noted that some spits record high weight measures even when sherds appear relatively low. This occurs when exceptionally large sherds for this assemblage are present in particular spits, for

example, spit 43 recovered a moderate sherd count of 151 yet a weight of 486 g is recorded, the second highest of the assemblage. Pottery use at Wara Liang commences around 600 BP or within a range of 659–560 years ago following an extended period of light, aceramic occupation.

Diagnostic earthenware pottery

A range of earthenware sherds that inform on vessel morphology and styling was identified (Table 3). These include 44 rim pieces where lip and juncture with the pot body is well preserved and clearly discernible, and 50 pieces that exhibit rim attributes but which are poorly preserved. There are 74 sherds that bear intentional decoration, including seven decorated rim sections.

Rims

Of the 43 well-preserved rim sherds (44 pieces, including two conjoining sherds forming a single rim section; reference A6-01), everted rims are the most common (Table 4). However, there is morphological variation within the range of everted rims. Some segments show a secondary inflexion point that accentuates the angle of eversion, creating the effect of a two-step rim. This attribute is clearly seen in samples including A33-02 (Figure 6B) and A19-01, A33-01, A35-02, A41-01, A42-01, and A43-01 (see S2.5). Additionally, sample A41-01 shows a scooped or guttered rim (Figure 6C).

The lip profiles are typically rounded but there are variations with a lesser number round-pointed, and fewer still flat (Table 4). The foremost pairing of rim shape and lip profile is everted rim with rounded lip (Figure 6A). There are a number of rims that bear notches, with some notching occurring on both rounded and flat lips. Photographs, measurements, and observations on each rim are provided in Supplementary Data files S1.5 and S2.5.

Decorations

The decorated sherds show several techniques resulting in a number of styles and motifs. Techniques include linear impression, linear incision, gouging, punctation, rim notching, and scalloping. Photographs, measurements, and observations on each decorated sherd are provided in Supplementary Data file S1.6 and S2.6.

Linear impressions

The most common decorative technique is impressed lines, featuring on 65% of the sub-assemblage. Although the distinction between impressed and incised lines is somewhat equivocal in some samples, the determination of impressed is due to the uniform straightness of the line created, often with a slight, raised lip of fabric apparently extruded from the furrow-like impression (Rice 2015).

Impressed lines are seen throughout the stratigraphy, although there is a concentration at spits 24–30 where over half of this sub-assemblage is found. Spit 29 in particular has 14 pieces, most of which are notably alike and probably from the same vessel,

Table 3. Wara Liang diagnostic sherds by spit.

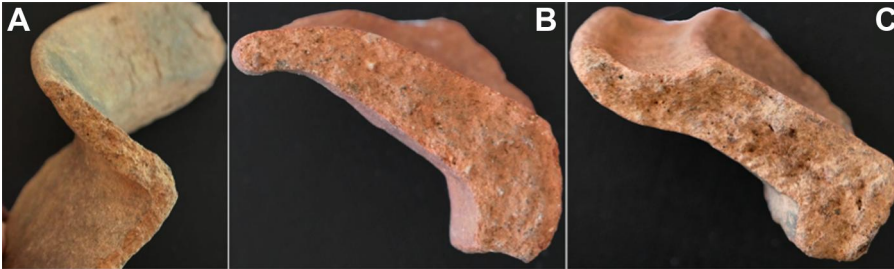
Spit	Body pieces	Rims	Incomplete rims	N/S/C/B*	Decorated	Tradewares
1	94		1		7	
2	83				1	
3	141					1
4	132	1			2	1
5	116	2			2	1
6	144	2	4		2	
7	153		1	1	2	1
8	192	2	3			2
9	120	1			2	3
10	155				2	
11	194	1		2		1
12	98	3		2	2	
13	99		1		1	
14	140			1	1	
15	183	1			1	
16	167	2	2			
17	313	2	2	1		
18	214					1
19	146	2				
20	149	1				
21	145	1				
22	173					
23	176		1			
24	271	1			1	
25	297		1	1	2	1
26	406	1	4	1	7	1
27	266	2	1	1		1
28	306	1	2	3	1	
29	286		2	4	15	
30	168		4		2	
31	116	1	3	3	1	
32	105			5		
33	159	4	4	1		
34	99		1			
35	136	2	2	2		
36	246	6	1	3	2	
37	180		5	4		
38	63			1		
39	74		1			
40	118			4		
41	131	1		2		
42	76	1		1	2	
43	145	1	3	2	3	2
44	63			4	2	
45	31	1				
46	39	1			2	
47	40			1	4	
48	62		1	1	4	
49	12				1	
50	1					
51	0					
52	1					
Total	7424	44	50	51	74	16

*Neck/shoulder/carination/base.

which is decorated with an intersecting line and crosshatch pattern (Figure 7A and B). Similar patterning throughout the sub-assemblage suggests this motif is characteristic. There is also a notable sample from spit 44 displaying a unique chevron impressed line motif (Figure 7C).

Table 4. Wara Liang rim and lip form combinations and counts.

Everted rim	Direct rim	Undetermined	
21	–	1	Round lip
5	–	4	Round-pointed lip
1	–	–	Pointed lip
3	–	–	Round-notched lip
3	2	–	Flat lip
1	–	–	Flat-notched lip
2	–	–	Notched fully lip

**Figure 6.** (A) Example of predominant Wara Liang everted rim and rounded lip form (A16-01); (B) two-step rim (A33-02); (C) guttered rim (A41-01).

Linear incisions and points

Incised line decorations are mostly seen in combination with point gouges. Combination lines and points are seen in lower spits 42–48 with several alike sherds probably from the same vessel (Figure 7D and E). One sample presents crosshatched lines and gouges that may be arrayed in triangular sectors (Figure 7F). Some of sherds show a continuous wavy line (Figure 7G).

One sherd from spit 48 shows a configuration of line and point decoration, with a stepped morphological feature and dual surface coloration (Figure 7H). Further sherds featuring the two-step formation and two colors are found in spits 44 and 48 and may be segments from the one vessel.

Rim notching and scalloping

Five rim sections bear notches at the lip as well as two that display a more open scalloped effect (Figure 8). Notching is confined to the upper spits (5–15) while scalloping appears in lower spits (36 and 42).

Comparisons

In comparing the Wara Liang decorative motifs with other Southeast Asian repertoires of which we are aware, there are five assemblages identified that share all, or all except one, of the Wara Liang motifs (Table 5). However, it should be noted that these comparable assemblages range chronologically between ca. 2000 BC and the second millennium AD, and they are distributed widely from Northeast Thailand to Timor-Leste (Table 5).

Other surface features

A high number of sherds are seen with striations. These markings and grooves are often parallel but can also be intersecting in a seemingly random fashion. Although striations

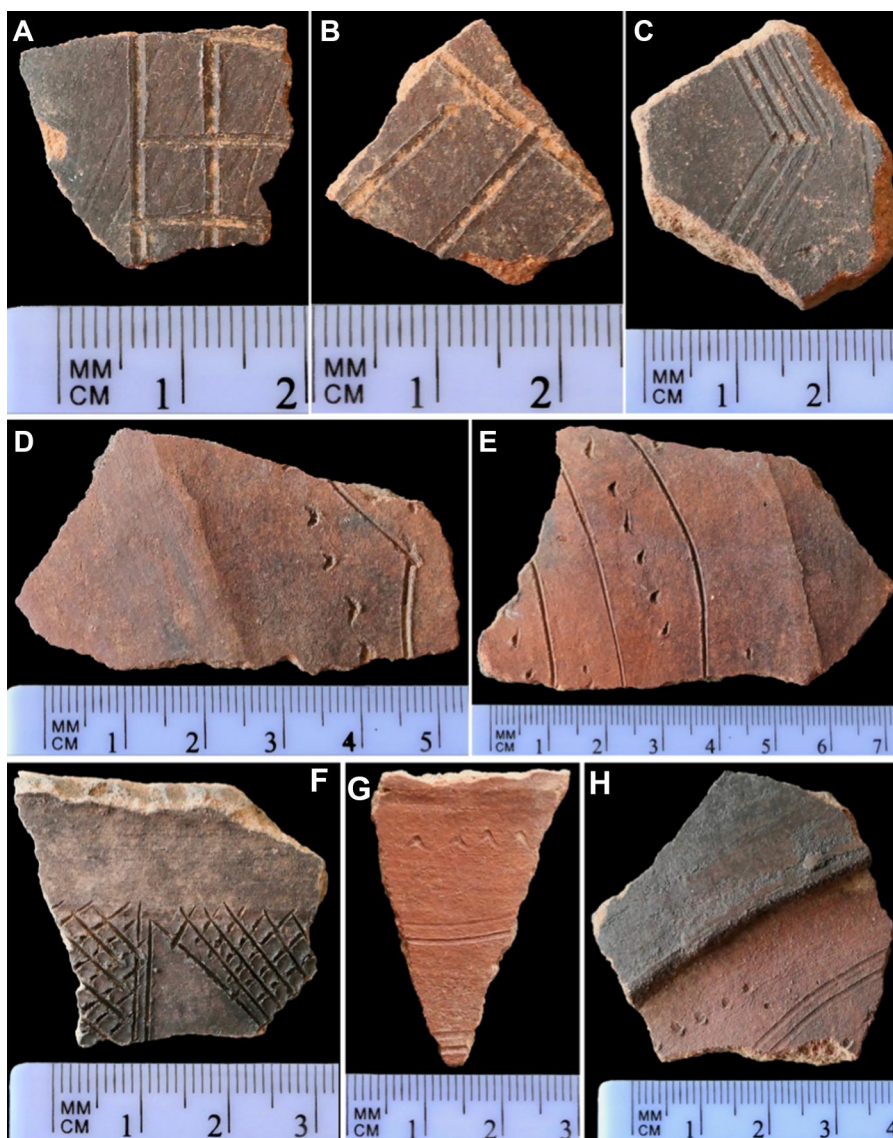


Figure 7. (A) Impressed line pattern (A29-01); (B) impressed line pattern (A29-02); (C) chevron pattern (A44-01); (D) incised lines and points pattern (A46-02); (E) incised lines and points pattern (A47-01); (F) crosshatch pattern (A7-01); (G) wavy line motif (A46-03); (H) unique combination decorated sherd (A48-01).

are found on all sherd types, clear examples of striated surfaces are seen on several decorated sherds (see [Figure 7A](#), A29-01, also S2.6: A1-03, A9-02, A10-02, A28-02, A29-14). The striations are inferred to be brush marks and the outcome of surface finishing processes (Rice 2015). Brush marking is seen on 12% of sherds between spits 1 and 29. However, the frequency decreases in lower spits 30–52 where burnishing is more prevalent. In addition, a smaller number of sherds exhibit rills encircling vessel circumferences (see S2.5: A17-01). The regularity of rilling implies manual wheel turning as a likely manufacturing technique (Rice 2015).

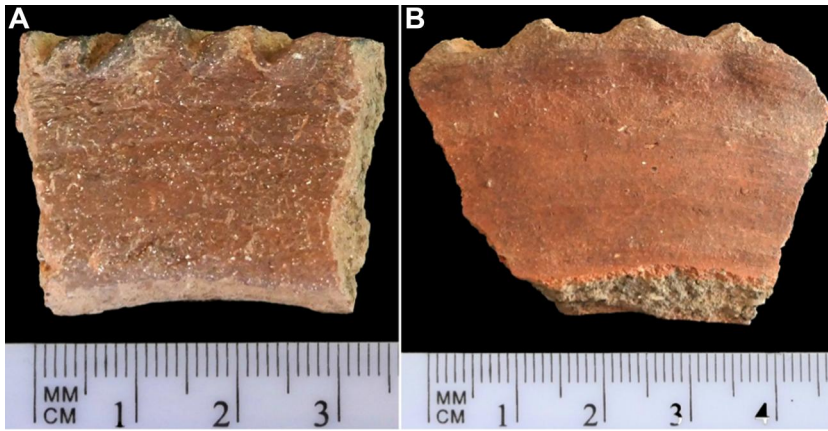


Figure 8. (A) Notched rim (A5-01); (B) scalloped rim (A42-01).

There is also considerable variation in the surface color of sherds overall, including slips and/or paints, which contrast with fabric color and perceived firing and usage outcomes. Thirty-eight percent of all sherds exhibit a black surface. Brown surfaces are seen on 9% with red appearing on 5%. Many colored sherds also display dual colors with a different color on the obverse side. The combination of black/brown surfaces is seen in 15% of sherds overall, black/red in 5%, and brown/red in 4%. A small number of light gray sherds are also found in spits 15 and 37 with an example from spit 35 showing light gray and red on opposite surfaces.

Tradewares

The identification and origin of the 16 fragments of high-fired, glazed tradewares ceramics recovered throughout the Wara Liang stratigraphy are listed in [Table 6](#), with detailed descriptions of the sherds and their provenance in [Supplementary Data file S2. 7](#). The majority of the tradeware sherds were recovered above or at spit 18 that has an associated median radiocarbon date estimation of AD 1565 ([Table 1](#)). Three pieces occurred below this level at spits 25–27 with a further two found at spit 43, which has an associated median radiocarbon date estimation of AD 1345 ([Table 1](#)). Overall, it may be noted that more recently manufactured sherds (as per their identification in [Table 6](#)) appear in the upper deposits with older sherds being recovered from the lower spits. These samples are representative of the ceramics known collectively as “tradewares” ([Figure 9](#)), which were imported in bulk quantities into Indonesia from production centers in China or mainland Southeast Asia during the second millennium AD, largely for use in commercial exchange between merchants and local communities.

Fabric analysis

All earthenware rims were examined by low-powered microscopy to identify possible fabric types and to guide the selection of samples for petrographic analysis. Five thin sections were produced from representative sherds, with two additional thin sections

Table 5. Wara Liang decorative motifs, compared with most similar SEA repertoires.

Wara Liang	Kuala Selinsing ^a	Fatu Aki Anik Knua ^b	Bronze Age Ban Non Wat ^c	An Son ^d	Khok Phanom Di ^e
Cross-hatching	Hassan Shuhaimi bin Nik Abd. Rahman 1999: Fig. 65	Supp. File 4 OS:5-52	Higham and Wiriyaromp 2012: e.g. Fig. 11.27, 9122/9126	Sarjeant 2014: e.g. Fig. 5.2, 97AS Layer 2-7	Vincent 2004: e.g. Fig. 107
Horizontal groove	Hassan Shuhaimi bin Nik Abd. Rahman 1999: e.g. Fig. 89	e.g. Supp. File 4 OS 5-28	Higham and Wiriyaromp 2012: e.g. Fig. 6.31, 8880/8884/12430	Sarjeant 2014: e.g. Fig. 5.16, vessel #1	Vincent 2004: e.g. Fig. 51 (top right and central right vessels)
Horizontal incision	Hassan Shuhaimi bin Nik Abd. Rahman 1999: e.g. Fig. 22	e.g. Supp. File 4 OS 1-04	Higham and Wiriyaromp 2012: e.g. Fig. 11.26, 1345/1346/1349	Sarjeant 2014: e.g. Fig. 5.14, AS Layer 5 Spit 8	Vincent 2004: e.g. Fig. 49 (bottom vessel)
Slanting diagonals	Hassan Shuhaimi bin Nik Abd. Rahman 1999: e.g. Fig. 11	e.g. Supp. File 4 OS 3-08	Higham and Wiriyaromp 2012: e.g. Fig. 6.53, 12220/12249	Sarjeant 2014: e.g. Fig. 5.17, C9 Layer 4 Spit 6	Vincent 2004: e.g. Fig. 47 (all 3 vessels)
Vertical groove	Hassan Shuhaimi bin Nik Abd. Rahman 1999: Figs 14, 61	Supp. File 4 OS 1-12	Higham and Wiriyaromp 2012: e.g. Fig. 6.8, 18229	Sarjeant 2014: e.g. Fig. 5.16, vessel #1	Vincent 2004: e.g. Fig. 158 (central-top left and central-top right vessels)
Serrated rim	Hassan Shuhaimi bin Nik Abd. Rahman 1999: Fig. 51	Supp. File 3 OS 3-30	Higham and Wiriyaromp 2012: e.g. Fig. 13.8, 18607/18609/ 18610	Sarjeant 2014: e.g. Fig. 5.14, B1 Layer 6 Spit 9	Vincent 2004: e.g. Fig. 52 (central-bottom right vessel)
Piecrust rim	Hassan Shuhaimi bin Nik Abd. Rahman 1999: e.g. Fig. 9	Supp. File 3 OS 3-63, OS 3-64	Higham and Wiriyaromp 2012: e.g. Fig. 13.18, 18617	Sarjeant 2014: e.g. Fig. 5.14, A5 Layer 7 Spit 9	Vincent 2004: Fig. 165 (top vessel)
Concentric semi-circles	Hassan Shuhaimi bin Nik Abd. Rahman 1999: Fig. 78	Supp. File 4 OS 4-69	Higham and Wiriyaromp 2012: e.g. Fig. 3.71, 26334/26367/ 26369	Sarjeant 2014: e.g. Fig. 5.17, C2 Layer 5 Spit 9	Not represented
Parallel stipples	Hassan Shuhaimi bin Nik Abd. Rahman 1999: e.g. Fig. 10	e.g. Supp. File 4 OS 4-12	Higham and Wiriyaromp 2012: e.g. Fig. 3.17, 1409/3707/4236	Sarjeant 2014: e.g. Fig. 7.32, "Fine zigzag roulette layer 3" vessel	Vincent 2004: e.g. Fig. 49 (both vessels)
Pock marks	Hassan Shuhaimi bin Nik Abd. Rahman 1999: e.g. Fig. 88	e.g. Supp. File 4 OS 3-56	Higham and Wiriyaromp 2012: e.g. Fig. 16.3, 6706	Sarjeant 2014: e.g. Fig. 5.14, burial 3 vessel #4	Vincent 2004: e.g. Fig. 72 (central and right vessels)
Ellipses	Hassan Shuhaimi bin Nik Abd. Rahman 1999: Figs 15, 60	Not rep-resented	Higham and Wiriyaromp 2012: Fig. 3.20, 1394	Not represented	Vincent 2004: e.g. Fig. 116 (top vessel)
Herring bone	Hassan Shuhaimi bin Nik Abd. Rahman 1999: Figs 4, 85	e.g. Supp. File 3, OS 3-30	Not represented	Sarjeant 2014: e.g. Fig. 5.17, C9 Layer 8 Spit 9	Vincent 2004: e.g. Fig. 258 (bottom right vessel)
Vertical incision	Hassan Shuhaimi bin Nik Abd.	e.g. Supp. File 4 OS 3-31	Higham and Wiriyaromp	Sarjeant 2014: e.g. Fig. 5.17,	Vincent 2004: e.g. Fig. 51

(continued)

Table 5. Continued.

Wara Liang	Kuala Selinsing ^a	Fatu Aki Anik Knua ^b	Bronze Age Ban Non Wat ^c	An Son ^d	Khok Phanom Di ^e
	Rahman 1999: e.g. Fig. 76		2012: e.g. Fig. 15.2, 14/53/56	B7 Layer 8 Spit 10	(bottom right vessel)
Rounded zigzag	Hassan Shuhaimi bin Nik Abd. Rahman 1999: Figs 69, 70	e.g. Supp. File 4 OS 3-55	Higham and Wiriyaromp 2012: e.g. Fig. 4.8, 1949/2311/2313	Sarjeant 2014: e.g. Fig. 5.17, B9 Layer 8 Spit 11	Vincent 2004: e.g. Fig. 51 (middle vessels)
Chain of dots	Hassan Shuhaimi bin Nik Abd. Rahman 1999: e.g. Fig. 95	Supp. File 4 OS 5-29	Higham and Wiriyaromp 2012: e.g. Fig. 5.30, 20660	Sarjeant 2014: e.g. Fig. 7.32, "Dotted line zigzag roulette layer 3" vessel	Vincent 2004: e.g. p.352, Fig. 154 (top vessel)
Looping grooves/ incisions	Hassan Shuhaimi bin Nik Abd. Rahman 1999: e.g. Fig. 59	e.g. Supp. File 4 OS 6-04	Higham and Wiriyaromp 2012: e.g. Fig. 3.36, 24303/24311/ 24318	Sarjeant 2014: p. 382, curvilinear incision example	Vincent 2004: e.g. Fig. 75 (bottom left vessel)

^aPeninsular Malaysia, first millennium AD (Bulbeck 2011).

^bTimor-Leste, mostly second millennium AD (Beaumont, O'Connor, and Leclerc 2020, including [Supplementary files 3](#) and [4](#) for decorative motifs).

^cNortheast Thailand, eleventh–ninth centuries BC (Higham 2022a).

^dSouth Vietnam, 2200–1500 BC (Piper et al. 2022).

^eCentral Thailand, 2000–1500 BC (Higham 2022b).

Table 6. Summary of tradewares recovered from Wara Liang.

Spit	Identification	Origin	Date AD
A3	Qing monochrome	Southern China – Guangdong kilns	18–19c
A4	Kraak porcelain	China	1575–1645
A5	Ming Swatow	China	late 16c
A7	Brittle ware	Southern China/central Vietnam	15–19c
A8	stoneware jarlet	China	15–19c
A8	Sawankhalok stoneware	Thailand	15–16c
A9	stoneware jar	China/Vietnam	10–19c
A9	stoneware jarlet	China	15–19c
A9	Qing	China	17–18c
A11	Brittle ware	Southern China/central Vietnam	15–19c
A18	Sawankhalok celadon	Central Thailand	15–16c
A25	Vietnamese celadon	Vietnam	15–16c
A26	Sawankhalok celadon	Thailand	15–16c
A27	Brittle ware	Southern China/central Vietnam	15–19c
A43	Brittle ware	Southern China/central Vietnam	15–19c
A43	Brittle ware	Southern China/central Vietnam	15–19c

Associated dates vary in precision from specific calendar years to centuries. See S2.7 for references for identifications and temporal allocations.

analyzed for comparison. These are from a surface sherd sample from Liang Lebenia, about 5 km from Wara Liang, and a modern-day pot purchased at Nualela ([Figure 2](#)).

The analysis of the Wara Liang samples revealed two fabric characters based on the substantial presence of either volcanic rock fragments or calcareous mineral inclusions. The temper in two samples (A4-01, A36-03) consists almost exclusively of calcareous inclusions. Volcanic fragments with lesser proportions of other terrigenous inclusions dominate the other two samples (A28-01, A43-01). In comparison, the Liang Lebenia specimen and the modern pottery show a relative consistency with the volcanic fabric type. The fabric types are consistent with the geologies of Lembata as well as the coastal

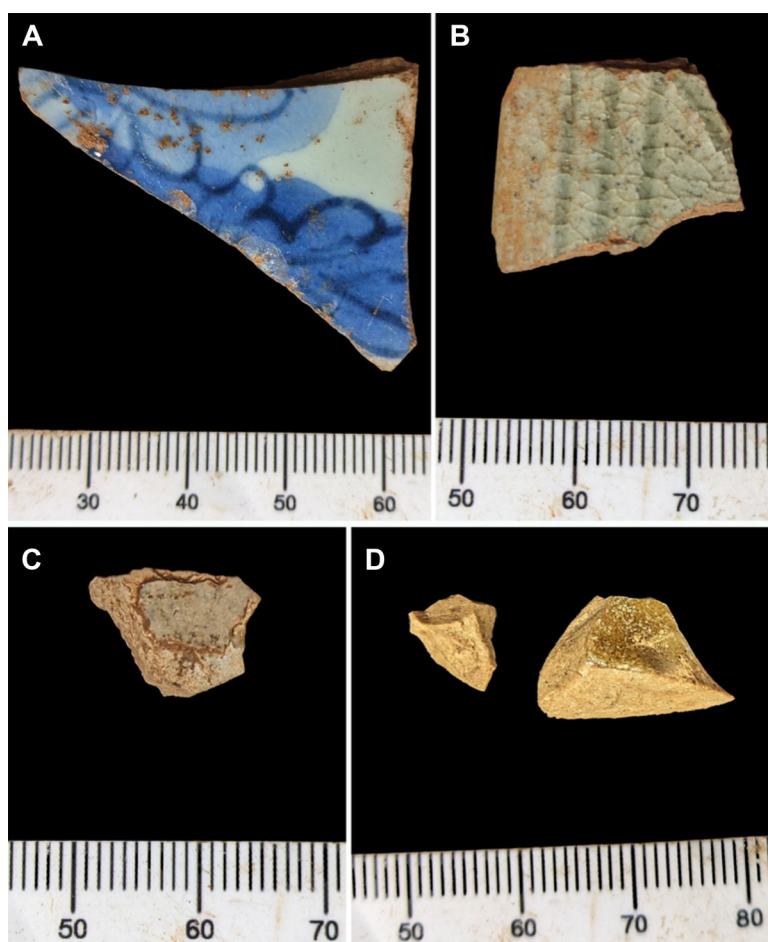


Figure 9. Selection of tradeware ceramics from Wara Liang. (A) Kraak porcelain (A4); (B) Sawankhalok celadon (A18); (C) Vietnamese celadon (A25); (D) Brittle Ware (A43).

environment of Wara Liang, suggesting the deposited pottery was locally made. Further petrographic details are provided at [Supplementary Data file S2.8](#).

Discussion

The Wara Liang earthenware pottery is characterized by everted rims with rounded lips, suggesting globular cooking pots or *periuk*, commonly found throughout eastern Indonesia both historically and contemporarily (Santoso 1995). The essentially domestic nature of the pottery, coupled with the copious food remains excavated, indicates that Wara Liang was used for habitation. Its decorated sherds feature various configurations of impressed and incised lines, some with point gouges, as well as some rim notching and scalloping. Impressed intersecting lines forming a crosshatch or lattice effect is the assemblage's most characteristic motif. These generic attributes in form (globular cooking pots) and style (incised-line decorations) are consistent with the sort of earthenware ceramic that becomes increasingly yet irregularly widespread throughout eastern

Indonesia during the Metal Age. However, the Wara Liang decorative motifs are undiagnostic in terms of pottery comparisons (Table 5) and the comparable assemblages identified range widely chronologically and in spatial distribution. Of more relevance, in NTT the use of motifs in delineating clan membership and alliance is central in other craft forms like *ikat*, and it is not inconceivable that decorative themes used on pottery conveyed similar symbolic meaning. The geometric patterns found on *ikat* in Lembata are similar to, and in some cases identical with, the motifs expressed on pottery (Barnes 1984, 302).

The introduction of pottery at Wara Liang from about 600 years ago places it notionally at the very end of the Metal Age. Throughout ISEA earthenware pottery is considered a Neolithic innovation spreading significantly through the Metal Age, and it may well be the transformation of extant trading networks and emerging communications driven by early exogenous influence and merchants that precipitates this significant spread. There are some sites within NTT where earthenware pottery first occurs at various times in the second millennium AD along with tradewares that may be compared with the arrival of ceramics at Wara Liang. Warloka on Flores produced earthenware and some tradewares dated to the thirteenth–fourteenth centuries (Rahmayani 2012). In Timor-Leste, the fortified sites of Macapainara, Vasino, and Leki Wakik have yielded abundant earthenware and tradewares dated between AD 1350 and 1600 (Brockwell et al. 2020; Fenner et al. 2020; O'Connor et al. 2020). Despite the similarity with the Timor-Leste fortified settlements, Wara Liang does not exhibit any characteristics of a refuge.

The ostensibly late occupation of Wara Liang, and hence the later arrival of pottery, can in part be accounted for by the habitability of the rockshelter itself. The excavation reached a basal level where non-cultural coral and marine shell samples produced dates around 1500–1300 BP. This is a clear indication that the site was a sea cave and subject to regular marine incursion at this time. It is probable that local volcanic and seismic forces resulted in uplift raising the cave above sea-level. Cultural deposits from around 1200 BP in the form of an anthropogenic pit with hearths and worked shell artifacts show human use of the cave begins practically immediately after it is uplifted above tidal ingress and that communities were resident in or frequenting the area. Site use during the initial, aceramic phase is relatively light compared with the rapid deposition and accumulation of sediments following the addition of pottery. Along with pottery, subsistence artifacts appear in much greater quantities and a broader range of faunal and floral remains are present indicating a greater intensity of site usage.

The occupation of Wara Liang, either permanent, seasonal, or intermittent, provides insights regarding settlement patterns in NTT. By the mid-second millennium AD, Austronesian-speaking peoples had substantially inhabited much of eastern Indonesia, and their hallmarks of ceramics and village settlement had become a widespread mode of life. Indeed, the Solor Archipelago including Lembata is characterized by the long-established Lamaholot language cluster, a part of the Austronesian Central Malayo-Polynesian grouping (Fricke 2020). However, Wara Liang provides an example where Austronesian-speaking people still opted to use cave and rockshelter locations, presumably in conjunction with village settlement (see Pannell and O'Connor 2005). Even when village settlements are habitual, the use of caves and other natural features for

specific purposes was an ongoing way of life. The physical aspects of Wara Liang, adjacent to the sea and fronted by a substantial rock platform, along with the abundant marine food remains excavated, indicates that fishing and littoral foraging were the foremost industries at the site. Indeed, the Watokleta headland remains a resource-rich zone and fishing site to this day. The site may also have been favorable for harboring seacraft and in that sense may be seen as a strategic location for maritime communications and movement. A present-day road leads from the vicinity of Wara Liang across the island's mountainous interior. Such a communication link following the most parsimonious path may have operated in prehistoric times with Wara Liang as its terminus providing a jump-off point for maritime travel.

The late introduction of pottery at Wara Liang is a phenomenon that requires interpretation specific to the locale and its people. Aside from the physical origins of the site that precludes a Neolithic arrival of pottery, its absence through much of the later Metal Age when ceramics were in use or introduced in locations throughout NTT seems anomalous. Wara Liang remains aceramic for an extensive period and evidently unaffected by the use of pottery in proximate island locations. Although the reasons for this are necessarily unclear, there are several scenarios that may be considered. The initial occupiers may simply have not used their pottery at the rockshelter, where particular activities at the time did not involve the use of the technology and where the nature of occupation may have been for specific purposes and brief. Alternatively, the early users of Wara Liang may not have been in contact with ceramic-using communities that could have provided the opportunity to acquire pottery technology. Labala Bay has historically been considered to be an impoverished and remote area (Barnes 1996, 341). Furthermore, there may have been cultural reasons why pottery was not in use during this period at this specific locality. The complexity of communities in NTT and the web of clan affiliations and prohibitions may have prevented certain groups from involvement with particular items or activities. It is the case that specific communities have specializations, often mandated tasks and monopolies, which prevent other groups from engaging in specific industries or functions. However, as is the case with pottery, such exclusivity usually extends to manufacture rather than use. Significantly, the village of Nualela, close by Wara Liang, became the exclusive pottery-production center on the island (Barnes 1984, 1996). It remains a speculative possibility that cultural constructs prevented the use of pottery at Wara Liang initially. But the introduction of pottery from around 600 years ago may indicate that a resident community had begun using the site more intensively where pottery use became beneficial at the rockshelter. Conversely, the introduction of pottery may suggest contact with or the arrival of a new ceramic-using population in contrast to earlier inhabitants who had not used pottery specifically at Wara Liang or who were aceramic either by choice, proscription, or lack of opportunity to acquire the technology.

The development of maritime trading networks was well underway through the first millennium AD and expanding significantly by the mid-second millennium, bringing peripheral locations in NTT into contact with external influences and actors. The presence of tradeware ceramics at Wara Liang is a clear indication that it was incorporated in the broader cosmopolitan networks and markets, directly or indirectly. Although the manufacture date of the tradewares can be estimated, their deposition at the site is

certain to have lagged from the time of production (see Fenner and Bulbeck 2013). Tradewares were distributed from regional entrepôt centers such as Banjarmasin, Makassar, and Javanese ports (Lim 2017). The Wara Liang tradewares are typical of these foreign-manufacture ceramics and are comparable in amount and characteristics with fort sites in Timor-Leste (e.g., Fenner and Bulbeck 2013).

While it is reasonable that the general expansion in communications and contact driven by the demand for spice island commodities exposed isolated locations, perhaps like Wara Liang, to new technologies, the origin legend of Lamalera represents a seemingly credible explanation for the introduction of pottery. However, there are discrepancies between the details of the legend, other circumstantial information, and the archaeological data that are cause for some reserve, particularly concerning the implied timeframe. The compelled exodus of the Lamaleran ancestors from Sulawesi by Gajah Mada begins the legend's timeline, and indeed Majapahit forces campaigned through eastern Indonesia in the mid-fourteenth century (Ricklefs 2008). The duration of the ancestors' subsequent voyaging, probably following traditional trading seaways through Maluku and to NTT, and settlement at Lapan Batan is unspecified but is implicitly long. In 1522, surviving vessels from Magellan's fleet record passing an inhabited Lapan Batan (Clark 2019). However, by 1525, the ruler of Larantuka on Flores seeks to enlist a "bold and bloody" group recently settled in Lembata after fleeing a tsunami to the east (Clark 2019, 327). This group is presumably the Lamalerans. These circumstantial accounts may be key in placing the arrival of the Lamaleran ancestors on Lembata about 500 years ago. The calibrated radiocarbon dates (Table 1: Wk-45561; S2.3) associated with the earliest pottery at Wara Liang set a range of about AD 1300–1400 or the fourteenth century. The radiocarbon dates appear to predate the timeframe suggested by the legend, albeit only by around 100 years, and it may be noted that while extensive modeling of the radiocarbon dates has been undertaken, the dates are inherently imprecise to an extent. Although comparison of the two notional timeframes shows just moderate consistency, there is still striking similarity. There is a good deal of coincidence between the timeframe described by the legend and the occurrence of pottery at Wara Liang, and the close match of key locations in the legend and the Wara Liang site provides a further degree of plausibility.

Most convincingly are the places detailed in the legend and their direct proximity to Wara Liang. The Lamaleran ancestors engage with the people of Nuaela and exchange technologies. Nuaela is in the immediate vicinity of Wara Liang and it is highly likely that the rockshelter was part of an overall village complex. On balance, despite some deficiencies, the details of the Lamaleran origin legend are well corroborated by the archaeological evidence. The Wara Liang pottery is found in the right location and at about the right time. Nevertheless, it may still be the case that the Lamaleran legend has been elaborated, for example, to associate with the prestige of the Majapahit era, as well as to justify a separation of economic functions and the production specializations of communities, and its details may not be precise.

The Lamaleran origin legend does provide a unique account of pottery introduction, and does address the seemingly late arrival of the technology at Wara Liang. It is therefore of material relevance to interpreting the earthenware assemblage. The introduction of pottery late in the Metal Age at Wara Liang shows that many and variable circumstances may promote or hinder the transfer of technologies, and reinforces the need for

locally informed explanations where broader models of diffusion may not adequately address specific occurrences. The Wara Liang pottery occurs at a time when the region was experiencing a “hotspot” of interactions, and it is the expanding connectivity and involvement of new trading powers that causes widespread technology transfers generally. The juxtaposition of trans-oceanic mercantile trade and small-scale societies affected the region considerably and irrevocably. But the Wara Liang assemblage represents an example where alternative explanations may be at least as relevant.

Conclusions

The Wara Liang excavation recovered clear evidence of habitation by a foraging group, without pottery use, from practically the moment the site was available for occupation ca. 1200 BP. About 600 years ago site use intensified, coinciding with the first appearance of pottery and a shift toward the keeping of domesticates and likely other agricultural practices. There is no clear explanation for the shift in economies and the introduction of pottery at this seemingly late time. However, the ultimate arrival of a ceramicist population with farming practices is a distinct possibility.

The extension of maritime networks, stimulated dramatically by exogenous merchants and imperialists seeking the region’s unique commodities, progressively exposed remote and peripheral locations to novel technologies. The presence of tradeware ceramics irrefutably demonstrates that Wara Liang had been incorporated into this broad mercantile web, either directly or indirectly. However, the origin legend of Lamalera provides unique and compelling information that attributes the introduction of pottery to the arrival of new people, refugees from natural disaster. Flight, migration, and community resettlement are immediate causes of technology transfers in a region and time where forced population movements due to natural causes or instigated by human pressures are conspicuous.

The Wara Liang pottery is an example of the variability that attends the emergence of pottery-using communities across NTT and eastern Indonesia. Although earthenware shows notable similarity in form and style across the region, its first occurrence does not conform to any anticipated spatial or temporal pattern. This case study exemplifies the multitude of factors, and especially the regard for immediate physical and historical circumstances including available indigenous knowledge, which should be considered to achieve a more nuanced and authentic interpretation for localized technology transfers.

Supplemental Material

Supplemental Data Tables S1

- S1.1 Radiocarbon dating results and modelling.
- S1.2 Cultural materials counts and weights by spit.
- S1.3 Tetrapod fauna identification and counts.
- S1.4 Marine shell identification and counts.
- S1.5 Pottery rims metrics and descriptions.
- S1.6 Pottery decorated sherds metrics and descriptions.

Supplemental Data Files S2

- S2.1 Uplift interpretation.
- S2.2 Stratigraphic interpretation.
- S2.3 Radiocarbon date calibrations and modelling.
- S2.4 Cultural assemblage description.
- S2.5 Pottery rims photographs.
- S2.6 Pottery decorations photographs.
- S2.7 Tradeware assemblage description.

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