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Wang Duan: upper Thai-Malay Peninsula coastal groups during the early and late Neolithic period

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Introduction

It is axiomatic that the Thai-Malay Peninsula (TMP) played a critical role as a commercial crossroad in the Maritime Silk Road (Jacq-Hergoualc'h and Hobson 2002; Wheatley 1961; Nunsuk 2017; Allen 1988; Stargardt and Stargardt 1983; Wisseman Christie 1990). Although we now have an improved understanding of the Metal Age economic, social and political landscape that witnessed the emergence of early cosmopolitan city-states with complex industrial production networks (Bellina 2017; Bellina, Favereau, and Dussubieux 2019; Bellina 2022) and evidence for involvement in well-established long-distance networks in the South China Sea and the Bay of Bengal (Hung 2017; Hung et al. 2013; Bellina 2018; Bellina et al. 2012; Bellwood 2007), the long span of the preceding Neolithic is still hazy. In the TMP, hypotheses for the Neolithic rely on limited data scattered over a large region and on sparse dates that mostly come from inland cave sites (Bulbeck 2011; 2017) with only a few from open air sites such as Jenderam Hilir (Malaysia) (Leong Sau Heng 1991) and Ban Kao (Thailand) (S rensen 1967). Coastal Neolithic sites are scarce in SEA, with Nong Nor and Khok Phanom Di so far the only well-known published sites in the central plain of Thailand (Higham and Thosarat 2004; Higham et al. 1998). To our knowledge, no such site has been reported so far in the TMP. Consequently, the groups that occupied the different environments of the TMP, and their respective economic organisations, networks and interactions, are not well understood. The characterisation of coastal, lowland and inland groups and the analysis of their interactions are elements that contribute to the discussion of the hypothesis of cultural differentiation and complementarity as early as the Neolithic, or the consideration of the establishment of symbiotic relationships between hunter-gatherers and farming communities as observed at Ban Non Wat in northeast Thailand (Higham in press; Higham et al. 2011) and at Rach Nui in Vietnam (Castillo et al. 2018; Oxenham et al. 2015). Currently, in the TMP, the most favored hypothesis is that cultural differentiation occurred within the same population from the second millennium BCE due to competition for land (Bulbeck 2017). However, the land exploitation issue is difficult to tackle given the limited botanical data available in TMP research for this period (Goh et al. 2019; Bulbeck 2014). But in the Metal Age, such complementarity can be observed in exchange networks and even seems to increase along with the exploitation of the populations' respective niches and the control of routes feeding regional demands (Bellina et al. 2019).

To better understand the gradual involvement of TMP populations in exchange networks and their consecutive evolution, the French-Thai Archaeological Mission in the Upper TMP has investigated a series of sites of varying nature and environmental setting, with age ranging from the Neolithic to the Metal Ages. Excavations were conducted at the inland sites of Tham Nam Lot in 2012 (Bellina et al. 2019), the neighboring site of Khao Chula in 2017-18 and Wang Duan (hereafter WD) in 2017. WD is a coastal site located in a former bay at the gateway of a major historical transpeninsular route linking Myeik (former Mergui) in Myanmar to Prachuap Khiri Khan through the Singkhorn Pass (Figure 1). Local villagers regularly find ancient pottery in the vicinity of the 2017 excavations, evidence of the use of this transpeninsular route in the second millennium CE.

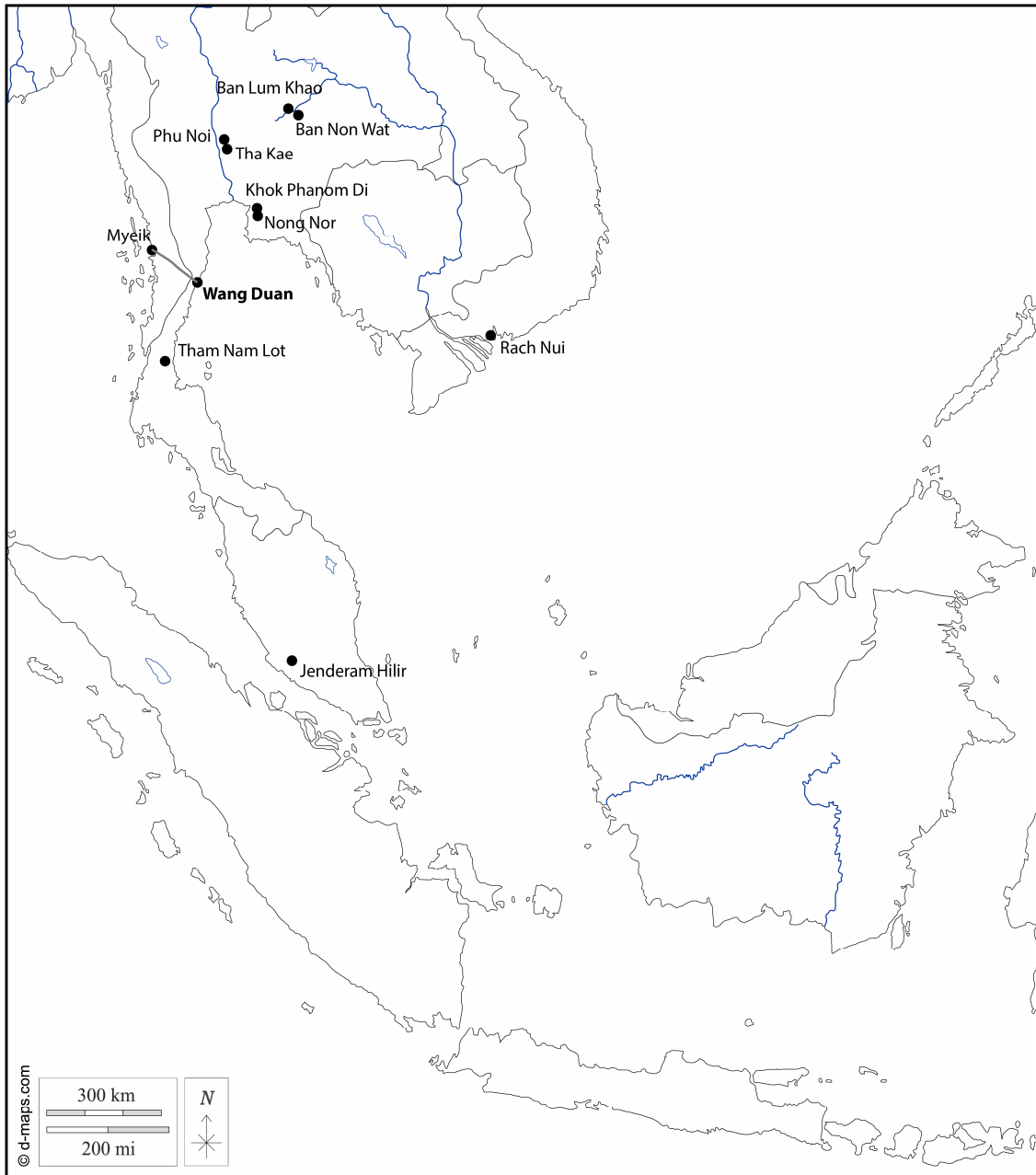


Figure 1: main sites cited in the text and the Myeik-Prachuap Khiri Kan transpeninsular route (B. Pradier).

These surface collections of Neolithic-related sherds, together with a polished adze made of slaty shale that was found by a local farmer (Figure 2) provided sufficient evidence of ancient occupation at WD for the site to be selected for archaeological investigation in 2017. Comparison of coastal and inland groups' socio-economic organizations and interactions from the Neolithic to the Metal Age was expected to provide information to consider cultural differentiations, respective groups involvement in exchange networks, and eventually to determine sequences of change amongst the different groups occupying distinct environments. More broadly, this research intended to contribute to defining the sequence of socio-cultural developments in relation to exchange in the TMP, and to determine what influences the different groups exerted on exchange networks and regional cultural evolutions.



Figure 2: Polished adze found on the surface at Wang Duan (P. Petchey)

1. Wang Duan current and ancient landscape

WD is situated at the Khi Mot River mouth, 14 km south of Prachuap Khiri Khan. A large tidal estuary is enclosed by a 400 m by 800 m sand spit, with the river mouth at the southern end. A number of streams drain into this estuary, creating low ridges intersected by shallow valleys. The modern railway and highway run parallel to the coast at 700 m and 2.7km inland, respectively. These transport features cut across the natural system of streams and rivers flowing towards the coast. Our investigation focused on the area between the coastline and the railway, within an area 1000 m north to south and 700m west to east.

This landscape has undergone considerable anthropogenic change since ca. 1900. The railway construction in 1914 was the first large-scale modification, with embankments and cuttings constructed through the coastal system of streams and inlets. Although culverts were built through the embankments for these streams, the shallow valleys behind inevitably silted up and some were used as rice fields. Until the 1980s this landscape probably altered slowly, with a gradual increase in population and agricultural intensification (a mixture of rice fields and plantations), and the construction of a road from the railway station to the river mouth and along the shoreline. (Aerial photograph No. E84, flown 10/5/1976). In the 1980s a control structure was built across the mouth of the tidal estuary that restricted its tidal range and has led to increased sediment build up (Aerial photograph Run 84B, flown 28/12/1994). The main channel has been formalized, and some of the former tidal flats have been reclaimed. At the same time agricultural practices have been changing, and several small dairy cattle herds have been established on land previously used for rice cultivation.

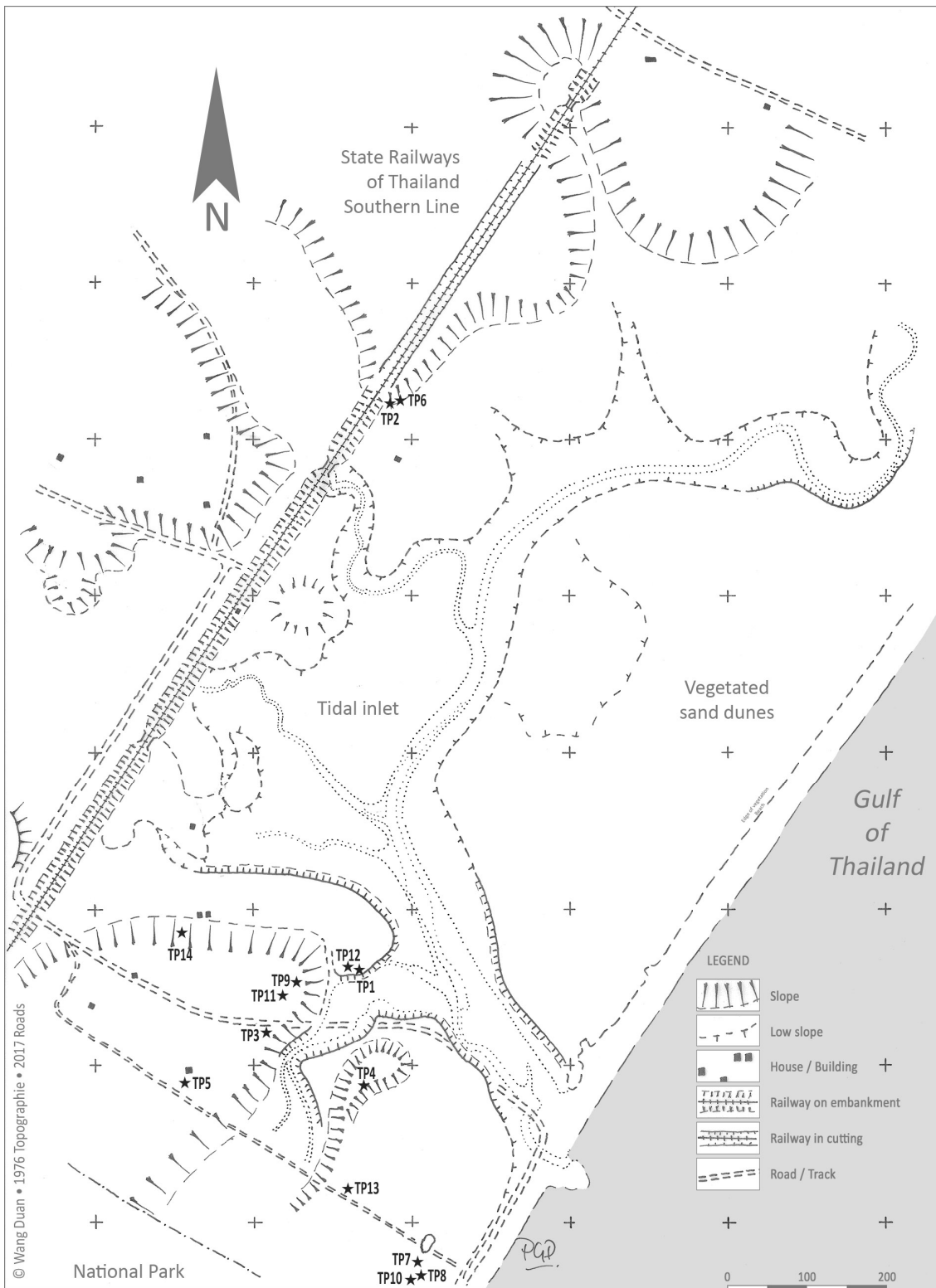


Figure 3. Map of Wang Duan based on an aerial photograph (drawing P. Petchey)

The modern landscape is therefore considerably different to the ancient, in both use and form. However, pre-1914 (i.e. pre-railway) features can still be identified, giving clues to the earlier environment. The area would have been a low-lying coastal strip, dissected by numerous small streams separated by low ridges. Closer to shore many of these streams would have been tidal, with possibly extensive tidal flats.

Interpretation of the coastal landscape deeper into the past requires consideration of sea level change. A combination of palaeoenvironmental studies (sediment, palynology, remote sensing, etc.) identify broad trends in sea-level changes in the TMP (Sinsakul 1992; Tjia 1996; Horton et al. 2005). The analysis by Horton et al. (2005) suggests a sea level rise of ca. 5.5 mm/yr from a minimum of -22.15 m at 9700-9250 cal. yr BP to a mid-Holocene high stand of +4.87 m at 4850-4450 cal. yr BP and from then a steady fall at ca. -1.1 mm/yr to the present. However, the authors warn that there are local variations in the available data and that a single scenario should not be drawn for the TMP. With regard to Prachuap Kiri Khan (the area on which this study focuses) examination of attached oysters from Khao Chong Krachok indicate a sea level as high as 2 m above present sea level by 4700 yr B.P. (Sinsakul 1992).

Human occupation would have followed the moving shoreline, making use of coastal and estuarine resources, and living on higher, drier areas of land interspersed by the streams and rivers running to the sea. The stream courses and areas of high land would have changed over time as streams cut down through sediments and storms threw up sand from the coastal dune systems. The age of the present coastal spit and estuary that it encloses at WD is not known, but excavations on the shore of the estuary behind the spit (see TP1 below) suggest people were living there in the early first millennium BCE. Numerous sand horizons in the excavations indicate the dynamic beach ridges system along the coastline might reflect the regional series of continuous falling of sea level from 6,000-3,000 years ago (Surakieatchai et al. 2018).

Overall, the WD landscape probably consisted of dune systems along the shore, with the Khi Mot River and smaller streams flowing towards the coast through shallow valleys interspersed by low ridges, meeting the coast in a shallow embayment. It is possible the estuarine environment behind a sand spit of today was similar at times in prehistory, but even without that spit the stream and river mouths would have provided access to wetland food resources. The low ridges constituted ideal dry occupation coastal sites with easy access to marine resources and fresh water.

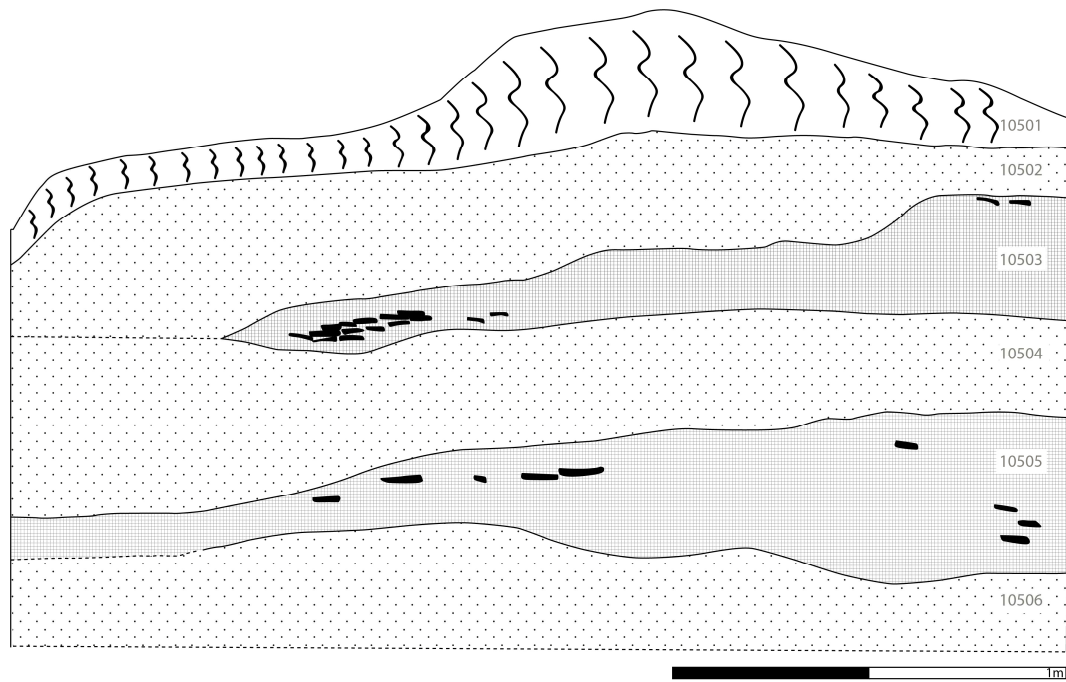
2. Excavations

Fifteen test pits and sections were excavated in three zones located to the west and south of the area bordering the ancient bay. Of these pits, five provided the most significant results in the form of successive occupation layers: TP1, TP1-ext, TP9 in the mid zone of the site, and TP2 (section), TP6 in the north zone of the site. With the exception of TP13, which provided an occupation level characterized by the presence of ceramic sherds on the surface, the test pits that were opened in the southern zone provided no archaeological evidence for ancient occupation.

* TP2 and TP6 (north zone)

TP2 was a 2.7m section cut in a mound located at the edge of the railway (see Figure 3) that revealed two levels of occupation (Figure 4). The upper cultural horizon consisted of two layers immediately below the topsoil. The upper layer (context no. 10502) was a compacted coarse sand that contained a few sherds of ceramics, overlaying a layer of a darker coarse sand (context no. 10503) that contained a high concentration of ceramic sherds. There was then a sterile layer (context no. 10504) of fine, light grey, powdery sand with no artefactual material.

The second cultural horizon (context no. 10505) contained a high concentration of sherds of large and thick ceramic with a coarse sandy temper. The composition of the soil was identical to that of the previous layer, except for the appearance of pockets of fine white sand. Below was a fine white sand with no cultural material.



KEY TO SYMBOLS





-  Top Soil
-  Sand / Sandy
-  Cultural layers
-  Pot sherds

Figure 4. Section TP2 (B. Pradier)

TP6 (4x4m) was located at the top of a promontory cut by the railway line, and provided the longest cultural section found in 2017, with cultural evidence to a depth of 2.3m below the surface (Figure 5). The occupation was represented by five distinct cultural layers, each of which (except layers 9 and 10) was interspersed with a layer of sterile sand. These intermediate layers sometimes contained ceramic sherds. Coarse-grained pottery was present in the deepest levels (layers 7, 9, 10). Several surfaces could be identified thanks to the presence of sherds lying flat in the same level, as in layers 5 to 10. TP6 provided at least four and possibly five phases, each with characteristic ceramic assemblages. No faunal material was found.

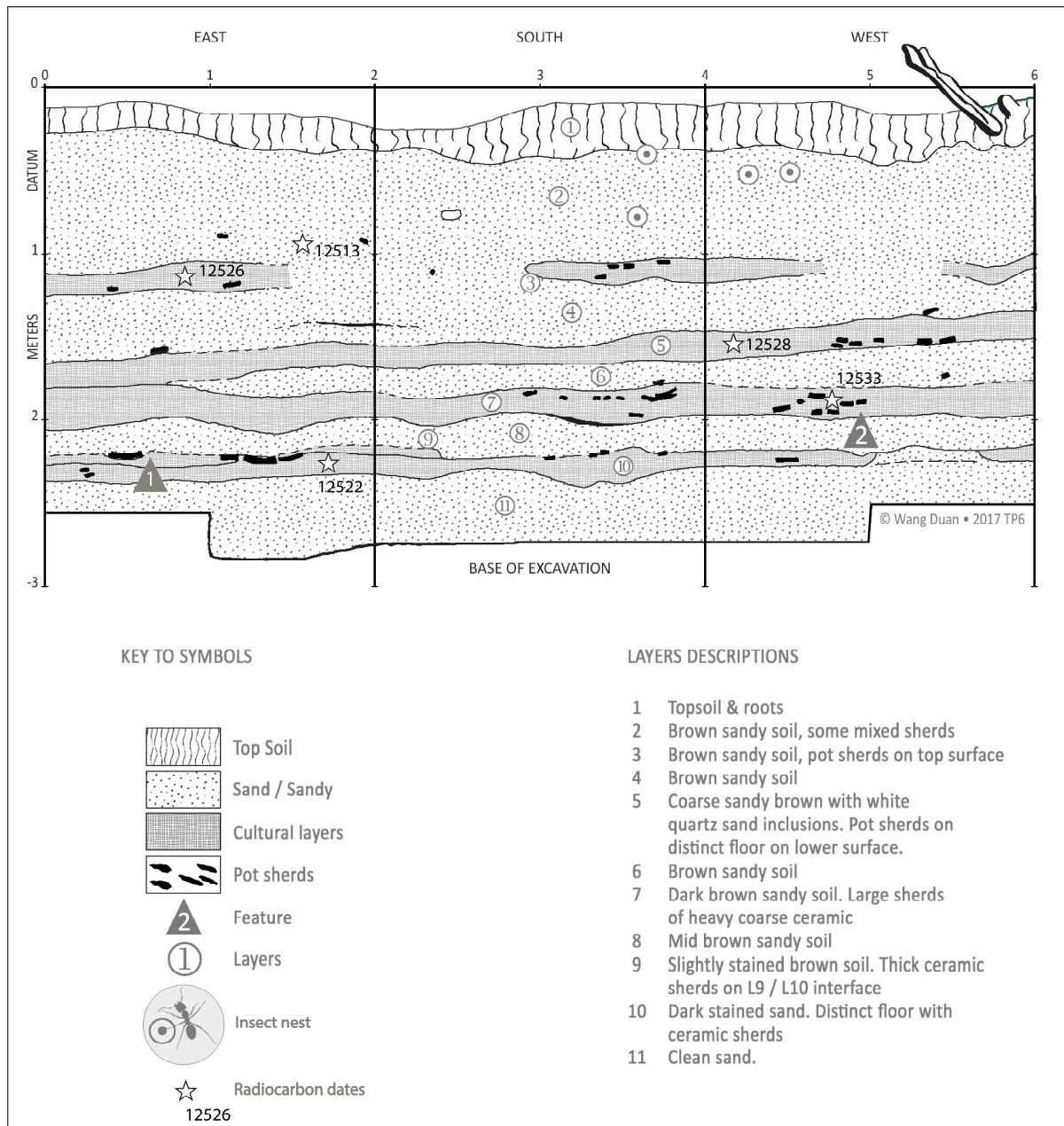


Figure 5. TP 6 section East, South and West (P. Petchey and B. Pradier).

*** TP1, TP1-extension, TP5, TP9 (mid zone)**

TP1 (1m x 4.5m) and TP1-ext (2 x 3m) were located on the eastern edge of a promontory on the shore of the estuary (Figure 6). This was a complex occupation site to interpret due to dune dynamics that had laid down multiple sand lenses. In addition, access restrictions on the private land limited the excavation area, making it difficult to understand a complicated stratigraphy due to the relationships between natural sand dunes and cultural processes, where successive sand deposition events sealed successive human occupation events.

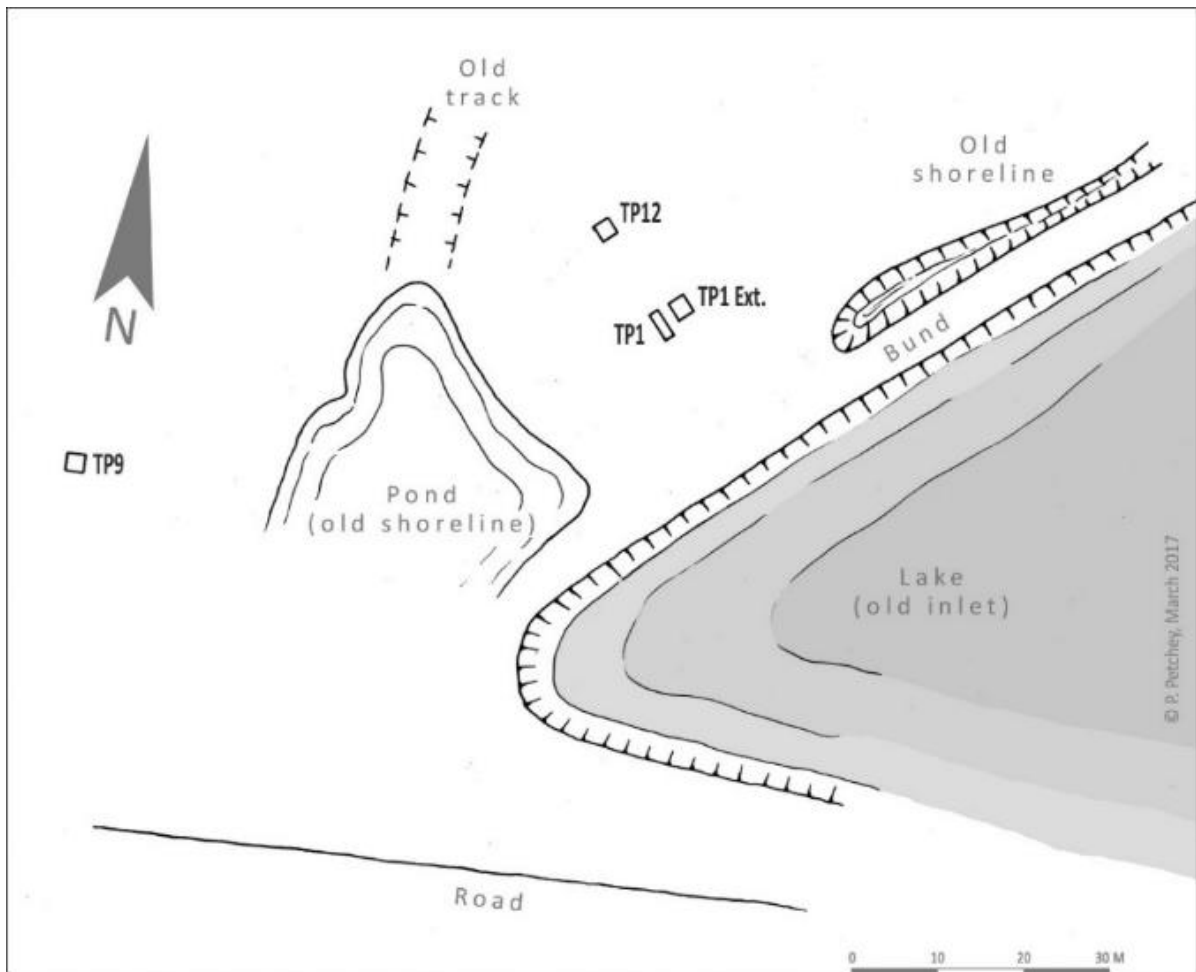


Figure 6. Location of the former bay and of the current coast and of TP1, TP1-ext and TP9 (P. Petchey)

TP1 provided 4 cultural levels corresponding to shell deposits (Figure 7). The surface layer (80cm thick) was sterile (layer 1). The first cultural level consisted of a yellow sand with red clay inclusions and ceramics (layer 2). The second cultural level (layer 3) was characterized by deposits of grey sand in which sherds were observed, with one particular concentration of sherds (Context 10008, layer 6 in the stratigraphy). The next occupation level (layer 10) was a grey-brown sand with ceramics and terracotta inclusions. The last sterile layer was a compact yellow sand with black concretions (layer 11). Layers 2 and 3 were probably contemporary. The older layer 6 yielded 4 whole pots stacked 1m below the surface.

TP1-ext was more complex than TP1 (Figure 8), despite the two units being only one metre apart, and contained 18 layers. Both TP1 and TP1-ext provided whole shallow pots characterized by a hole in the bottom and looking very much like a "flowerpot", all found stacked together (figure 15). Some of these stacked pots were found in the same cultural level (1m below the surface) and under a floor on which sherds lay flat. These ceramics were contemporary with level 6. No botanical or faunal remains, ash or traces of residue were identified with the pots.

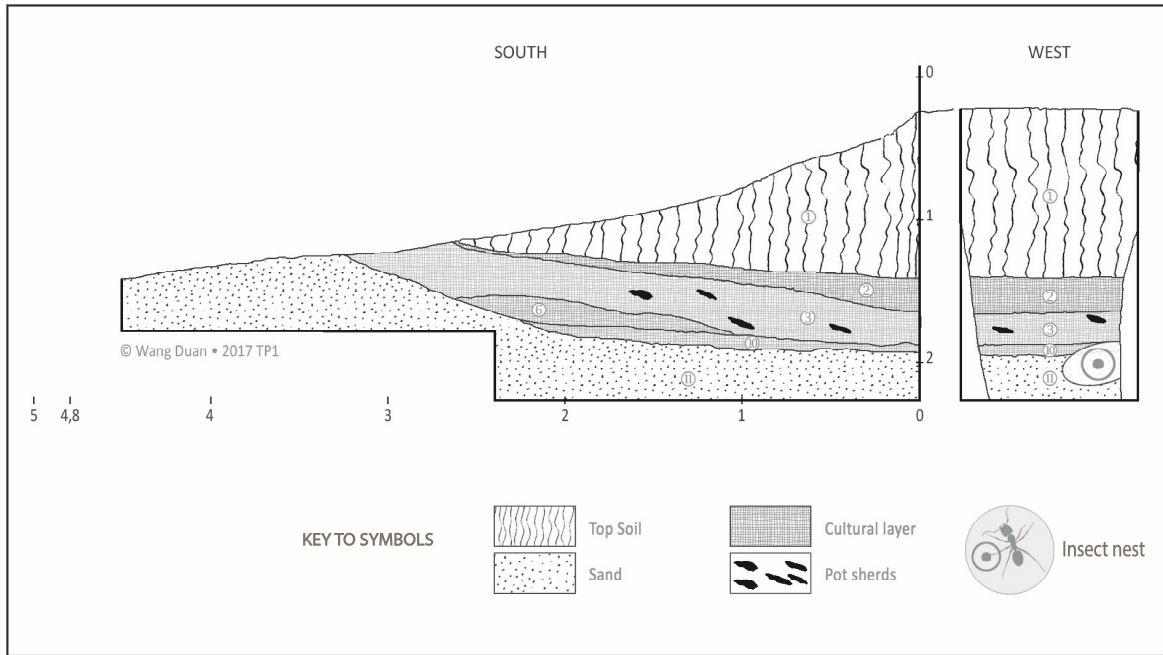
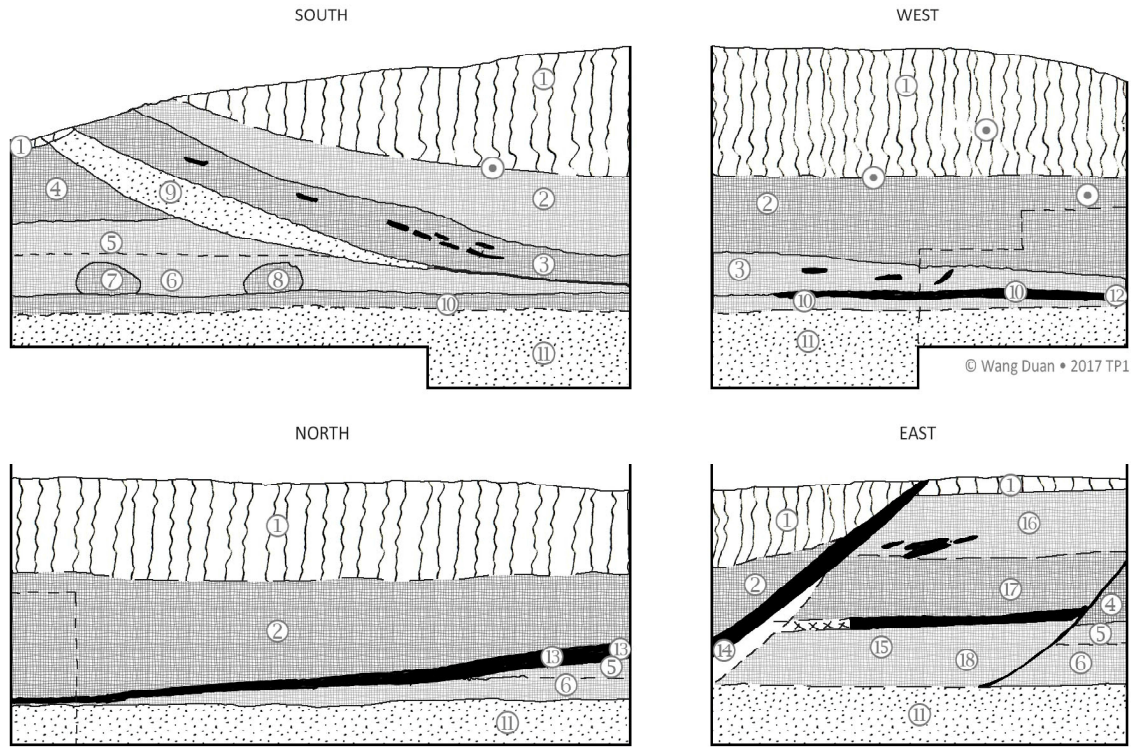
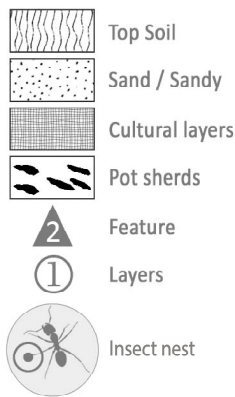


Figure 7. TP 1. Profile South and West (drawing B. Pradier)



© Wang Duan • 2017 TP1

KEY TO SYMBOLS



LAYERS DESCRIPTIONS

- 1 Topsoil. Brown / yellow hard clay
- 2 Brown / yellow hard clay with sherds
- 3 Dark brown sandy soil (pot sherds)
- 4 Yellow / brown sandy soil (pot sherds)
- 5 Brown / yellow friable sandy soil (pot sherds)
- 6 Similar to 5, turning black. Sandy, with sherds
- 7 to 8 Black sandy soil
- 9 Grey sandy soil with no cultural material
- 10 Interface between sterile Layer 11 and cultural
- 11 Sterile compact yellow sand with black mineralisation inclusions
- 12 to 15 Ceramic layer, sheet deposit
- 16 Yellow / brown sandy soil with burnt clay inclusions
- 17 Similar to 16, but browner
- 18 Light brown sandy soil with pot sherds.

Figure 8. TP1-ext sections (drawings L. Champion)

TP9 (2m x 2m) was opened near the top of one of the headlands in the south-western part of the former bay, upslope from TP1 (Figures 9 and 10). It had five layers, of which only layer 3 (1.2-1.4m below the surface and 150-200mm thick) contained cultural material, consisting of several sherds of thick, rough pottery (see pottery report) and charcoal. This represents a single occupation phase, after which the area was abandoned and covered with layers of dune sand.

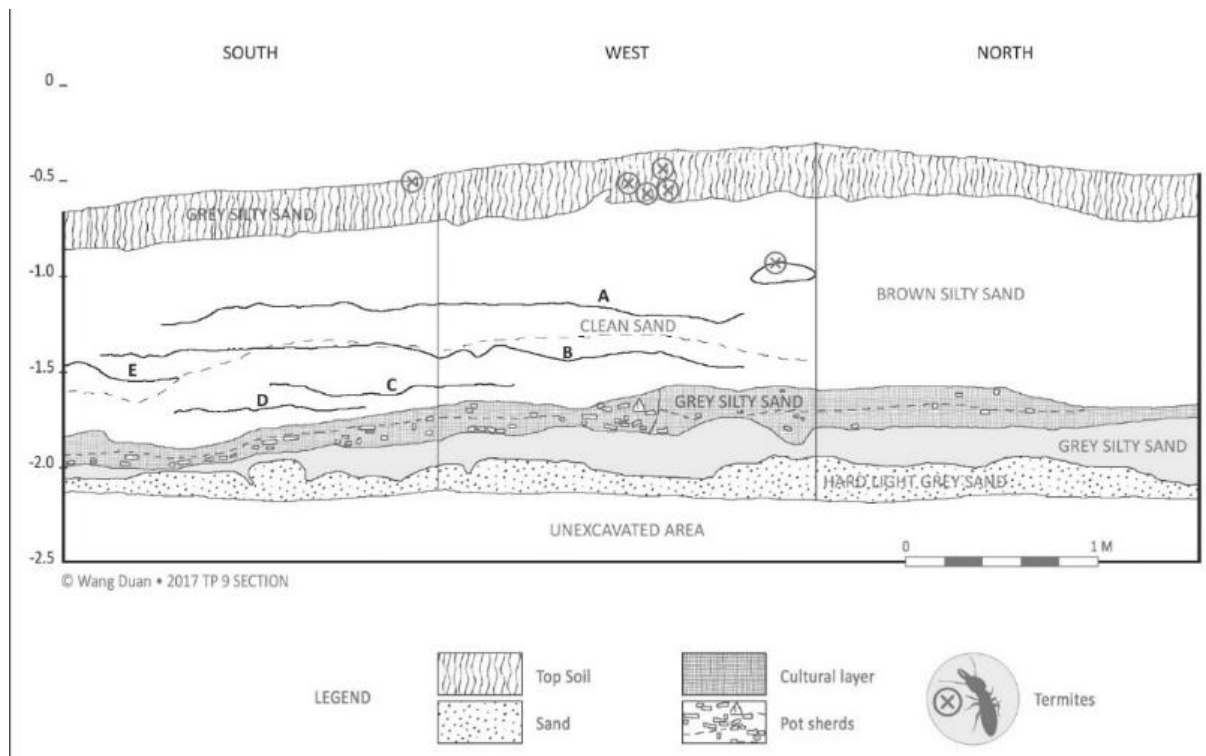


Figure 9. TP9 south-west-north profile (J. Innanchai & C. Duval).

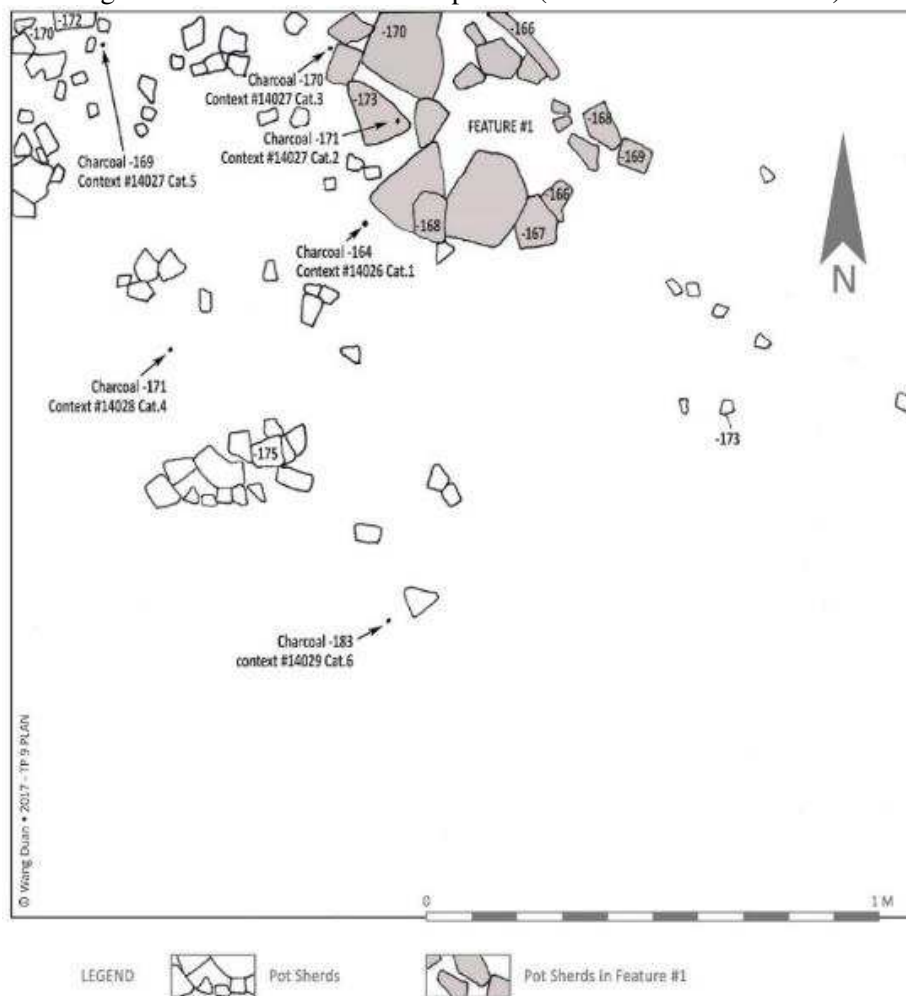


Figure 10. TP9 Plan showing artefacts in the cultural layer (drawings J. Innanchai).

*** TP13 (south zone along a coastal dune)**

TP13 (1m x 2m) was opened at the back of the main dune ridge behind the beach. It contained a single level of ceramics lying within the otherwise consistent beach sand matrix, indicating a single phase of human activity in this area (Figure 11).

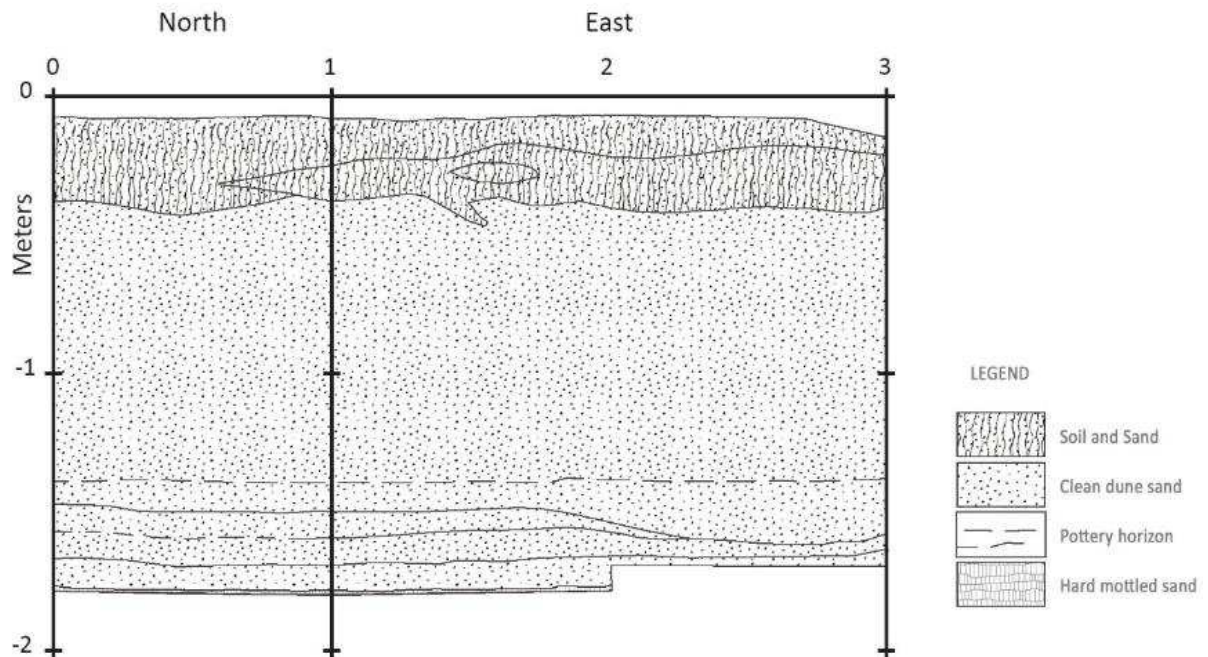


Figure 11. TP 13 North and East section (drawing P. Petchey)

3. Site Dating (14C)

The French ARTEMIS program dated seven layers, revealing two periods of occupation taking place during:

-An early Neolithic period with three dates of the late third millennium ranging from 2400 to 2200 BCE (**3760±30; 3820±30; 3755±30**)

-An early first millennium BCE period with 4 dates ranging from 1100 to 700 BCE (4 dates: **2615±30; 2860±30; 2565±30; 2725±30**) (Table 1 and Figure 8).

One layer date likely the result of bioturbation is anomalous: TP6 US12513 (¹⁴C 1315 B.P).

| Sample Ref. | Lab Ref. | ¹⁴ C age (yr BP) | material | 2σ calibrated age ranges (probability) |
|-----------------|------------|-----------------------------|---------------------------|--|
| TP1-ext US10024 | SacA 50716 | 2615±30 | charcoal | cal BC 827-774 (95.4%) |
| TP1-ext US10015 | SacA 50727 | 2860±30 | charcoal | cal BC 1110-918 (95.4%) |
| TP6 US12513 | SacA 50718 | 1315±30 | charcoal (archaeo botany) | [cal AD 655: cal AD 724] [cal AD 739: cal AD 767] |
| TP6 US12526 | SacA 50717 | 2565±30 | charcoal | cal BC 801-741 (42.1%) cal BC 693-662 (14.3%) cal BC 648-547 (39.0%) |
| TP6 US12528 | SacA 50719 | 3760±30 | charcoal (archaeo botany) | cal BC 2280-2252 (6.3%) cal BC 2209-2034 (89.2%) |
| TP6 US12533 | SacA 50720 | 3820±30 | charcoal (archaeo botany) | cal BC 2396-2388 (0.6%) cal BC 2344-2138 (94.8%) |
| TP6 US12522 | SacA 50721 | 2725±30 | charcoal (archaeo botany) | cal BC 911-806 (95.4%) |
| TP9 US14027 | SacA 50722 | 3755±30 | charcoal | cal BC 2276-2255 (4.2%) cal BC 2206-2033 (91.3%) |

Table 1. Radiocarbon dates obtained at WD (B. Bellina)

4. Palaeoenvironment and Archaeobotany

Six contexts from WD were analysed by Castillo showing very poor preservation of archaeobotanical remains and high bioturbation (Table 2). Furthermore, the archaeobotanical analysis did not reveal any economic crop consumption nor cultivation (e.g. rice, pulses, etc.). The remains consist of a few weedy plants such as *Acmella paniculata* (para-cress), *Galium* and *Fimbristylis* sp. Para-cress is associated with dry rice cultivation but is also used in traditional medicine and eaten in many parts of Southeast Asia as a herb and vegetable (Castillo 2018). Although para-cress has been used in many studies by Castillo as an indicator of the agricultural ecosystem wherein rice grew, there have been no rice remains identified at WD yet and only one achene of para-cress was identified. *Fimbristylis*, including *Fimbristylis miliacea* (Figure 12), grows in wetlands whereas *Galium* is found in both wet and dry environments. The botanical assemblage at WD represents the surrounding habitat.

| | TP6 12524 | TP6 12529 | TP6 12531 | TP6 12532 | TP6 12533 | TP9 14009 | TOTAL |
|---------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-------|
| volume of soil | 35 | 40 | 40 | 35 | 45 | 30 | |
| plant parts per litre | 0.143 | 0.975 | 0.175 | 2.829 | 2.089 | 0.067 | |
| no. of taxa | 1 | 2 | 3 | 3 | 2 | 1 | |
| roots | 10% | 90% | 60% | 60% | 60% | 95% | |
| unidentified | 4 | 3 | | | 3 | 2 | 12 |
| <i>Acmella paniculata</i> | | | | | 1 | | 1 |
| charred root /tuber | | | 3 | | | | 3 |
| cf. <i>Galium</i> | | 35 | 6% | 95 | 90 | | 220 |
| thorns | 1 | | | | | | 1 |

| | | | | | | | |
|------------------------------|-----------|-----------|-----------|------------|------------|----------|------------|
| Poaceae awn silicified | | | | 1 | | | 1 |
| Poaceae culm node | | 1 | 1 | | | | 2 |
| <i>Fimbristylis miliacea</i> | | | 2 | | | | 2 |
| <i>Fimbristylis</i> sp. | | | 1 | 3 | | | 4 |
| NISP | 5 | 39 | 7 | 99 | 94 | 2 | 246 |
| modern | 1 | | | 1 | 3 | | 5 |
| fungal sclerotia | 28 | | | 5 | 3 | 5% | 36 |
| termite frass | | | 2 | 5 | 1 | | 8 |
| coprolite | | 1 | 2 | 1 | | | 4 |
| NSP | 34 | 40 | 11 | 111 | 101 | 1 | 298 |

Table 2: List of archaeobotanical identifications (C. Castillo)



Figure 12: Left - *Fimbristylis miliacea* from WD 12531; Centre – charred roots and tuber from WD 12531; Right – *Fimbristylis* sp. from WD 12531 (C. Castillo).

5. Ceramics

WD yielded a large quantity of pottery fragments (4952 sherds, weight 94kg), spread over five areas (TP1/1-ext, TP2, TP3, TP6, TP9)¹. Technological observations (i.e. *chaîne opératoire* analysis) focusing on the identification of techniques, methods and tools used to make ceramics, allowed classification of the assemblage into three main technological groups (figure 13; table 3). Group 1 (WD-1) contains ceramics made using coiling and paddling techniques. Group 2 (WD-2) contains ceramics possibly shaped using a paddle. Group 3 (WD-3) contains ceramics manufactured without the help of a paddle.

¹ Ceramic fragments were also recovered from TP13, but no information was recorded apart from the fact that they belong to pottery group 1.

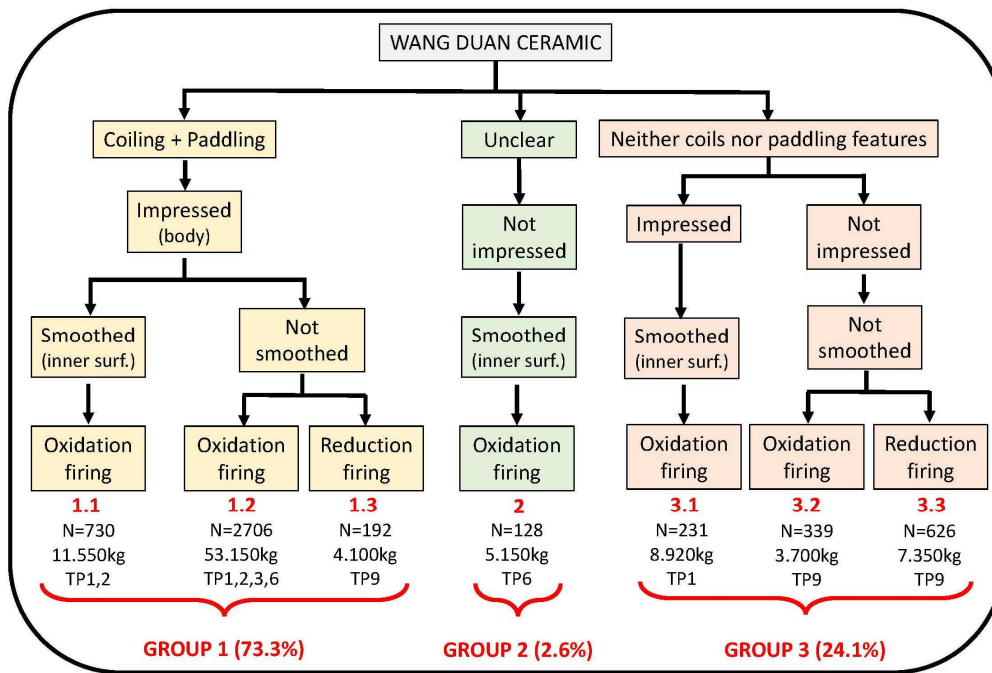


Figure 13. techno-stylistic diagram showing the three ceramic technological groups at WD, as well as variations (sub-groups) (A. Favereau & B. Hrysiewicz).

| Pottery groups | N. of sherds | % | Weight (kg) | Minimum number of vessels | TP yielding sherds | Contexts yielding sherds | Associated dating (2σ calibrated age ranges (see table 1 for more details)) |
|----------------|--------------|------------|---------------|---------------------------|--------------------|---|---|
| WD-1.1 | 730 | 14.7 | 11.550 | 52 | TP1, 2 | TP1: all TP2: 10053 | cal BC 1110-918 (95.4%) cal BC 827-774 (95.4%) |
| WD-1.2 | 2706 | 54.7 | 53.150 | 103 | TP1, 2, 3, 6 | TP1: 10002 to 10026 and 10030 TP2, 3, 6: all | cal BC 2344-2138 (94.8%) cal BC 2209-2034 (89.2%) cal BC 1110-918 (95.4%) cal BC 911-806 (95.4%) cal BC 827-774 (95.4%) |
| WD-1.3 | 192 | 3.9 | 4.100 | 19 | TP9 | TP9: all | cal BC 2206-2033 (91.3%) |
| WD-2 | 128 | 2.6 | 5.150 | 9 | TP6 | TP6: 12507 to 12516 | - |
| WD-3.1 | 231 | 4.7 | 8.290 | 17 | TP1 | TP1: 10019 to 10033 | cal BC 827-774 (95.4%) |
| WD-3.2 | 339 | 6.8 | 3.700 | 35 | TP9 | TP9: 14010-14027 to 14031 | cal BC 2206-2033 (91.3%) |
| WD-3.3 | 626 | 12.6 | 7.350 | 51 | TP9 | TP9: 14027 to 14031 | cal BC 2206-2033 (91.3%) |
| Total | 4952 | 100 | 93.870 | 286 | - | - | - |

Table 3. summary table showing details on ceramic groups at Wang Duan (A. Favereau & B. Hrysiewicz).

Group WD-1

Most of the pottery at WD belongs to this group (total: 3628 sherds; 73.3% of the assemblage; NMI=174) (figure 16). Group WD-1 vessels have a coarse mineral temper and a friable paste, and were identified in all test pits and contexts that yielded ceramics. Sherd wall thickness ranges from 0.4 to 0.8 cm. Horizontal breaks at the body and rim and irregular and wavy topography suggest the use of coils. Flat elongated voids in the radial section and numerous impressed bands of parallel lines or cord-marks overlapping on the outer surface suggest the use of the paddling for shaping. The inner surface of the ceramics is sometimes smoothed (sub-group WD-1.1; 730 fragments; 11.550 kg) at the body and rim. Shiny parallel facets horizontally oriented indicate burnishing on the inner surfaces of some of the unrestricted vessels of sub-group WD-1.1. Finally, most fragments have light surfaces indicative of oxidation firing, but some (sub-group WD-1.3; 192 fragments; 4.100 kg) display dark surfaces suggesting a reducing atmosphere.

Unrestricted and restricted morphologies were identified. Several complete or archaeologically complete unrestricted vessels with trapezoidal shapes were uncovered from TP1 and TP1-ext: bases are flat, the body walls are divergent straight to divergent concave, the rims are an extension of the body or everted, and the lips are rounded. A hole at their base was probably made before firing (figure 15). Rim shapes are rounded, everted, thinned, plumped or flat, shapes that are also found in the three subgroups (WD-1.1, 1.2 and 1.3), strengthening the coherence of group WD-1.

Contemporaneous vessels with shapes similar to the trapezoidal pots with perforated bases recovered from TP1 seem rare. Few without perforated base are reported on sites of the Isthmus of Kra in the peninsula, on the inland cave site of Khao Chantha (KCH), as well as Khao Khloab and Khao Pha Daeng (Khao Talu sub-district, Chumphon) (figure 14). In Central Thailand, pottery with similar shapes but without a hole in the base are documented at the open-air coastal foraging site of Nong Nor and is dated to 1000-500 BCE.

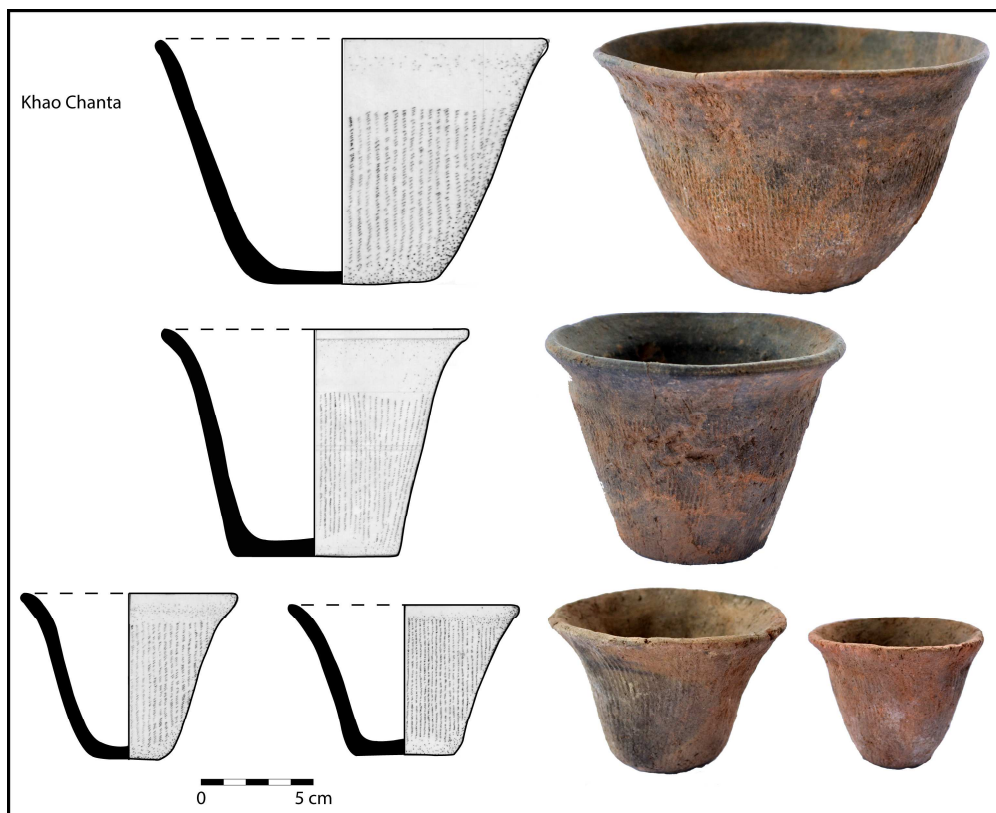


Figure 14. Left: trapezoidal-shaped pots from Khao Chanta (KCH) (J. Innanchai and A. Favereau). Right: pictures of the pots from KCH (B. Pradier).

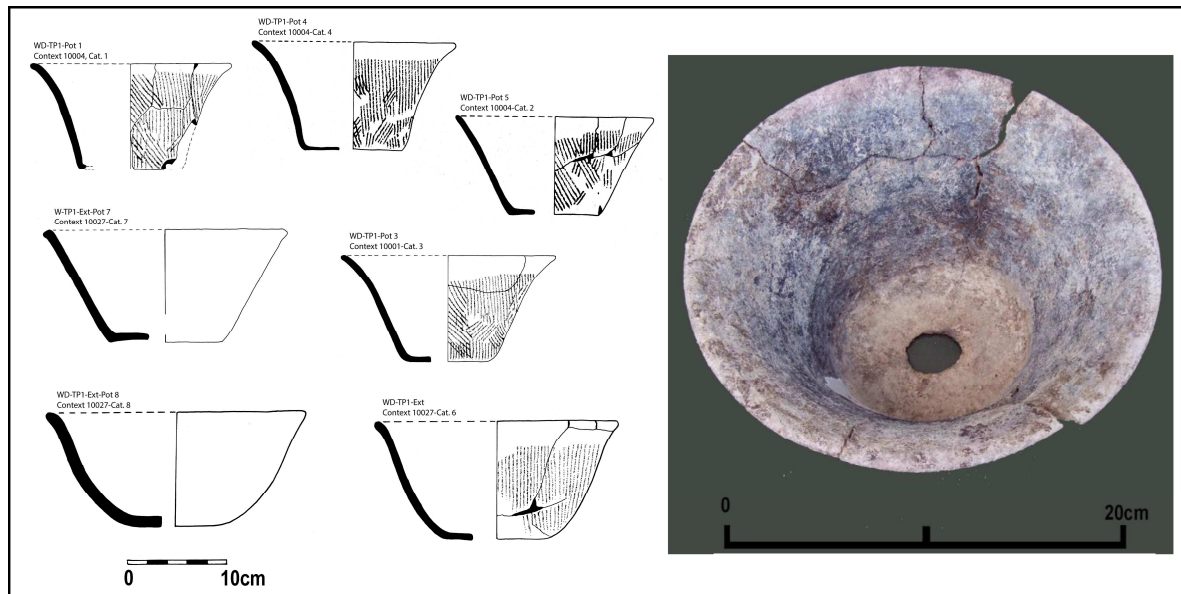


Figure 15. Left: group WD-1 vessels with perforated base recovered from TP1 and TP1-ext (J. Innanchai). Right: complete vessel with perforated base from TP1 (B. Bellina).

As for vessels with central hole at the base, we are not aware of any comparable type in the TMP. In central Thailand, vessels with perforated bases but different in shape were discovered at Tha Kae (C. Higham, comm. pers. to B. Bellina, 02.06.2021), Phu Noi and Ban Lum Khao. The latter two examples are dated to the late Bronze Age (ca. 800-500 BCE) (Carratoni, Meucci, and Rispoli 2018; Rispoli, Ciarla, and Pigott 2013). Finally, neither tripod pottery vessels as those recovered from Neolithic context in the TMP or further north at Ban Kao and Nong Ratchawat (Sørensen 1967; Duangsakul 2009) nor ceramics with “incised and impressed” designs (Higham and Rispoli 2014; Rispoli, Ciarla, and Pigott 2013; Rispoli 2007) were identified.

Despite variations in terms of finishing techniques and firing atmospheres, the homogeneous shaping of the vessels, combined with similar impressions on surfaces (indicating the use of similar tools) and the presence of homogeneous shapes within the group suggest that vessels from group WD-1 belong to the same potting tradition. The group is ubiquitous at WD and is identified in several contexts associated with dating ranging from the late third millennium to early first millennium BCE. Such technical continuity suggests that WD may have been occupied over time by the same community. Given the large quantities (almost 70 kg), proportions (more than 73%), and ubiquity of the vessels of this group at WD, the potters that produced them may represent a local group.



Fig 16. Impressed ceramics from group WD-1 (a, d, e, f, g: outer surfaces covered with impressions; b, c: radial sections showing elongated voids typical of paddling) (B. Hrysiewicz and A. Favereau).

Group WD-2

Group WD-2 encompasses 128 non-impressed ceramic fragments (2.6% of the assemblage; 5.150 kg; MNI=9), and was only identified in TP6 from upper contexts 12507 to 12516 (figure 17). The paste is filled with medium-sized mineral grains. The temper is not clearly visible from the surfaces. Sherds' thickness is also limited compared to group WD-1 (i.e. less than 0.4 cm). Elongated voids parallel to the pottery walls in the radial section suggest that paddling was possibly employed, but the surfaces remain plain, meaning that no textured paddle was used. Surfaces are smoothed inside, and vessels are fired in oxidation. Due to the high rate of fragmentation, no morphology was documented.

Given the limited number of fragments and vessels in group WD-2, and their restricted spatial distribution (i.e. limited to TP6, upper contexts), these ceramics seem to represent an anecdotal, perhaps intrusive, group of potters on which information remains incomplete.

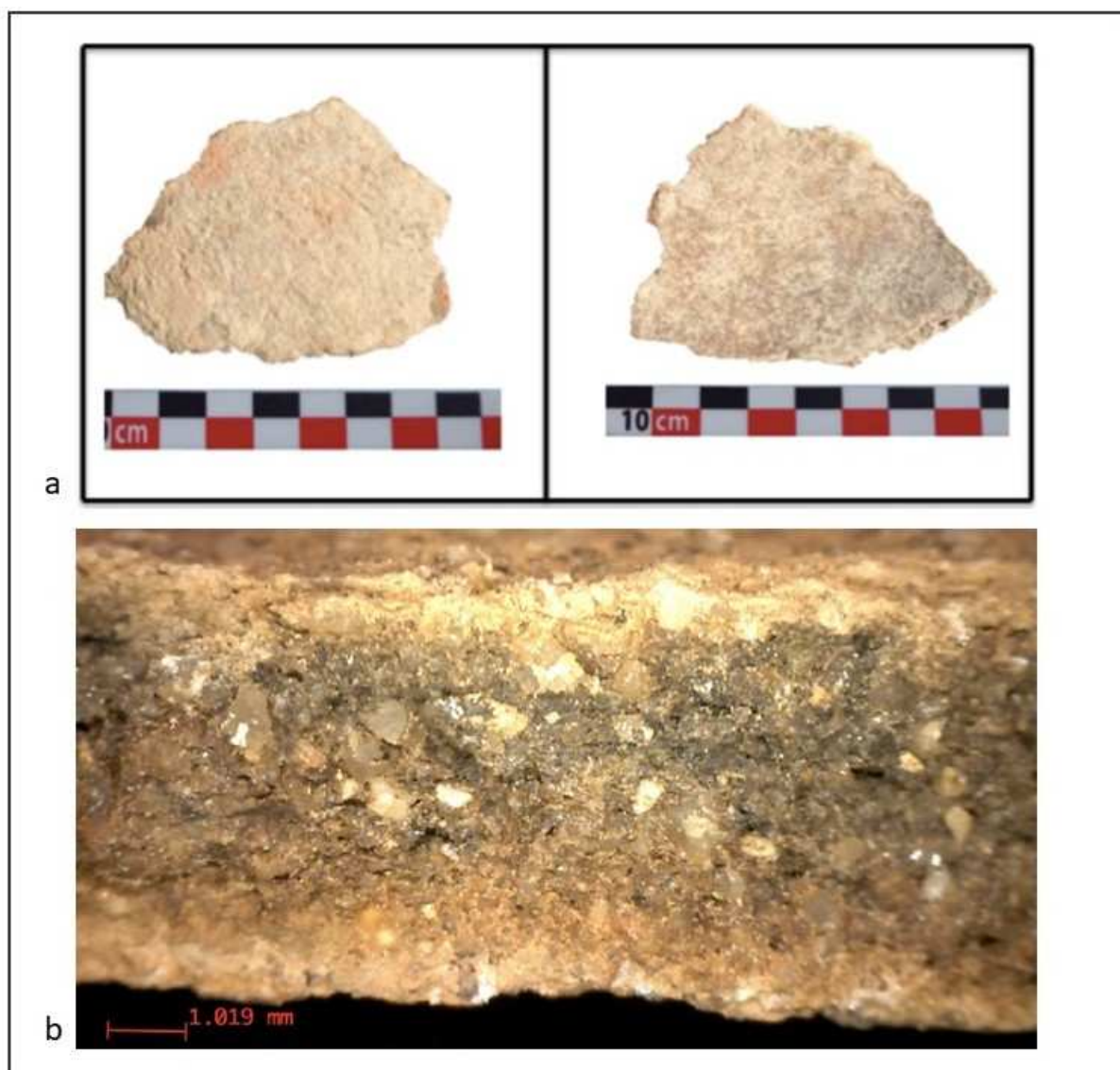


Figure 17. a. ceramic fragment of group WD-2 at Wang Duan (a, left: outer surface; right: inner surface; b: radial section) (B. Hrysiewicz and A. Favereau).

Group WD-3

Group WD-3 consists of 1196 sherds (24.1% of the assemblage; 19.970 kg; MNI=103) of non-paddled ceramics only identified in TP1 and TP9 (figure 18). The paste (different in TP1 and TP9) is light to dark gray, with a medium-sized mineral temper. No evidence of coiling or paddling was found. Most fragments are not smoothed, apart from 231 sherds (8.920 kg; NMI=17) which inner surface was smoothed all found in TP1. Vessels were fired in oxidation (TP1 and TP9) or reduction (TP9) atmosphere. Morphologies are restricted and unrestricted, but the limited size of most ceramic samples did not provide opportunity to further document shapes.

The ceramics from group WD-3 seem to have a specific spatial and temporal distribution: in TP1/1-ext, they are identified from contexts 10019 to 10033; in TP9, they are overrepresented in contexts 14028 to 14031 (i.e. lower contexts associated with early dates).



Figure 18. ceramic fragments of group WD-3 (a, b: outer (left) and inner (right) surfaces; c: radial section) (B. Hrysiewicz and A. Favereau).

Ceramics: Summary and hypotheses

Groups WD-1 and WD-3 are associated with dates as early as the late third millennium BCE (table 3). While group WD-3 is only found in TP1 and 9, group WD-1 is found in all TPs yielding ceramics. Group WD-3 may represent a group of individuals settled in a small area (encompassing TP1 and 9), while group WD-1 may reflect individuals that occupied the site more widely and over a longer period. Interestingly, the quantity of vessels from group WD-1 do not seem to have increased or decreased dramatically through time. Group WD-2 is found in upper contexts associated with group WD-1. It remains an anecdotal group (128 fragments) and has a limited distribution (TP6).

6. Discussion

The single excavation campaign at WD provided the rare opportunity to study the remains of a coastal open-air foraging site of the UTMP used for a period spanning almost two millennia with at least two main phases: an early Neolithic period occupation took place by the end of the third millennium (by 2400-2200 BCE), and a later occupation corresponding elsewhere in MSEA to the Bronze Age by the early first millennium BCE (1000 to 700 BCE).

At least four and possibly five successive prehistoric cultural phases (according to the longest sequence in TP6) were characterised by ceramics of slightly different types. Human or animal bones were absent, but this is possibly due to taphonomic processes as preserved skeletal remains are rarely preserved in the peninsula due to acidic soils (Chia 2005). There were a few macrobotanical remains identified but these are habitat indicators and do not represent cultivation. Furthermore, plants were not used as ceramic temper. No habitation structures such as post holes or terraces, other than a floor that was indicated by a layer of sherds, were found. With the exception of a polished adze collected on the surface several years ago by villagers, no fishing, hunting or agricultural tools have been found. This limited range of evidence restricts our interpretations of the social and economic organisation. The low density of remains suggests that WD hosted small, dispersed communities of coastal foragers, perhaps family units. The site was probably occupied for short periods.

Two major ceramic technical traditions have been identified. Group WD-3 was exclusively found during early occupation, whilst group WD-1 (paddle-impressed) was found throughout the site occupation. From a morphological and technological perspective, trapezoidal shaped vessels of group WD-1 compare with types found in inland sites of the Isthmus of Kra (Favereau, n.d.) and roughly correspond to a broad Neolithic (these pots are often out of context). These data might suggest that the foraging groups that frequented WD may relate to the groups in the forested interior in the UTMP. Such a comparison has not been done before and provides tenuous information on the cultural differentiation amongst the UTMP groups.

Pots with perforated bases such as those from group WD-1, but different in shape, are found in Northeastern Thailand at Ban Lum Khao (Higham and Rachanie Thosarat 2005) and in Central Thailand at Phu Noi and Tha Kae (see Rispoli: <https://www.lorap-ismeo.eu/archaeological-investigations-at-phu-noi/>) and have been dated to the Bronze age (about 1000-500 BCE). Such vessels at WD may relate either to new culinary (e.g. steam cooking) or to funerary practices. Overall, there is so far no direct evidence for contacts with other sites and for the participation in exchange networks in the form of staple food, exotic ornaments, or manufactured artefacts such as metal objects.

At WD, there is no data that could inform on the domestication of animals (dog, pigs, cattle) or plants. Even if weedy plants commonly associated with rice cultivation were identified, no cereals have been found yet in the sediment floated or used as temper in ceramic. We don't know if these coastal groups practiced some kind of horticulture, or whether they were in contact with farmers providing them cereals (rice, millet) as at Khok Phanom Di and Rach Nui. They surely came to the site to collect sea and estuarine resources.

The absence of organic material is common in the UTMP. There, the Neolithic is not signaled by the characteristic traits found elsewhere in MSEA, in particular Thailand and Vietnam. There is no evidence for permanent village communities, such as burials with skeletons in extended supine position accompanied with incised and impressed pottery (Higham in press). Neither is there evidence for domesticated rice, dogs, pigs and cattle. In the TMP, the Neolithic is characterized by ground stone artefacts, earthenware pottery industries, and a subsistence economy mostly based on hunting-gathering and increasing arboriculture (Bulbeck 2017; Chia 2005; Leong Sau Heng 1990). As a consequence, it is not possible to determine whether the groups at Wang Duan were hunter-gatherers established in a marine environment or if they developed a mutualistic relationship with agriculturalists/traders or even if they were agriculturalists who continued practicing a mixed economy including hunting, gathering, and fishing. In any case, temporary camp sites yield a low density of archaeological evidence. These archaeological variations have been recognized elsewhere in Southeast Asia, both archaeologically (Headland et al. 1989; Junker 2002; Shoocongdej 2014) and

ethnographically (Griffin 1984; Peterson 1978). These issues need further investigation, particularly in the TMP where data is scarce for this period.

The coastal environment and sea levels during the periods of occupation were probably broadly similar to those of today, although even small sea level changes can affect marine resource availability. Given the uncertainty of food resources brought about by climatic and sea level changes, hunter gatherer foragers would have had to adopt new strategies and most likely practiced a mixed economy. Due to the limited evidence recovered we are not able to adequately address this in our study of WD, but research in Australia and southern China on hunter-gatherers show that during periods of stress, hunter gatherers tend to decrease in population or move to areas with higher food yields sometimes leading to low level food production (Chi and Hung 2012; Williams et al. 2015). Higham & Thosarat have discussed how environmental changes due to sea level changes at Khok Phanom Di, lead to substantial changes in subsistence patterns before the settlement was abandoned in about 1600 BCE (Higham and Rachanie Thosarat 2004; Higham and Thosarat 2012: 67-69), but the less-invested nature of small mobile groups such as those at WD would have made adaptation easier.

7. Conclusion

The excavation at WD has revealed well-preserved patches of coastal and estuarine foraging occupations that took place during to the Neolithic period, a still poorly understood period in the TMP. Ceramic techniques and shapes, including the presence of base holes, show similarities with other groups inland in the UTMP, particularly in the Kra Isthmus, as well as in Central Thailand. This is the first study to identify a similar ceramic group based on technological analysis (group WD-1) on distant and environmentally different sites in the UTMP, thus contributing to the defining of local groups and their cultural evolutions. Some cultural and/or economic change occurred by the early first millennium BCE perhaps with the introduction of new culinary (perhaps associated to new agricultural practices) or funerary practices as attested by the pots with a central hole. This is also the period during which bronze artefacts are first found in the TMP such as at Tham Nam Lot (Chumphon province) (Bellina, Favereau, and Dussubieux 2019, 106) and in Gua Harimo in Malaysia (Goh et al. 2019). Despite the absence of direct evidence of involvement in exchange networks for the groups who visited WD, the evolution of ceramic production, its parallels with others in Thailand, and the introduction of bronze artefacts elsewhere in the peninsula, demonstrates a connection with regional networks during the first part of the first millennium BCE. This entailed economic and cultural change that is yet to be documented entirely. The absence of organic (plants and bones) and metallic materials in open-air sites of the coastal strip in the peninsula such as Wang Duan is a particular interpretative issue, but may well be a taphonomic problem rather than due to the absence of change. Future research in the region might provide the currently missing evidence to document the changes that took place at the turn of the first millennium BCE and to address issues such as rising social complexity and the possibility of a distinct Bronze age there too.

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Aerial Photographs

Run E84, flown 10/5/1976. Scale 1:15,000

Run 84B, flown 28/12/1994. Scale 1:15,000. Department of Lands, Thailand.