

EARTHENWARE CERAMIC TECHNOLOGIES OF ANGKOR BOREI, CAMBODIA¹

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INTRODUCTION

The period from 500 BCE – 500 CE witnessed the emergence of urbanism and state formation throughout the region (Carter 2015; Stark and Allen 1998). Increasingly complex trade networks connected island archipelagoes and peninsular regions to the upper reaches of major river systems into what is now Laos and central Myanmar through rivers and artificial canals (e.g., Bourdonneau 2003; Calo et al. 2015; Sanderson et al. 2003). Early urban forms emerged by the end of this period, with residents organized into socially stratified systems that scholars frequently equate with states (Stark 2006a; Stark and Bong 2001). Organizational changes accompanied the shift from prehistoric to protohistoric time periods across most of mainland Southeast Asia, as localized technological traditions emerged (e.g., Eyre 2011) and populations aggregated into large administrative complexes (Evans et al. 2016; Lorillard 2014; Stark 2006a).

Growing evidence also exists, however, for biological and material continuity through time in the Lower Mekong basin and neighboring riverine systems to the west (e.g., Heng 2016: Figure 2 & 6; Lertcharnwit 2014; Matsumura et al. 2011; Murphy 2016; Murphy and Stark 2016; Reinecke 2012; Rispoli et al. 2013). The Mekong and its tributaries increasingly served as communication routes that connected discrete regional traditions during the first millennium CE (Bourdonneau

¹ This paper is an outgrowth of Shawn Fehrenbach's (2009) unpublished Master's thesis in the Department of Anthropology at the University of Hawai'i at Mānoa (Fehrenbach 2009). S. Jane Allen, James Bayman and Heng Piphah offered insights on the study. Our sincere thanks go to Cambodia's Ministry of Culture and Fine Arts, the Royal University of Fine Arts, and the Lower Mekong Archaeological Project at the University of Hawai'i for making the Angkor Borei ceramics available for analysis. Compositional analyses reported in this paper were undertaken on an internship at the University of Missouri Research Reactor Archaeometry Lab, supported in part by their NSF Grant #BCS-0504015 and with thanks to Michael Glascock and Jeff Ferguson. Earlier versions of this paper were presented at the 19th IPPA Congress in Hanoi in December 2009 (Fehrenbach) and at the 5th Annual COSTIKS in Siem Reap in December 2014 (Stark). We thank an anonymous reviewer of this manuscript, and take full responsibility for its contents.

2003; Domett and O'Reilly 2009:75; Heng 2016; Lorillard 2014:204); subsequent polities used these routes to unite and defeat neighboring states for the next 1500 years. Local political and environmental conditions varied across the region. Bioarchaeological analysis of populations in areas flanking the Dangrek Mountains offers ample evidence of conflict (e.g., Domett et al. 2011), for example, while residents further south in the Delta were healthy and bore few little evidence of violence (Krais et al. 2012; Pietruszewsky et al. 2006).

Whether Mekong Delta sites comprised an early first millennium CE Funan kingdom remains a matter of discussion, as does its scale and scope (Le Thi Lien 2011, 2015; Manguin 2009; Pelliot 1903; Stark 1998; 2003). Growing archaeological evidence suggests, however, that Mekong Delta populations played critical political and economic roles from 500 BCE to 500 CE. The delta's coastal ports moved goods and people from the South China Sea network to the Southeast Asian mainland. The delta's fertile alluvial plains yielded abundant harvests that supported large populations and underwrote commodity trade that linked settlements throughout the Mekong River basin and its tributaries. Archaeologists frequently rely on artifact patterning as proxies for studying broader-scale change. Patterning in earthenware ceramics from Cambodia's largest protohistoric settlement, Angkor Borei (Figure 1), enriches our understanding of continuity and change during this millennium-long period of time. This paper describes ceramic wares at Angkor Borei, their interrelationships, and the ways in which they reflect social developments among potting communities.

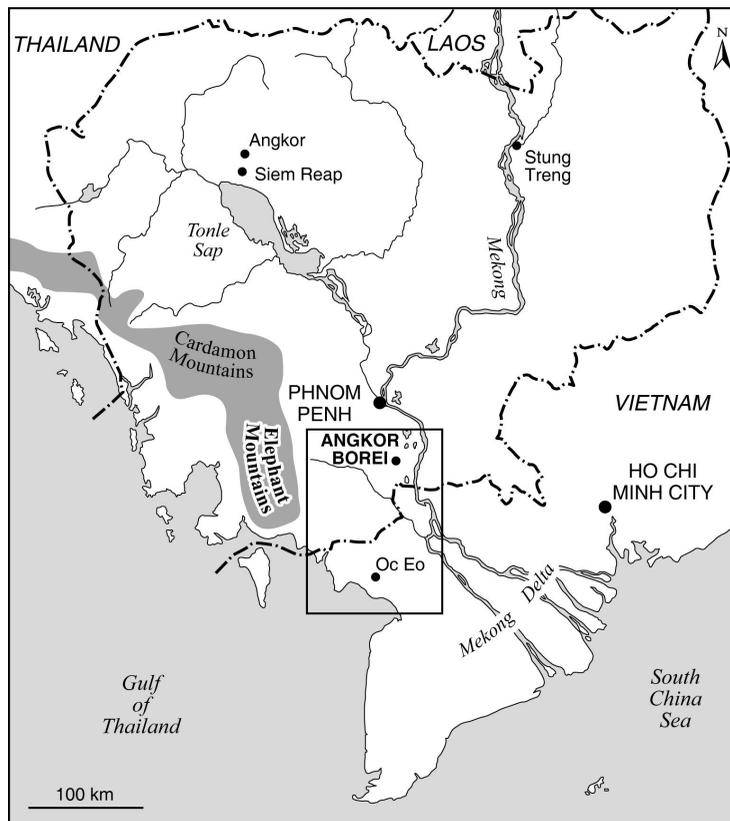
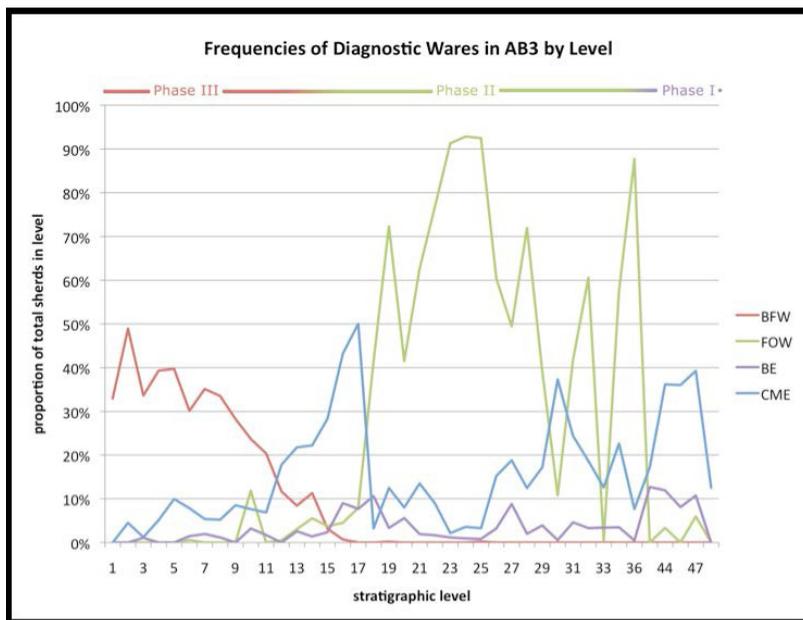


Figure 1. Location of Angkor Borei (reprinted from *Quaternary Geochronology 2*, Sanderson et al., *Luminescence Dating of Canal Sediments from Angkor Borei, Mekong Delta, Southern Cambodia*, Figure 1, p. 323, 2007, with permission from Elsevier).

Etienne Aymonier (1900:197-201) was the first colonial scholar to recognize the historical significance of Angkor Borei, a current district and commune in Takeo Province (southern Cambodia). The site’s importance lies not only in its proximity to the Phnom Da hill (type-site for a pre-Angkorian art tradition) and its provenance for the earliest-dated Khmer language inscription: the 4.5-meter-deep archaeological deposits that lie beneath the town’s contemporary surface extend the site’s history back more than a millennium. Research at Angkor Borei by the Lower Mekong Archaeological Project took place between 1996 and 2009, and has been described in detail elsewhere (e.g., Stark 1998, 2001; Stark and Bong 2001; Stark et al. 1999). Fragments of a brick-faced core-rubble 4-meter tall perimeter wall still surround 300 hectares of the site’s epicenter; its construction dates correlate with a settlement-wide brick monumental building program documented also in the Vat Komnou mound (e.g., Stark et al 2006: Table 2; Stark 2001: Table 1). Once settled, Angkor Borei may never have been abandoned: pre-Angkorian and Angkorian artifacts and features dot the site and its environs. Angkor Borei reached its political and economic apex during the protohistoric period (c. 500 BCE – 500 CE), when Chinese emissaries visited the Mekong Delta and described the Funan kingdom. Vietnamese archaeological research to the south has identified dozens of “Oc Eo” culture sites (e.g., Le Thi Lien 2011, 2015; Lê Xuân Diễm and Đào Linh Côn 1995; Lê Xuân Diễm et al. 1995; Manguin 2009) whose occupation began a few centuries after Angkor Borei’s establishment. It is likely that Angkor Borei was one of the delta’s northernmost political centers during both the protohistoric and pre-Angkorian periods.

The site’s intact, deep deposits contain a well-documented stratigraphic sequence with clear ceramic groups associated with stratigraphic layers (Stark *et al.* 1999: 16-20, Table 1). Figure 2 presents frequencies of key Angkor Borei ware groups from excavation unit 3 (AB3), described in a previous publication (Stark et al. 1999:16-17). This radiometric-linked ceramic chronology,



| Sample type | Count |
|--|-----------|
| Burnished Earthenware (BE) | 16 |
| Fine Orangeware (FOW) | 15 |
| Fine Buffware (BFW) | 16 |
| Cord-marked Earthenware (CME) | 18 |
| Orange-Slipped Finewares/Vat Komnou (VK) | 24 |
| Clay Anvils | 9 |
| TOTAL | 95 |

Table 1. NAA Sample Sizes by Ware Groups.

Figure 2. Frequencies of Diagnostic Wares in Angkor Borei Unit 3 by level.

presented in Figure 3, provides the basis for relative dating sites throughout the Takeo drainage system on the 2003-2009 Lower Mekong Archaeological Project survey (Stark 2006b). Analysis of these ceramics also offers information on patterns of technological continuity and change through time, and offers insights regarding the changing patterns of nature of intra- and interregional interaction during the protohistoric period throughout the Lower Mekong basin.

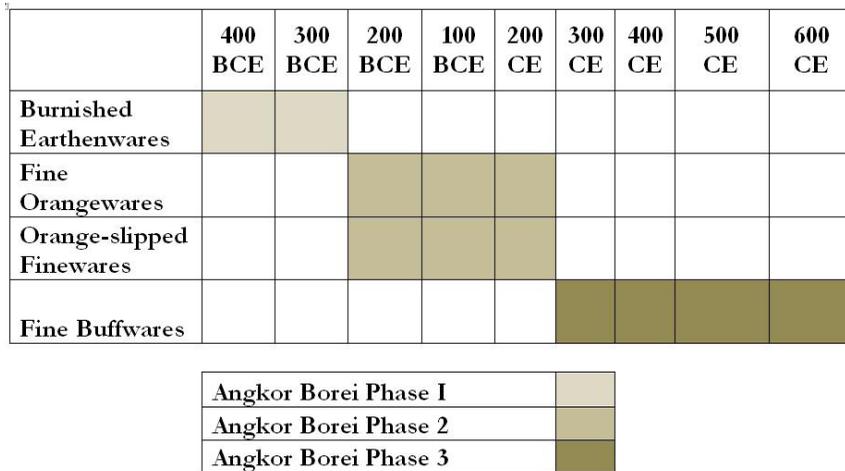


Figure 3. Angkor Borei Ceramic Chronology by phase.

Our discussion is organized into three sections. We begin by explaining the conceptual assumptions that underlie our technological approach. Next we describe the technological and contextual distinctions that define the key ware groups at Angkor Borei, building on previous research (Bong 2003; Stark 2000). We then examine dimensions of technological continuity that unite these ware groups within multifaceted and dynamic traditions of local ceramic manufacture at the site. The third and final section examines the distribution of ceramics that have technological similarities to the Angkor Borei assemblages throughout Southeast Asia, and proposes hypotheses to explain these distributions in terms of inter-regional ceramic horizons and localized traditions of manufacture. This allows for consideration of the ways in which material differences and similarities in archaeological ceramics from Angkor Borei inform on technological traditions of ceramic manufacture at that site through time, and placement of these traditions within a broader inter-regional perspective that contributes to our understanding of state development processes across mainland Southeast Asia.

A TECHNOLOGICAL APPROACH TO ANGKOR BOREI CERAMICS

Ceramic analysis is essential for identifying and tracking changes in past social boundaries, and the *technologie* approach pays particular attention to manufacturing steps in the production process (e.g., Lemonnier 1986; Stark 1999; Stark et al. 2008). Artisans using different media, from ceramics to metal to stone, transmit these technological traditions inter-generationally

(Dietler and Herbich 1998; Gosselain 1998; Lechtman 1977:15; Stark 2003b). Formal variability in manufactured goods thus reflects local traditions (culinary and otherwise), technofunctional considerations, and environmental constraints. Each step in the ceramic manufacturing process (or *chaîne opératoire*) represents one or more technological choices, and many steps leave material traces in archaeological ceramics. Southeast Asian archaeologists have begun to embrace this approach to understand artisans involved in bead manufacture (Bellina 2003), Neolithic potters' 'mental templates' (Sarjeant 2014a:387-412; 2014b), the emergence of regional subtraditions by the first millennium BCE (Eyre 2011), and to track fluctuations in the scale and directionality of interactional networks that emerged no later than c. 500 BCE (e.g., Favereau and Bellina 2016).

Most Angkor Borei ceramics were manufactured using locally available alluvial clays, and all pre-8th-century ceramics are earthenwares (Stark 2003a). Yet one's first impression is of striking diversity within the assemblages (for detailed descriptions, see Bong 2003:191-233; Fehrenbach 2009:25-47). We privilege technological aspects of the assemblage to highlight both similarities and diversities within assemblages (and through time) by concentrating on four chronologically diagnostic earthenware ceramic groups (Figure 4). Chronological boundaries were determined by stratigraphic changes, radiometric dates (e.g., Stark 2001: 27, Figure 7; Stark et al. 1999:13-14, Table 1), and frequency seriations in the ware groups (for the latter, see Fehrenbach 2009: 161, Table A-2).

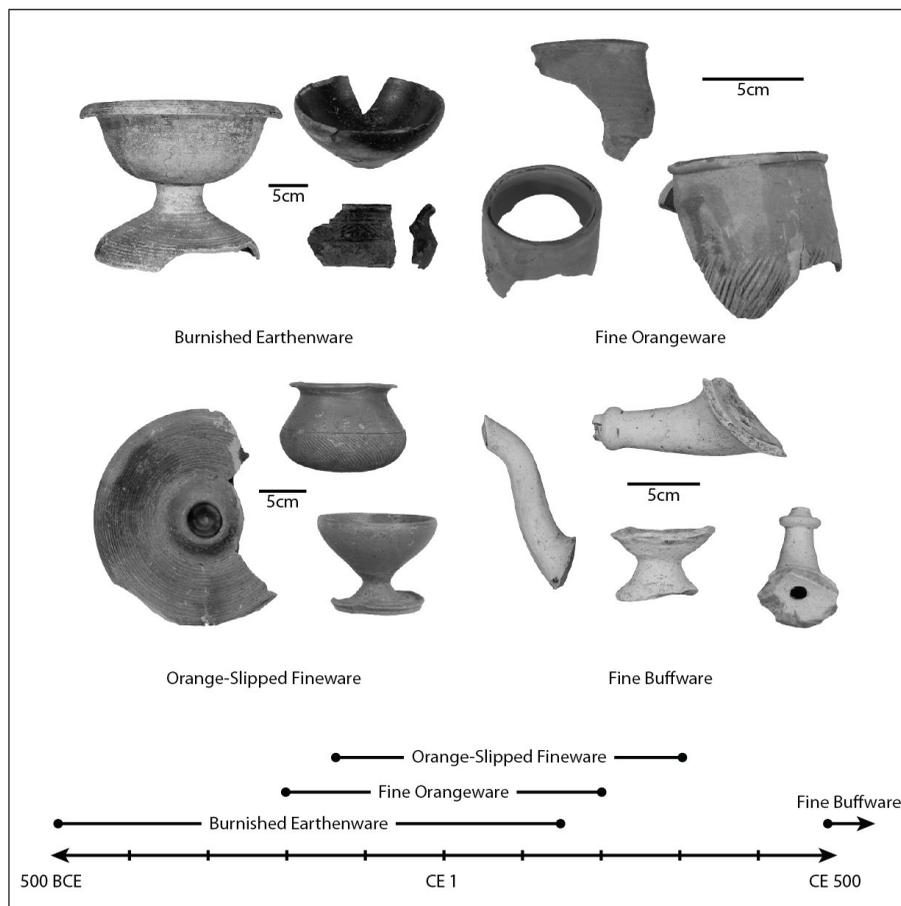


Figure 4. Representative sherds and approximate timeline of relevant Angkor Borei ceramic ware groups.

Technology and Temporal Placement of Angkor Borei Ceramic Wares

Angkor Borei potters manufactured four chronologically diagnostic earthenware groups between the mid-first millennium BCE and c.300 CE. Detailed descriptions of these ware groups can be found in other publications (Bong 2003; Fehrenbach 2009; Stark 2003a; Stark *et al.* 1999) and are only briefly described here, along with variations and developments in naming conventions. These four ware groups (i.e., Burnished Earthenwares, Fine Orangewares, Orange-Slipped Finewares [or Vat Komnou wares], Fine Buffwares) all exhibit evidence of hand-built manufacturing techniques, irrespective of ware group. Angkor Borei potters smoothed, and in some cases burnished, the visible of their vessels: bowl interiors and jar exteriors are uniformly smoothed. Some jar interiors exhibit dimpling from the use of an anvil, coil scars or light stria that suggest both coil-and-scrape and paddle-and-anvil techniques, and the use of a slow wheel or *tournette*. No production facilities (workshops, kilns) nor potters' wheels were recovered during excavations. Sixteen anvils of varying size were recovered from excavations, and were particularly abundant in Phase II (Ibid. 150; Fehrenbach 2009:35). Figure 5 illustrates two clay anvils from Angkor Borei. This use of paddle-and-anvil construction techniques resembles techniques described in ethnographic research by Cort and Lefferts (2000; see also Moure 1986).



Figure 5. Characteristic examples of anvils excavated at Angkor Borei (from Fehrenbach 2009: 46, Figure 3.9).

Burnished Earthenwares

The Burnished Earthenware group is diagnostic of Phase I (c. 400 BCE – 200 BCE) in the Angkor Borei ceramic chronology, and persists in fair abundance into Phase II (c. 200 BCE – CE 300). The most distinctive characteristic of this ware group is the black, dark gray, or brown surface color, indicating firing in a reduced or incompletely oxidizing atmosphere. The wares generally have a burnished surface treatment. Two forms of decoration are common on Burnished Earthenware vessels. The first is geometric incised patterns. Typically, these are found on the shoulders or rims of jar forms. Incising is also common, if not universal, on the pedestals of a tall pedestal dish form (Figure 6). The second commonly seen decoration is pattern-burnishing, often found on the interiors of a shorter pedestal dish form, which is described below. The group is diverse in terms of vessel forms represented. The Burnished Earthenwares may also be referred to as “Reduced Wares,” particularly when discussed in regional perspective.

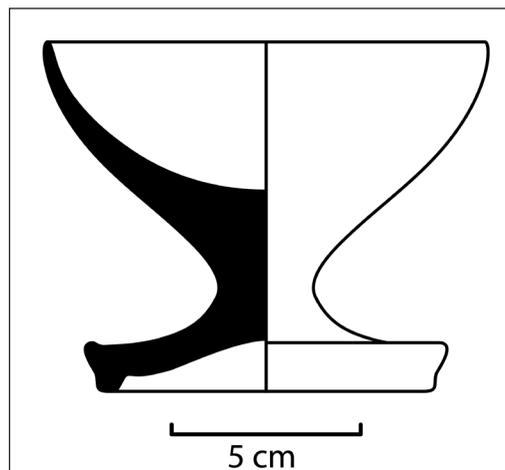


Figure 6. Illustration of a typical pedestal dish form found in Burnished Earthenware, Orange-Slipped Fineware, and Fine Buffware groups at Angkor Borei.

Fine Orangewares

Stark (2000:76-77) describes Fine Orangewares from Angkor Borei, which have very fine paste and few recognizable mineral inclusions. These are found only in a small cylindrical cup-like vessel form; their interiors often show small radial striae and dimpling from the use of a small anvil. They are fired in oxidizing atmospheres and have a consistent orange paste color. Many sherds bore evidence of some organic liquid (perhaps a slip) on either their interior or exterior surface, producing a somewhat mottled appearance. The vessels can be cord-marked or smoothed in exterior surface treatment. Cord-marking is generally around the base of the vessel, when present. Fine Orangewares are spatially restricted to and extremely abundant within Angkor Borei and a few very nearby sites (Stark 2000:77). Temporally restricted to Angkor Borei's Phase II (200 BCE - CE 300), these wares were encountered in thick lenses during excavation and comprised approximately 30% of the matrix in some layers (Stark *et al.* 1999). The spatial and temporal restriction of these wares, combined with their abundance and high degree of morphological uniformity, distinguish them clearly from other wares at Angkor Borei.

Orange-Slipped Finewares (or Vat Komnou wares)

The Orange-Slipped Finewares comprise the vast majority (91.4%) of the reconstructable ceramic mortuary assemblage recovered from test unit AB7 (at the Vat Komnou temple) at Angkor Borei. This mortuary component dates within Phase II of the ceramic chronology (c. 200 BCE – CE 300), and nicely parallels the “red and buff-to-orange wares” documented for Iron Age 2 (200 BC – 200 CE) in central Thailand (Rispoli *et al.* 2013:143). Orange-Slipped Finewares were also recovered from non-mortuary contexts at the site; however, they are not as abundant as other ware groups discussed here. Vessels of this ware group have very fine pastes, with few inclusions. The vessels are generally well fired, with carbon cores appearing in only 13.1% of the vessels in the mortuary assemblage for which this variable could be measured. The paste ranges from a cream to reddish-orange color, and the vast majority are slipped red or orange on both their interior and exterior surfaces. Despite the continuity in paste characteristics, several vessel forms are apparent

in the VK ware group, including small pots with or without ring bases, pedestal dishes, and small flare rimmed cups (Fehrenbach 2009:87-125).

Archaeologists have used several names for this ceramic ware. At Angkor Borei, they were originally recorded as “Fine Orangeware” (Stark 2000, 2003a), but after further laboratory analyses, it was deemed that these wares should be distinguished from small cylindrical vessels of the Fine Orangeware group found in abundance at that site (see Bong 2003). Based on their high association with mortuary contexts, they became known as “Vat Komnou Wares”, after the wat where the cemetery excavations were located (see Fehrenbach 2009). At Prohear, similar vessels associated with burials have been called “Orangewares” (Reinecke *et al.* 2009). Efforts are currently under way to standardize the naming of these wares using the term “Orange-Slipped Finewares.”

Fine Buffwares

Stark (2000:77-78) describes Fine Buffwares from Angkor Borei, which exhibit some variability in temper (from no visible temper or fine sand-temper to rice chaff-temper). Buffwares frequently have well-defined gray carbon cores that might reflect dense fabric texture rather than lower firing temperatures [e.g., Rice 1987:88-90]. Vessel surface treatment is always smoothed; slip is rare; no cord-marking was observed. Some buffware vessels were decorated with geometric incising or simple red-painted designs, most commonly thin banding around the central body and/or a simple design on the shoulder. Buffware vessels at Angkor Borei were made in two basic forms: the *kendi* (spouted globular) form with ring base and flared neck, and the small pedestaled dish. Dates from Angkor Borei suggest only that Phase III post-dates 300 CE (Stark 2001; Stark *et al.* 1999), but comparative analyses of *kendis* with similar characteristics found at other archaeological sites in the region suggest that this ware group may date later, in the mid to late 1st millennium CE.

Technological variability in the various production sequences provide the basis for constructing ware groups for Angkor Borei (see Bong 2003; Stark 2000). The following section will track similarities between the ware groups in an effort to argue that all belong to a dynamic, but continuous local tradition of ceramic manufacture. In the final section, the Angkor Borei ceramics are compared with similar traditions from other sites, in an effort to extend a very coarse-grained ceramic chronology to broader regions of Southeast Asia, and to develop hypotheses that might explain patterns of variability in the Angkor Borei ceramics and the distributions of the broader inter-regional traditions.

Compositional Patterning

Scholars have consistently characterized Funan (and Angkor Borei as one ancient capital) as a maritime state, and international maritime trade may have been one catalyst for the polity's emergence. Might the high diversity in Angkor Borei's ceramic assemblage then represent a variety of production localities? Or does it instead reflect a relatively cosmopolitan artisan community, with producers who employed distinctive technological styles? We hoped that chemical compositional analyses would shed light on production source variability. Stark and Bentley's (1999) pilot ICP-

MS study suggested that significant differences characterized Fine Orangeware and Fine Buffware samples, although Ruth Prior's 2001 pilot petrographic study of 30 fine-paste sherds did not yield sufficiently large enough inclusion to merit further study (Fehrenbach 2009:53-55).

Shawn Fehrenbach submitted 95 Angkor Borei ceramic samples for Instrumental Neutron Activation Analysis (INAA) in 2008 to the University of Missouri Research Reactor (MURR) Archaeometry Laboratory (Table 1). Most samples derived from sherds or partially reconstructible vessels, but six anvil samples were also included as a control (reasoning that potters made anvils out of locally available clays). A detailed rationale for this sampling program and description of sample preparation and analysis methods is available in Shawn Fehrenbach's thesis (2009:56-81).

Figure 7 presents graphic results of the first two components of a Principal Components Analysis (PCA) of the 95 NAA samples. The overlap of ellipses for parts (and in some cases, all) of each compositional group suggests that almost no compositional differences were found to parallel other distinctions between the ware groups outlined above. The lone ceramic form (the carinated cord-marked cooking pot, excluded from Figure 7) with a distinct compositional signature was also sand-tempered, affects its chemical signal in INAA studies. Despite this homogeneity, some ware groups do show differences in the relative degrees of compositional standardization, i.e., greater or lesser "spreads" of compositional variability around a roughly common center. These differences in spread are interpreted to represent greater or lesser standardization in the recipes of clays and tempers used in the production of the different ware groups.

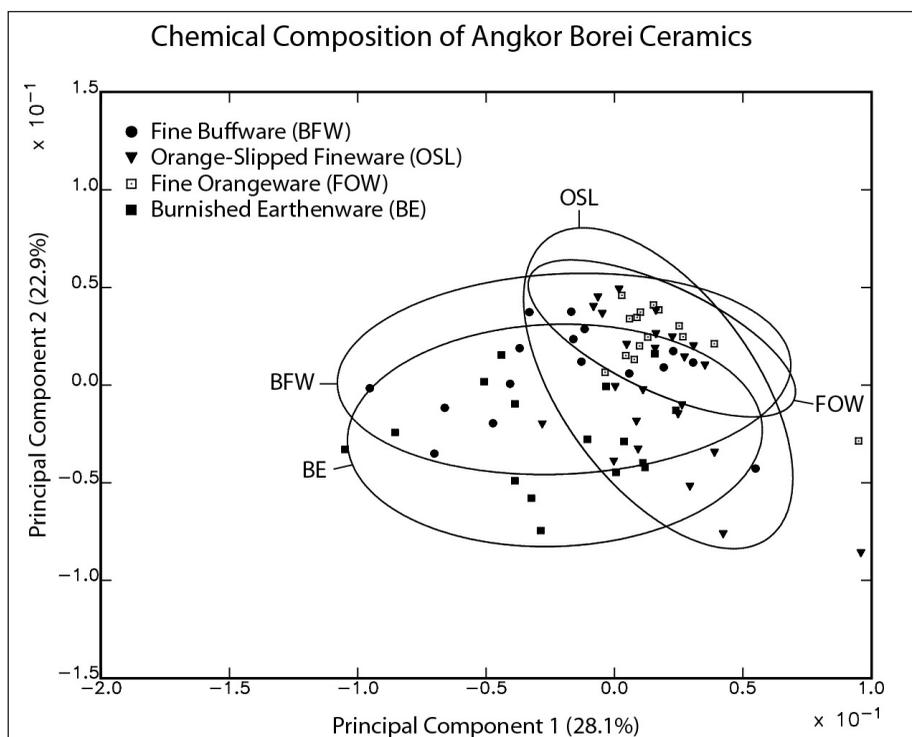


Figure 7. Chemical compositional (INAA) data of relevant ware groups from Angkor Borei displayed in the first two principal components with 90% confidence ellipses.

Angkor Borei potters used similar Mekong basin alluvial clay sources and/or similar clay preparation methods to manufacture a wide range of vessels through time. The high level of homogeneity recorded amongst most of the Angkor Borei ceramics may thus indicate localized production at or near Angkor Borei, both through time and across mortuary and non-mortuary depositional contexts. A recent follow-up pilot compositional analysis including similar ceramic wares from additional sites in the Mekong Delta identified chemical variability in archaeological ceramics from various sites across different parts of the Mekong Delta (Fehrenbach 2010), lending support to the interpretation of localized production for Angkor Borei throughout the excavated ceramic sequence. More specifically, compositional patterning in the Angkor Borei assemblages speaks to consistency in the procurement and preparation of raw materials through time and between contexts at the site.

Technological Continuity in Angkor Borei Ceramics

Understanding compositional homogeneity and ware variability within and between Angkor Borei ceramic groups requires attention to several steps in the manufacturing sequence, from clay preparation to vessel forming. Using this strategy identifies threads of technological continuity that unite the assemblages into coherent contextual and chronological relationships. Take, for example, vessel form: although vessel form diversity increases through time in the assemblage, generations of potters manufactured some basic forms for more than a millennium. One is the pedestal dish, is seen in the Burnished Earthenwares (Phase I), Orange-Slipped Finewares (Phase II), and Fine Buffwares (Phase III). This particular vessel morphology is defined as a small hemispherical bowl, situated on a flaring pedestal base. A tapered rim form and squared base end-point form are diagnostic features (see Figure 4). These vessels share very fine-paste characteristics, even in the Burnished Earthenware ware group where paste textures are more variable. Though the texture and morphology are quite consistent, other attributes vary between the ware groups. The color of the paste of these vessels changes from black or gray to orange to buff, depending on the ware group and associated chronological phase. Also, a streak-burnishing pattern seen on the interior of the dish is common in the Burnished Earthenware vessels, rare in the Fine-Slipped Orangeware vessels, and unknown in the Fine Buffware dishes. The pedestal dish vessel form links ware groups that are diagnostic of each of the three chronological phases at Angkor Borei, providing one line of technological continuity.

TEMPORAL AND SCALAR ISSUES IN TECHNOLOGICAL TRADITIONS

Previous sections have documented dimensions of technological variability and homogeneity within the Angkor Borei ceramic assemblages. Each tradition shares suites of morphological, paste, decorative, and other technological attributes that suggest cultural transmission within the broader region: from the protohistoric period (AB Phase I) to that preceding the pre-Angkorian period (AB Phase III). Comparison of published ceramic assemblages from 16 Lower Mekong region site with occupational spans that overlap Angkor Borei's sequence provide a basis for comparison, provide a basis for comparison. Figure 8a identifies archaeological sites with published ceramic assemblages from Lower Mekong basin sites whose occupational sequence overlaps with Angkor Borei. Comparison of these ceramic assemblages with the Angkor Borei earthenware traditions illustrates the approximate boundaries of three of these technological traditions. Previous scholars have emphasized the emergence of pan-regional interactional networks in Southeast Asia shortly after 500 BCE (see review in Bellina et al. 2012:7-10; Hung et al. 2013), or more specifically within

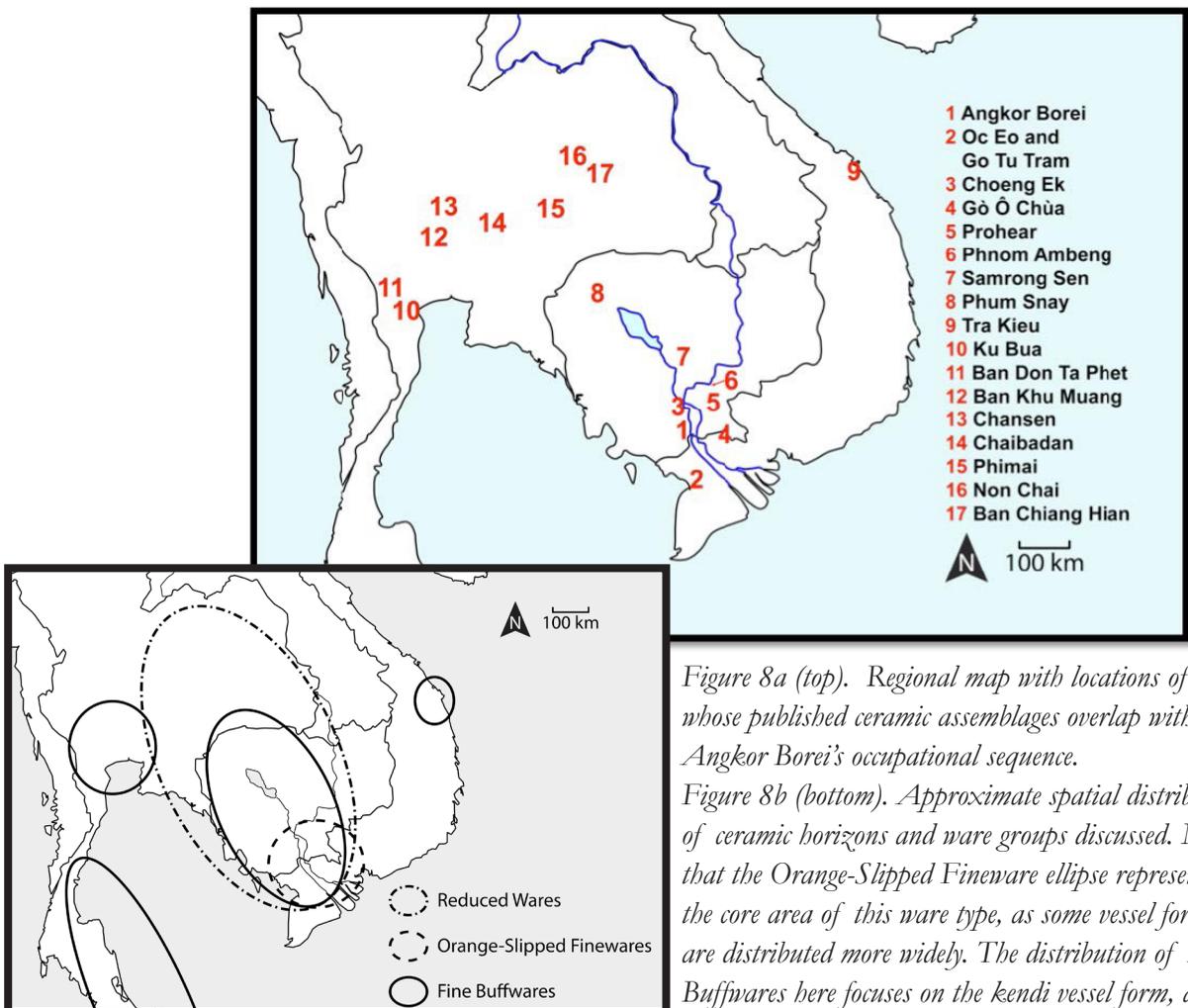


Figure 8a (top). Regional map with locations of sites whose published ceramic assemblages overlap with Angkor Borei's occupational sequence.

Figure 8b (bottom). Approximate spatial distributions of ceramic horizons and ware groups discussed. Note that the Orange-Slipped Fineware ellipse represents the core area of this ware type, as some vessel forms are distributed more widely. The distribution of Fine Buffwares here focuses on the kendi vessel form, and their distribution in Island Southeast Asia is not considered.

the Mekong River basin with its tributaries (Carter 2015; Stark 2006a). Technological aspects of the Angkor Borei ceramic manufacturing tradition, we believe, mirror some of these trends.

Two ceramic horizons in the Angkor Borei ceramic assemblage are particularly noteworthy. First is the Reduced Ceramic Horizon, which subsumes the Burnished Earthenwares of Angkor Borei's Phase I and several late-prehistoric ("Iron Age") to protohistoric traditions of reduced ceramic manufacture found elsewhere in the Lower Mekong Basin. Ceramics in Angkor Borei's Phase II appear to belong to a more regionally focused tradition within the Mekong Delta, with possible linkages along the Mekong River. Fine-paste buffware ceramics appear in Phase III deposits (c. fourth century CE), suggesting the use of similar clays and manufacturing steps that protohistoric potters used throughout mainland Southeast Asia by the mid-first millennium CE (Indrawoath 1985:61-66; Murphy 2016:372; Rispoli et al. 2013:148-149). That these shared ceramic manufacturing traditions reflect pan-regional changes (and perhaps the emergence of global cultures [Carter and Kim 2017]) underscores the importance of fine-grained technical studies in archaeological research.

Angkor Borei Phase I: The Reduced Ceramic Horizon

Burnished earthenwares associated with Phase I at Angkor Borei have a distinctive black or dark gray surface color, which firing in reducing (low oxygen) atmospheres produces. The second most important attribute is a burnished or polished surface treatment, which gives the vessels a characteristic lustrous appearance. Decoration, in the form of pattern-burnishing or incising, is the third and final attribute that can be used to define the Reduced Ceramic Horizon in Southeast Asia, but is not present in all traditions assigned to this horizon. Pattern-burnishing may be found on the interior surfaces of unrestricted vessels or the exterior surfaces of restricted vessels. Incising on these vessels is generally in geometric patterns of squares and triangles. These three variables (color, surface treatment, and decoration) can be used to hypothesize a Reduced Ceramic Horizon, which is defined by black or dark gray surface and paste color, polished or burnished surface treatment, and commonly pattern-burnished or incised decorations.

The Burnished Earthenwares, the Phimai tradition of northeastern Thailand, other traditions in northeastern and central Thailand, and traditions in northern Cambodia define the spatial distribution of the Reduced Ceramic Horizon. The distribution of ceramics similar to Angkor Borei's Burnished Earthenwares is wide within the Delta. The Phimai ceramic tradition, including the particularly well-known Phimai Black wares, was originally defined by Solheim (1965) and is described in detail in several subsequent publications (Solheim and Ayres 1979:66-73; Talbot and Janthed 2001: 188-189; Welch and McNeill 2004:527-529). In general terms, Phimai tradition wares are chaff tempered, with a platy texture. The vessels are generally fired in a reducing atmosphere rendering their surfaces black in color. Pattern-burnishing, generally in geometric designs, is the characteristic decoration of the Phimai Black ware group. The distribution of Phimai Black wares has been reported elsewhere (e.g., Talbot and Janthed 2001:189; Welch and McNeill 2004: Table 2), but their production and primary distribution appears to have taken place within the upper

Mun River valley (NE Thailand), and derive from deposits dating from roughly 200BCE – CE 600 (McNeill 1997:169).

Similar traditions that are not strictly considered Phimai Black wares and that are consistent with the proposed Reduced Ceramic Horizon have been reported more broadly in Thailand. Similar reduced-ware traditions with pattern-burnished decorations are found at sites such as Ban Chiang Hian, the Roi Et sites, and Non Chai (Welch 1985:355). Bronson (1976) reports black pattern-burnished sherds from Chansen in central Thailand, some of which he interprets as imports of Phimai black and others as a locally produced tradition. Lertrit (2003) has reported a black burnished ware dating between 200 BCE and CE 200 for the site of Chaibadan in eastern-central Thailand. These reports suggest a broad trend of reduced burnished or pattern-burnished wares in late prehistoric central and northeastern Thailand.

More recently, Phimai Black style vessels (O'Reilly 2004) and a variety of black polished vessels (Yasuda and Chuch 2008) have been reported from Phum Snay in northern Cambodia. While additional parallels to ceramic assemblages from northeast Thailand, including red slipped wares and various vessel morphologies, do suggest some relation between the two areas, the ubiquity of the reduced-fired vessels may suggest some degree of localized production. This hypothesis has yet to be tested and more work to understand the relationships between these two regions at this time is important and underway.

We associate this Reduced Ceramic Horizon dates with what archaeologists working on the Khorat Plateau describe as the Iron Age (e.g., Domett and O'Reilly 2009; O'Reilly 2004, O'Reilly and Scott 2015:10) and archaeologists working elsewhere in the region (e.g., Heng 2016; Murphy and Stark 2016) describe as the Protohistoric period in Southeast Asia, particularly the later portions of this period, and to the transition to and beginnings of the Early Historic period. Though these chronologies are dependent upon cultural landmarks that are to some degree variable between different areas in the region, an approximate range from the mid-first millennium BCE to the mid-first millennium CE can be given for the relevant temporal distribution of the horizon. The temporal distribution of this horizon in Southeast Asia spans Phases I-III of the Angkor Borei ceramic chronology, but at Angkor Borei itself, only the Burnished Earthenwares (diagnostic of Phase I and also present in Phase II) are consistent with the horizon. In other words, this tradition appears to persist into slightly later periods in other regions where it is found than it does in Angkor Borei, though it may also start later in these regions.

The diversity in vessel forms and paste characteristics that have been assigned to this horizon is interpreted to indicate many localized production centers for the ceramics. Phimai Black wares have been used to argue for centralized production as one indicator of increasing dimensions of social complexity in the upper Mun River Valley (Evans et al. 2016; Welch 1985). Indeed, the same may apply to other wares included in the horizon, particularly Burnished Earthenwares. The Reduced Ceramic Horizon is not, however, meant to suggest only a few centers of production for these ceramics or the necessary inclusion of the vessels in vast distributional networks. Rather, it seems that a very general aesthetic was spread over a large region, indicating some degree of interaction, though not necessarily trade in black, burnished ceramic vessels. This broad interaction

is also consistent with increasing social and political complexity as interpreted from the distribution of more restricted ware groups within the horizon, such as the Phimai Black and Burnished Earthenwares. For now, the temporal and spatial distributions of this ceramic horizon remain only tentatively defined here. As ceramic assemblages from more sites are excavated, analyzed, and reported, these distributions are likely to be refined or altered.

A final group of widely known, contemporaneous ceramics elsewhere in the region may have been produced using similar firing techniques to those associated with the Reduced Ceramic Horizon. Darkened, burnished bowls with impressed circular patterns, known as Rouletted wares, have been found at sites in Bali, Java, and Vietnam, dating roughly to the early centuries of the first millennium CE, and possibly the last few centuries of the first millennium BCE (Bellina and Glover 2004:78). These wares are also found in many sites across the Indian subcontinent. Compositional and stylistic analyses strongly suggest that Rouletted wares originate in South Asia (Ardika and Bellwood 1991; Schenk 2006). Additionally, Rouletted wares immediately post-date the Northern Black Polished ware (NBP) culture in South Asia dating to the latter half of the first millennium BCE (Allchin 1995; Magee 2010). As of yet, the evidence is not sufficient to suggest that these South Asian wares and the Reduced Ceramic Horizon of Southeast Asia could form a broader interactional horizon, but potential relationships between these wares could be a productive avenue for future investigation.

Angkor Borei Phase II: Regionalism in the Mekong Delta

For Angkor Borei's Phase II ceramics, including Fine Orangerwares and Orange-Slipped Finewares, fewer productive comparisons can be drawn outside of the Mekong Delta region, and thus these appear to be more regional in character. However, at least two vessel forms from this ware group are distributed beyond the Mekong Delta. The first such vessel class includes various forms of lids (see Figure 9). Lids similar to Angkor Borei's Orange-Slipped Fineware lids have been reported throughout the Mekong Delta, including from Tra Kieu, Go Tu Tram, and Oc Eo (Glover and Yamagata 1994:90; Hirano 2005:175; Malleret 1960: Pl. XL). The central conical knob, which is present in only a portion of these lid forms, may bear affinities to vessel forms from South Asia. Several sites in central and western Thailand, most notably Ban Don Ta Phet, have produced bronze bowls with a central cone in the interior of the bottom of the dish. These bowls have been related to a variety of vessels with central cones recovered from across

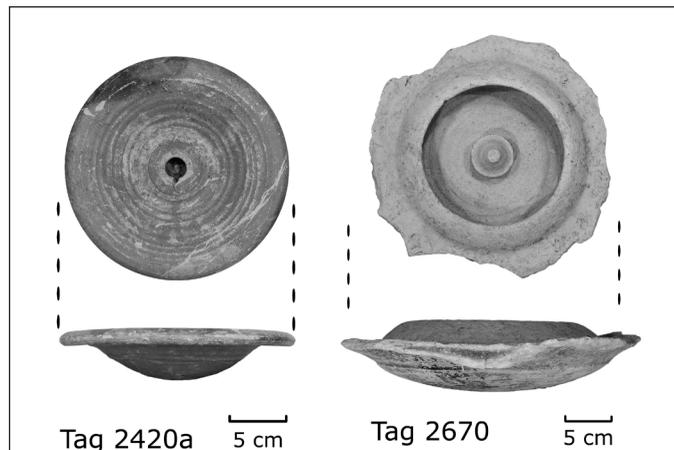


Figure 9. Two typical lid forms from Angkor Borei's Orange-Slipped Finewares

the South Asian subcontinent dating to the late centuries of the first millennium BCE (Bellina and Glover 2004:75-77). This vessel form is known to have been produced in pottery, stone, bronze, and silver in South Asia. Though the lids at Angkor Borei are not bowls, the similarities in the central conical knob could reflect a shared technological tradition of ceramic manufacture.

In addition to the knobbed lids, a single Orange-Slipped Fineware vessel from Angkor Borei's Vat Komnou mortuary assemblage bears characteristics of a widely discussed Southeast Asian form with relationships to South Asian vessels. This is a globular vessel with a flaring neck. It has a ring base and a spout, but no handle (see Figure 10). These are the characteristics of the Southeast Asian vessel form known as the *kendi*. Gupta- and Post-Gupta period parallel forms have been documented in South Asia (Aussavamas 2011:5), and this vessel form was widespread by the early second millennium CE (Adhyatman 2004; Khoo 2003). The Vat Komnou vessel is one of the earliest securely dated archaeologically recovered *kendis* in Southeast Asia. A strikingly similar vessel to the Vat Komnou *kendi* has recently been recovered from excavations at Phum Snay (Yasuda and Chuch 2008:33), sharing basic morphology, shoulder decoration, and surface treatment characteristics (though this vessel is not slipped), and dating to 160 ± 85 CE calibrated. This is roughly contemporaneous with the later end of dates for the Vat Komnou cemetery at Angkor Borei (see Stark 2001). Malleret illustrated a similar vessel form (1960:163, Type 46) these vessels come from undated contexts.



Figure 10. Orange-Slipped Fineware *kendi* from Angkor Borei

These *kendi* vessels are nearly identical in form, decoration, production technique, texture, and firing characteristics to two other vessels in the Vat Komnou assemblage, where the addition of the spout to the *kendi* is the only major difference between these vessels. *Kendi* spouts demonstrate great but consistent temporal and geographic variation across much of Southeast Asia, and merit comparative study. If the addition of spouts to vessels in order to form these early *kendis* was inspired by South Asian forms such as the *kundika*, this small addition appears to have been incorporated into local traditions of pottery making to produce a novel vessel form which later came to characterize ceramic traditions in Southeast Asia (Stark 2000:79; 2003:220).

Apart from the *kendi* and the lids, all vessels directly comparable to Angkor Borei's Orange-

Slipped Fineware vessels come from within the Mekong Delta or nearby surrounding regions. Small globular and ring-footed jar forms that are the most common Orange-Slipped Fineware vessel forms at Angkor Borei have also been described at the site of Prohear in the province of Prei Veng, Cambodia (Reinecke *et al.* 2009) and at Oc Eo (Malleret 1960:158-159). These vessels share general morphological characteristics, firing characteristics, and the smoothed/obliterated cord-marking surface treatments. The pedestal dish form described above as seen in the Orange-Slipped Finewares, Burnished Earthenwares, and Fine Buffwares at Angkor Borei is also widely distributed throughout the Mekong Delta. This particular form, sometimes called “stemcup”, has been reported at Oc Eo (Malleret 1960:167-168, Pls. XXXIX, LIII, LXV, and LXVI), Go Tu Tram (Hirano 2005:175), Nen Chua, Canh Den, and Go Hang (Tan 2003:111). At Oc Eo, this vessel form is also reported to vary from black or gray to reddish or “ochre” color (Malleret 1960:167-168), suggesting possible parallels with the variation seen between Burnished Earthenware and Orange-Slipped Fineware pedestal dishes in the Angkor Borei assemblages. Mourer (1986:110, Pl. 20) illustrates a similar form from the site of Samrong Sen, though the provenience and thus the dating of these vessels at this site remains uncertain due to the excavation and reporting methods of archaeologists who excavated the site in the late 19th and early 20th centuries. Finally, one more vessel form in the Orange-Slipped Fineware group at Angkor Borei, a large hemispherical bowl with deep radial striae around its body, appears to be nearly identical to vessels recorded at Oc Eo (Malleret 1960:140-141, Pl. XXIII) and Go Tu Tram (Hirano 2005:175).

The other ware group diagnostic of Angkor Borei’s Phase II, the Fine Orangewares, appear to be primarily restricted to Angkor Borei. Fine Orangeware vessels have been recovered only at Angkor Borei and in surface collections at a few sites within approximately 5 km (including Phnom Borei, Phon 2004). These wares are highly standardized in terms of morphology, color, texture, and surface treatment. They occur in very large quantities, but only in Phase II of the Angkor Borei ceramic chronology. It is likely that they were produced locally, or very nearby, and employed for a particular purpose at Angkor Borei, possibly ritual or industrial, though their specific function remains unclear. They do not relate to other ceramics within or outside of Angkor Borei.

An overall pattern of the distribution of wares found in Angkor Borei’s Phase II assemblages can be summarized as follows. The distribution of potentially South Asian inspired forms, including knobbed lids and *kendis*, extends well outside of the Mekong Delta. The distribution of other Phase II ceramic forms, however, is restricted either to the region of the Mekong Delta or to the immediate vicinity of Angkor Borei. This pattern suggests a strong local ceramic tradition within the Delta at a time when broad interregional interaction spheres were developing.

The Fine Buffware Horizon

The Fine Buffware group represents the diagnostic ware group for Angkor Borei’s Phase III. These fine-paste, buff colored ceramics are documented in two primary forms at Angkor Borei, pedestaled dishes and *kendis*. The Fine Buffware pedestal dishes are identical in form to the small pedestal dishes found in Burnished Earthenware and Orange-Slipped Fineware groups,

as discussed above. Only a few Fine Buffware pedestal dish fragments were recovered during excavations at Angkor Borei, but these sherds are consistent with that form. Also, unprovenienced specimens of Fine Buffware vessels in this pedestal dish form are housed in the Angkor Borei museum (Stark 2000:79). Based on the predominance of the *kendi* form in sherds with Fine Buffware paste characteristics from Angkor Borei, the remainder of this discussion focuses on these vessels.

The origins of the *kendi* form are considered in the previous section. The consideration of *kendis* here concerns the distribution of fine-paste, light colored spouted vessels during the mid to late first millennium CE in mainland Southeast Asia. The *kendi* is found in relative abundance at sites in the Mekong Delta during the later half of the first millennium CE (Malleret 1960), and is also found more broadly at Late-Early Historic and Historic period sites throughout Southeast Asia (Bellina and Glover 2004:80). Very similar buff-colored, fine-paste *kendi* vessels are widely distributed in present-day central Thailand, Cambodia, and southern and central Vietnam. Nearly identical vessels are reported from Oc Eo (Malleret 1960:163-164, Pls. XXXVI-XXXVIII, LXV), Choeng Ek (Phon Kaseka, pers. comm., Feb. 2009), and Banteay Meanchey (Phum Snay [Yasuda and Chuch 2008]). Unprovenienced examples from various sites are also reported from the Vietnamese side of the Mekong Delta (Tan 2003:109-111). At Chansen, Bronson (1976:519, 521) reports several fine-paste spouts with gray carbon cores, fading to buff at the surface.

This shift away from reduced firing conditions and toward fine-pasted buff ceramics is evident throughout Thailand. Evans et al. (2016:447) documents an Upper Mun River Valley settlement shift from the Iron Age to a “post-Iron Age” in which Iron Age Phimai ceramics are replaced by fine paste ceramics that closely resemble the Mekong Delta tradition (op.cit. Figure 4, p. 449) but occurred several centuries later. Lertrit (2003: 29-31) illustrates a similar trajectory in the Pa Sak River Valley that leads into the slightly later Dvaravati period ceramic tradition (Indrawooth 1985:61-66). Several similar, though not identical, buff-colored *kendis* are reported from Tra Kieu, from both archaeological and unprovenienced contexts (Glover and Yamagata 1994:89). These *kendi* are all sufficiently similar to suggest a limited number of production centers and broad economic distributions, or other interactional factors that could account for high degrees of standardization in techniques employed in the production process for the vessels.

Miksic and Yap (1990) have summarized the distribution of similar fine-paste ceramics from sites across island Southeast Asia, including Malaysia, Thailand, Indonesia (Borneo, Java, Sumatra) and the Philippines. For Kota Cina (Sumatra) at least, the similarities between these wares and those from Angkor Borei and other sites in Cambodia and the Mekong Delta include the predominance of the *kendi* form and even similar red stripes often found painted around the shoulder of these vessels. Miksic and Yap (1990, 1992) have proposed the possibility that these wares may represent a commodity that was widely distributed in a regional trade network, indigenous to Southeast Asia. Two potential production locales in south Thailand and east Java have been identified by Miksic and Yap through compositional analyses.

The Mekong Delta or nearby regions are likely to have been additional production localities for the wares, based on the compositional evidence for localized production of these vessels at

Angkor Borei. Additionally, an earthenware kiln with dense concentrations of similar fine-paste buff-colored spouts, rims, and other sherds consistent with this form, as well as a complete fine-paste, buff-colored *kendi*, has been excavated at the archaeological site of Choeng Ek near Phnom Penh, Cambodia (Phon Kaseka, pers. comm., Feb. 2009). The Delta would represent an early production site relative to the sites sampled by Miksic and Yap, and the peninsular kiln site described by Srisuchat (2003). Further sampling of fine-paste *kendis* in Southeast Asia for compositional analysis will help to illuminate the role of Southern Cambodia and the Mekong Delta in the production of these vessels, and the extent of their distribution from various production localities.

CONCLUSIONS

Archaeologists use ceramic patterning as proxies to track a range of processes, and technological approaches have provided some of the most useful ceramic studies of interactional systems. Ceramic evidence presented here, like bead compositional patterning reported previously (Carter 2010, 2015), suggests that Phase I Angkor Borei residents interacted with populations across the Mekong Delta; they also had relationships with populations throughout the Mekong basin at least as far north as the Upper Mun River valley. Such interaction persisted into Phase II, when for the first time we see ceramic evidence for growing involvement in South China Sea trade networks to the south, off the coast of present-day Vietnam.

Interestingly, this geographic extension in interactional networks took place concurrently with greater localization involved in Phase II ceramic technologies at Angkor Borei. Emulation of certain South Asian manufacturing techniques that add to, but do not fundamentally alter, local technological traditions. The Phase II scale of production for Phase II wares may have increased relative to Phase I (based on standardized attributes of some wares, such as the Fine Orangewares). By the fourth century CE (Phase III), homogeneity in certain ceramic forms like the *kendi* and in buff-colored fine pastes suggests the florescence of an inter-regional interaction sphere that linked communities from the Bay of Bengal to most of Southeast Asia that began during the protohistoric period (Favereau and Bellina 2016).

In short, evidence exists for the development of broad interactional networks and clear intensification of these through time, while local traditions of ceramic manufacture also remain pronounced. That early state formation in the delta involved, in part, efforts to assert control over increasing involvement in maritime trade networks seems clear (see Allen 1997), and the ceramic evidence for Angkor Borei is consistent with this trajectory if Angkor Borei was an inland component of a Delta coastal polity. Yet identifying the settlement's involvement in maritime trade networks does not undermine the importance of inland interactional relationships within mainland Southeast Asia. Nor must such interaction entail the weakening of local ceramic technological traditions. Rather, these local traditions seem to have become entrenched through time as potters

defined their repertoires and borrowed selectively from South Asian models.

This paper has identified patterns in technical choices through time that are consistent with a continuous but complex and dynamic community-based local potting tradition over the period studied. There is no indication of any large-scale introduction of foreign potters or foreign ceramic products into Angkor Borei from any place beyond the Mekong Delta throughout this period. In Phases II and III, specialized groups of ceramic producers likely made some wares (almost certainly for Fine Orangeware vessels and possibly for Fine Buffware *kendis* as well) and there were relatively strict social prescriptions for technical choices in the production of others (the Orange-Slipped Fineware mortuary vessels), as indicated by greater standardization in technical choices. Increasing standardization in potting communities was likely influenced by a multiplicity of interrelated factors concerning the development of sociopolitical complexity at the time, including expanding economic markets, the assertion of political control and religious authority, and intensification of prestige goods production.

Traditions of ceramic technology at Angkor Borei reflect the dynamic social environment of state development in the Mekong Delta. Technical choices in the production of these ceramics were made with pragmatic attention to established conventions, introduced forms, and innovative practices. These choices are nested within and thus reflect dimensions of social complexity. Rather than monolithic trajectories, the social approach to technology adopted here illustrates how the analysis of quotidian artifacts like ceramics reveals nuances of social and political complexity involved in state development across mainland Southeast Asia.

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Earthenware Ceramic Technologies of Angkor Borei, Cambodia

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អត្ថបទនេះនិយាយពីបច្ចេកវិជ្ជាក្នុងការផលិតកុលាលភាជនៅស្ថានីយអង្គរឬរី។ កំណាយនៅទីនោះធ្វើនៅ ឆ្នាំ១៩៩៦-២០០០ ក្នុងកម្មវិធី Lower Mekong Archaeological Project ហើយបង្ហាញលទ្ធផលថាជាទីផលិតនៅ ចន្លោះឆ្នាំ៥០០មុនគ.ស.ដល់គ.ស.២០០។ យើងបានពិនិត្យសាជាថ្មីនូវបច្ចេកទេសនានាដែលគេប្រើ ជាពិសេស ពិនិត្យសមសធាតុគីមីនៃដីឥដ្ឋធ្វើកាដនៅរណ្តៅខាងត្បូងនៃទួលឡវត្តគំនូរ ក្នុងក្រុមឡស្រទាប់ក្រោមប៉ែក កណ្តាល។ យើងប្រើបច្ចេកទេសហៅថា *technologie* ក្នុងការស្រាវជ្រាវនេះ។ ក្នុងករណីខ្លះបច្ចេកទេសដែលប្រើក្នុង ការផលិតកុលាលភាជនៅអង្គរឬរី បង្ហាញថាមានទំនាក់ទំនងជាមួយបច្ចេកទេសដែលគេស្គាល់នៅទីដទៃ ទៀតក្នុងតំបន់បាតខ្លះទន្លេមេកុងប៉ែកខាងក្រៅនិងប៉ែកកណ្តាល។ មានន័យថាមានការជះឥទ្ធិពលគ្នាទៅ វិញទៅមក។

Abstract

Earthenware Ceramic Technologies of Angkor Borei, Cambodia

Miriam T. STARK & Shawn FEHRENBACH

This paper explores the technology of earthenware ceramic traditions from the archaeological site of Angkor Borei (Takeo Province, Cambodia). Excavations at the Angkor Borei site from 1996-2000 by the Lower Mekong Archaeological Project produced a well-dated chronological sequence of locally-manufactured earthenware ceramics that spans the period from c. 5 00 BCE – 200 CE. Here we review the range of earthenware technological traditions reflected in the excavated archaeological, and focus in detail on the technology and geochemistry ceramics recovered from an excavation trench into the southern edge of the Vat Komnou mound, located in the central section of the community’s lower segment. We use a *technologie* approach to contrast a localized geochemical signature in the Angkor Borei ceramic assemblage with particular morphological and production-related characteristics that reveal broader technological traditions through cultural transmission. In some cases, and at some points in the sequence, aspects of the Angkor Borei earthenware ceramic assemblage echo technological traditions encompass much of the Lower and Middle Mekong regions in which protohistoric populations interacted.

Résumé

Earthenware Ceramic Technologies of Angkor Borei, Cambodia

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Le présent article examine la technologie de la céramique en terre cuite provenant du site

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archéologique d'Angkor Borei (province de Takeo, Cambodge). Les fouilles entreprises de 1996 à 2000 par le Lower Mekong Archaeological Project révèlent une séquence chronologique de production locale de la céramique en terre cuite partant de vers -500 à 200 AD. Ici on reconsidère la gamme des techniques mises en œuvre, se concentrant sur la technologie et la géo-chimie telles qu'elles ressortent d'une tranchée pratiquée vers la bordure sud de la butte du Vat Komnou, située dans la section centrale de la partie inférieure de l'ensemble. Nous adoptons l'approche dite *technologie* pour mettre en relief la signature géo-chimique locale du groupement céramique d'Angkor Borei caractérisée par certains traits morphologiques ainsi que d'autres traits provenant des processus de production, mais qui, en même temps, révèlent une transmission culturelle des traditions technologiques au sens le plus large.

Dans certains cas, à certains points de la séquence, différents aspects de la céramique d'Angkor Borei trouvent des échos dans les traditions technologiques des régions du bas et du moyen Mekong où évoluaient des populations préhistoriques.