IDENTIFYING DOMESTIC CERAMIC PRODUCTION IN THE MAYA LOWLANDS: A CASE STUDY FROM UXBENKA, BELIZE

Jillian M. Jordan and Keith M. Prufer

Utilitarian ceramic vessels form the bulk of artifact assemblages in the Maya Lowlands, but little is known about their production beyond the likelihood that they were made in a domestic context without elite involvement. Characterizing the production and distribution of these vessels is vital to understanding ancient Maya economic systems; nevertheless, this is a difficult task in the absence of primary production locales. We use spatial data, use-wear analyses on stone and ceramic tools, and analyses of finished products to identify households involved in ceramic production at three settlement groups at Uxbenka, Belize, during the Late Classic Period (A.D. 600–800). Our analyses indicate that Uxbenka potters were likely involved in some level of residential specialization focused on specific vessel forms. These data, in conjunction with ceramic data from nearby Lubaantun and Nim Li Punit, suggest that all three polities were self-sufficient in terms of utilitarian pottery production and primarily engaged in intrapolity distribution. We argue that this self-sufficiency is due to widely available resources, smaller population sizes, and the availability of high quality agricultural lands.

Las vasijas de cerámica utilitaria forman el grueso de los conjuntos de artefactos en las tierras bajas mayas. Sin embargo, se sabe poco acerca de su producción, más allá de la probabilidad de que se hayan manufacturado en contextos domésticos, sin la participación de la élite. La caracterización de la producción y distribución de estas vasijas es vital para entender los antiguos sistemas económicos mayas; sin embargo, esta es una tarea difícil en ausencia de los lugares de producción primaria. En este estudio se utilizan los datos espaciales, el análisis de uso-desgaste de las herramientas de piedra y cerámica y el análisis de los productos terminados para identificar los lugares domésticos que participaron en la producción de cerámica en tres grupos de asentamientos durante el Período Clásico Tardío (600–800 d.C.) en Uxbenka, Belice. Los análisis indican que es probable que los alfareros de Uxbenka hayan participado en un cierto nivel de especialización residencial centrado en formas de vasijas específicas. Estos datos, junto con los datos de la cerámica procedente de los centros cercanos de Lubaantún y Nim Li Punit, sugieren que las tres entidades políticas fueron autosuficientes en términos de la producción de cerámica utilitaria. Esta fue principalmente realizada para la distribución adentro del mismo asentamiento. Se argumenta que esta autosuficiencia se debió a la amplia disponibilidad de recursos, los tamaños de población reducidos y la presencia de tierras agrícolas de alta calidad.

Understanding the production of utilitarian vessels is critical to our interpretation of ancient Maya economies and can aid in evaluating nonelite, hinterland social organization (Freter 2004; McAnany 1993a; Masson and Freidel 2002). Production locales, often identified based on the presence of primary firing features, raw materials, production tools, products, and by-products (Stark 1985), are notoriously difficult to detect in the archaeological record (Sullivan 1988). This is especially true in the Maya Lowlands because of multiple factors, including poor preservation, the tendency of archaeologists to focus on architectural remains, heavy vegetation obscuring activity areas, and the nature of domestic production itself. Utilitarian ceramic production is often seasonal and sporadic, with timing linked to both agricultural cycles and seasonality. This can result in relatively low volumes of finished products (Rice 1987). Researchers working in some parts of Mesoamerica, particularly in the Gulf

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Lowlands, have identified ceramic production locales through systematic survey. In that region, the presence of at least two lines of evidence form the "gold standard" (Stark 2007:168) of investigating ceramic production: primary production features (kilns, kiln furniture), high densities of ceramic wasters (misfired or overfired sherds and vessels) or finished products, and unusually high percentages of particular pottery types or form classes (Arnold 1991; Arnold et al. 1993; Feinman and Nicholas 2007, 2011; Pool 2009; Santley et al. 1989; Stark 2007; Stark and Garraty 2004).

The adoption of these same criteria for the Maya Lowlands is problematic in two ways. First, potters likely used open firing methods. These are difficult to identify archaeologically, even if researchers focus their efforts on areas between house structures, where open firing likely occurred. Such identification has been difficult even in the arid American Southwest, where visibility and preservation are considerably better (Sullivan 1988). In the absence of kilns or open firing features, it is unlikely that wasters (a major line of evidence elsewhere) would be found in any abundance. Second, although potters at some sites surely participated in larger-scale community specialization, not all utilitarian ceramics were produced in large quantities. It is likely that many household potters, particularly in smaller polities, produced ceramics solely for the household or for intrapolity exchange. Household production does not leave the same signatures as community specialization, if it leaves any trace at all in the archaeological record.

Although locating primary firing features would be ideal, the lack of these features should not preclude researchers from investigating utilitarian pottery production. Nonetheless, it is necessary to rely on multiple lines of evidence given the ambiguities that can exist when determining the function of simple household tools of production. In this article, we discuss use-wear analysis on pottery production tools made of ceramic and stone material, analyses of finished products, and the spatial organization of settlement groups as evidence for utilitarian production at Uxbenka during the Late Classic period (A.D. 600–800). We draw on ethnographic and ethnoarchaeological literature to identify patterns of domestic production and develop a model of evidence that should be visible in the archaeological record. The model is useful for researchers working across the Maya Lowlands and in other regions where remains of open firing features are elusive. This case study highlights the variability in domestic production and the difficulty in understanding the scale and intensity of domestic ceramic production in the Maya Lowlands. To contextualize our study, we provide a brief review of studies of ceramic production in the Maya Lowlands. We recognize that human behavior cannot be placed into discrete typological bins, although typologies can be useful for comparison. In order to avoid reducing pottery production to a mode defined by the presence or absence of a series of traits, we use data to evaluate how domestic production fit into the overall economy of the Uxbenka polity and the southern Belize region (Hirth 2009). We argue that the medium-sized Maya polities of southern Belize were self-sufficient in terms of ceramic production. Self-sufficiency might have been supported by an abundance of natural resources (such as clay), a wealth of high-quality agricultural lands that did not necessitate intensification of ceramic production to supplement household income, or lower population densities resulting in less demand (Arnold 1985).

Ceramic Production in the Maya Lowlands

Many studies of pottery production in the Maya Lowlands distinguish between polychrome vessels produced by elites and utilitarian vessels made by commoners. These traditions existed simultaneously during the Late Classic period and "their products circulated among different populations by means of different mechanisms at both local and larger regional levels" (Ball 1993:259). Scholars have invested considerable effort in understanding elite pottery production in the Maya Lowlands. Evidence suggests that specialists attached to and working within architectural palace complexes decorated, and perhaps constructed, polychrome vessels (Ball 1993; Foias 2007; Halperin and Foias 2010; Inomata 2007; Reents-Budet 1994, 1998; Reents-Budet et al. 2000; Rice 2009). Direct evidence for

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palace production is generally limited to tools used to decorate vessels (Inomata 2001; Inomata and Triadan 2000). Nonetheless, examination of stylistic, epigraphic, chemical, and typological attributes provides indirect evidence of regional production, workshops, and individual artisans (Reents-Budet et al. 2000). The Maya used polychrome vessels for serving food and drink, to record historical events and ideological information, and for gift giving and tribute (Reents-Budet et al. 2000; Rice 2009).

Unlike elaborately decorated polychrome vessels, little is known about utilitarian ceramic production, distribution, and consumption in the Maya Lowlands (e.g., Lopez-Varela et al. 2001, 2002; Pool 2009; Rice 2009; Stark 1985). Late Classic elites consumed utilitarian vessels but likely did not participate in their production or distribution (Ball 1993). Ethnographic and archaeological evidence indicates that utilitarian pottery production among the Maya and in much of Mesoamerica took place at the household level, although not all households were producers (Arnold 1985; Deal 1998; Feinman and Nicholas 2007; Hayden and Cannon 1984; Hirth 2009; Reina and Hill 1978; Rice 2009). Lowland Maya household production is often characterized as a decentralized, part-time, seasonal activity conducted in rural areas, where domestic craft production was a means to diversify household production and mitigate against risk (Hirth 2009: 13–32).

In the absence of known production areas, regional studies of consumption and distribution present one way to approach utilitarian ceramic production (Fry 1979, 1980; Hammond et al. 1976; Rands and Bishop 1980). Such studies suggest community specialization at larger centers, such as Palenque and Tikal, but "cannot rule out production by individual households or local part-time specialists" (Fry 1979:495). At Palenque, compositional and microscope data (instrumental neutron activation analysis [INAA] and petrography) identified four primary paste groups that could be traced to four distinct geographic zones due to the heterogeneity of the landscape, which is fortuitous and anomalous in the Maya Lowlands. At Palenque, ceramic vessels were produced on a "community or zonal basis" (Rands and Bishop 1980:42). A similar pattern, based on fall-off curves, exists at Tikal, where there were three to five production zones in the periphery that were distributed up to 20 km from the site core (Fry 1979, 2013; Straight 2016). On the basis of high sherd densities of specific wares at Tikal, Becker (1973:400) also identified a household that possibly participated in specialized production. At Copán, unfired clays, wasters, production tools, and high frequencies of ceramic sherds indicated the existence of seven production locales (four residential, three nonresidential single mounds) near clay sources (Freter 1996, 2004). By contrast, at Lubaantun, located 13 km northeast of Uxbenka, Hammond and colleagues (1976) determined that utilitarian and polychrome vessels were produced locally using similar raw materials recovered from within 6 km of the site core. Based on INAA data, they determined that "Lubaantun was basically self-sufficient in ceramics; domestic and ceremonial wares were all made on the spot, and a flourishing school of potters and vase-painters existed there" (Hammond et al. 1976:167). Subsequent work on the Lubaantun assemblage supports this assertion (Fauvelle et al. 2012). Notably, compared to Palenque and Tikal, Lubaantun is a much smaller site, with a low population density; it is located in the southeastern periphery and lacked integration into wider political and economic spheres (Daniels and Braswell 2014; West 2002).

Uxbenka and Southern Belize

Uxbenka is a medium-sized polity located in the fertile foothills of the Maya Mountains near the modern Mopan Maya village of Santa Cruz in the Toledo District of southern Belize (Figure 1). It is one of the earliest and longest occupied sites in what is today a peripheral and sparsely populated region of the Maya Lowlands (Prufer et al. 2011). The three other major centers in the region, Pusilha, Lubaantun, and Nim li Punit, also are located in hilly terrain between the Maya Mountains and the coastal plain. Uxbenka, Lubaantun, and Nim li Punit are located on highly fertile upland soils of the Toledo Beds, but Pusilha is located on limestone bedrock and is associated with the Moho River drainage. Accelerator mass spectrometry

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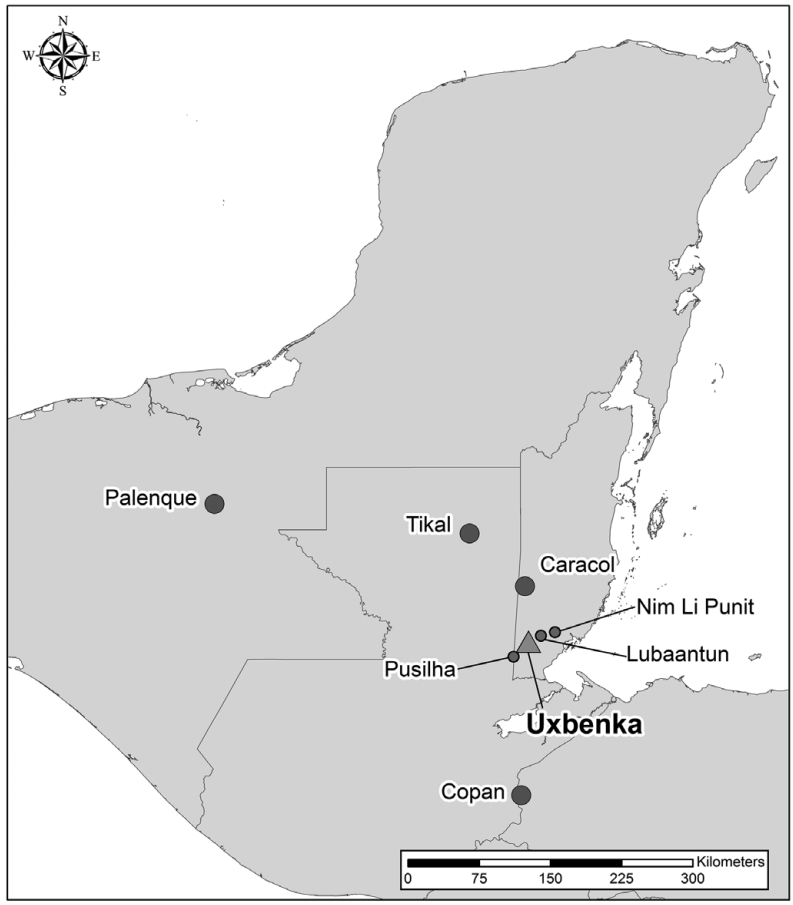


Figure 1. The location of Uxbenka. (Map by A. E. Thompson.)

radiocarbon dates (Culleton et al. 2012:1583–1585; Prufer et al. 2011:205–214) and ceramic crossties (Jordan 2014; Jordan and Prufer 2014; Prufer et al. 2017) indicate that Uxbenka was initially settled during the Late Preclassic (prior to A.D. 100) and its occupation extended into the Late/Terminal Classic period (ca. A.D. 800). Southern Belize reached its demographic peak during the Late Classic period, when all four major inland sites were occupied. Although the region is geographically isolated from other areas of the Maya Lowlands, inland and coastal sites exhibit evidence of trade and interaction with sites in the Petén, Guatemala, Highlands and the Belize Valley (Dunham et al. 1989; Hammond 1975; McKillop 2009; Prufer et al. 2011).

The Uxbenka Archaeological Project (UAP) began survey and excavation at Uxbenka in 2005. Excavation strategies focused primarily on building an absolute chronology to understand the founding and demise of the Uxbenka polity in relation to ecological variables and climate change (Culleton 2012; Prufer et al. 2011). The site core is comprised of nine groups of monumental architecture located atop modified hilltops. Masonry structures are limited to hilltops and are widely distributed across the landscape; this can be partially attributed to high rainfall levels (often greater than 4 m/year) that make low-lying areas unsuitable for habitation and subsistence *milpa* farming, which occurs on hillslopes (Prufer et al. 2015). Using a combination of pedestrian survey and Light Detection and Ranging (LiDAR), the UAP has identified 80 settlement groups of varying sizes and architectural complexity. These structures

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Table 1. Evidence for Ceramic Production at Uxbenka, by Settlement Group

SG	Low Status	Ceramic Tools	Polishing Stones	Abundance of Finished Products	Focus on Particular Form
Best Evidence					
38	•	•	•	•	•
52	•	•	•	•	•
54	•	•	•	•	•
Some Evidence					
4	•		•		
36	•		•	•	
62			•	•	
60	•	•	•		
3					
37				•	•

are dispersed over approximately 30 km^2 and extend as far as 3 km from the site core (Prufer et al. 2015). Like many other Lowland Maya centers, the Uxbenka settlement area is best described in terms of low-density agrarian-based urbanism with a center surrounded by a dispersed settlement, emphasizing the importance of farming in these communities (Fletcher 2009, 2012; McAnany 1993b; Robin 2003).

To date, 44 settlement groups have been excavated. Type-variety analyses of diagnostic sherds from excavated settlement groups indicate that nearly all ($n = 37$) exhibit evidence of Late Classic occupation. The most represented ceramic groups are Remate Red, Puluacax Unslipped, and Turneffe Unslipped, with limited amounts of Belize Red, Zacatal Cream polychromes, and Hondo (see Supplemental Table 1). The Belize Red and Hondo Group ceramics are almost certainly imported, the first from western Belize and the second from Nim li Punit. Many of the Late Classic structures are ephemeral (less than 1 m high) and contain few diagnostic artifacts. Small sample sizes are due to the excavation of test pits focused on chronology building rather than the exposure of larger areas. Because settlements are located on hilltops, refuse was probably disposed of off hillsides. As a result, communal household middens did not develop and, unfortunately, were not incorporated into construction fill. On the positive side, the discrete hilltop placement of each settlement group also increases the likelihood that artifacts recovered nearby were consumed—and even produced—at that location. Although not all of the materials discussed in this paper were recovered from primary contexts (e.g., middens, burials), the ceramic sherds and tools recovered from within settlement groups are probably reflective of activities performed there.

We identify households involved in ceramic production based on the presence of manufacturing tools, the abundance of finished products, and a focus on particular vessel forms within single settlement groups (Table 1). The strongest evidence for Late Classic household ceramic production comes from Settlement Groups (SGs) 38, 52, and 54. All three SGs have ceramic and ground stone tools, have greater quantities of finished products compared to other households, and evince production focused on a particular vessel form. SG 4, SG 36, and SG 62 also show evidence of Late Classic utilitarian ceramic production, although they do not present the full suite of features discussed above. There is evidence of Early Classic ceramic production at SG 60 (Figure 2). Lastly, residents of SG 37 likely participated in the production of incense burners, perhaps as attached specialists. This settlement group is located close to the site core and elite residences, and it contains an unusually large quantity of specialized ceramic forms.

Our discussion focuses on SG 36, SG 52, and SG 54 because these groups exhibit multiple lines of evidence for Late Classic utilitarian ceramic production. All three settlement groups

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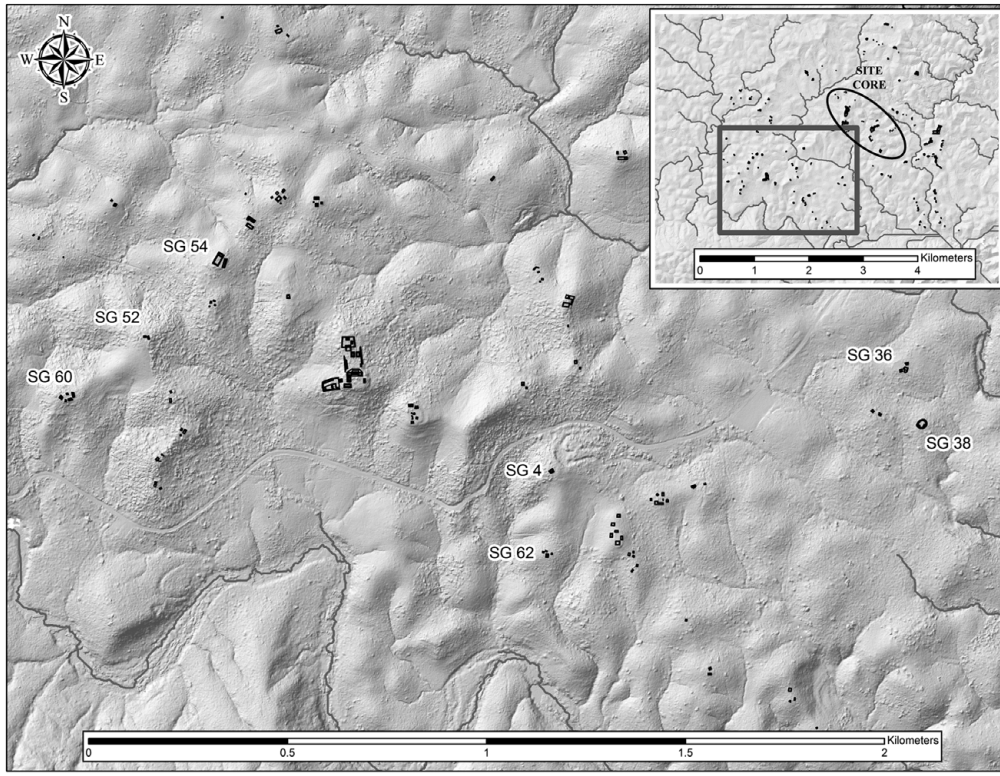


Figure 2. Uxbenka site core and location of SGs with evidence of ceramic production. (Map by A. E. Thompson.)

are low to moderate status households (Types 1–3). Similar to settlement typologies at other Maya sites (Ashmore 1981), the settlement type designation at Uxbenka is based on the number, arrangement, and architectural elaboration of structures within a settlement group. Type 1 groups consist of a single structure, Type 2 groups consist of two to three structures with no formal arrangement, and Type 3 groups consist of four to seven structures formally arranged around a plaza. At a larger scale, Type 4 groups consist of seven to nine structures on raised platforms, and Type 5 groups consist of over 10 structures arranged around multiple plazas. The types represent status or functional differences between settlement groups. Artifact assemblages from SG 36, SG 52, and SG 54 are comparable and include locally produced ceramics, tools made from locally acquired chert, tabular sandstone abraders, granite grinding-stones, and obsidian blades. We hypothesize that settlement Types 1–3 at Uxbenka represent domestic residences of single family units of varying sizes (Figure 3).

Lack of Firing Features at Uxbenka

We did not locate any primary firing features associated with the firing process. This is no surprise. At Uxbenka, as elsewhere in the Maya Lowlands, potters likely used the open firing method. Results from a refiring experiment show that locally produced Uxbenka ceramics were fired at a temperature of between 700 and 800°C, consistent with open firing (Rice 1987:156). Because Uxbenka household groups are located on hilltops, the extent of the architecture and high winds on hills would have made firing difficult. Ethnographic data indicate that most open firing is done in the early morning to avoid high winds (Bryant and Brody 1986; Deal 1998; Reina and Hill 1978; Rice 1987; Shepard 1980). At Uxbenka, potters probably fired clay vessels at low points on the landscape, away from

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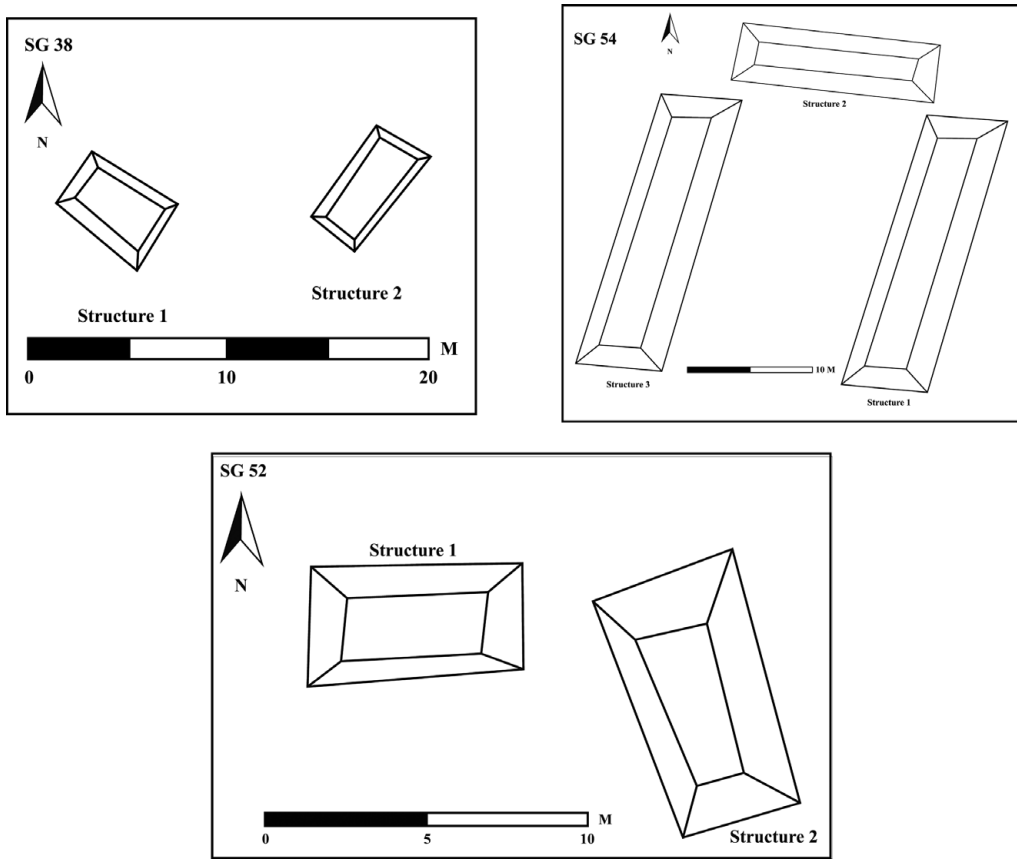


Figure 3. Plan view of SG 38, SG 52, and SG 54.

settlements, and perhaps on the leeward side of hills to reduce the effects of wind. Archaeological and ethnographic evidence indicates not all households were involved in craft production. In the absence of primary firing locations, the co-occurrence of the tools used in ceramic production, higher frequencies of finished products, and focus on a particular functional form are suggestive of individual (household) specialization at Uxbenka.

Tools of Manufacture

To create a functional ceramic vessel, potters must collect and process raw materials and form, finish, and fire the vessel (Rye 1981). Many of the tools used throughout the manufacturing process are made from perishable materials, and they can be difficult to identify in the archaeological record. Excavations at Uxbenka did not recover evidence of resource acquisition (e.g., lumps of unfired clays, tempers, or pigments). Nonetheless, we did find an abundance of tools that are associated with finishing treatments such as smoothing, burnishing, and polishing. Usually, this process involved hard tools, such as stone, shell, wood, or ceramic sherds, that are moved over the vessel surface (Rye 1981:89–90). The identification of portable production tools can be problematic because recovery context does not necessarily equate to production context (Hayashida 1999; Stark 1985) and household tools are often multipurpose implements. We use a combination of use-wear studies and the presence of multiple tool types within a single settlement group to identify households that engaged in pottery production at Uxbenka.

Ceramic Tools

Broken ceramic vessels are used for various purposes including household construction and ritual activities. They also are used in the

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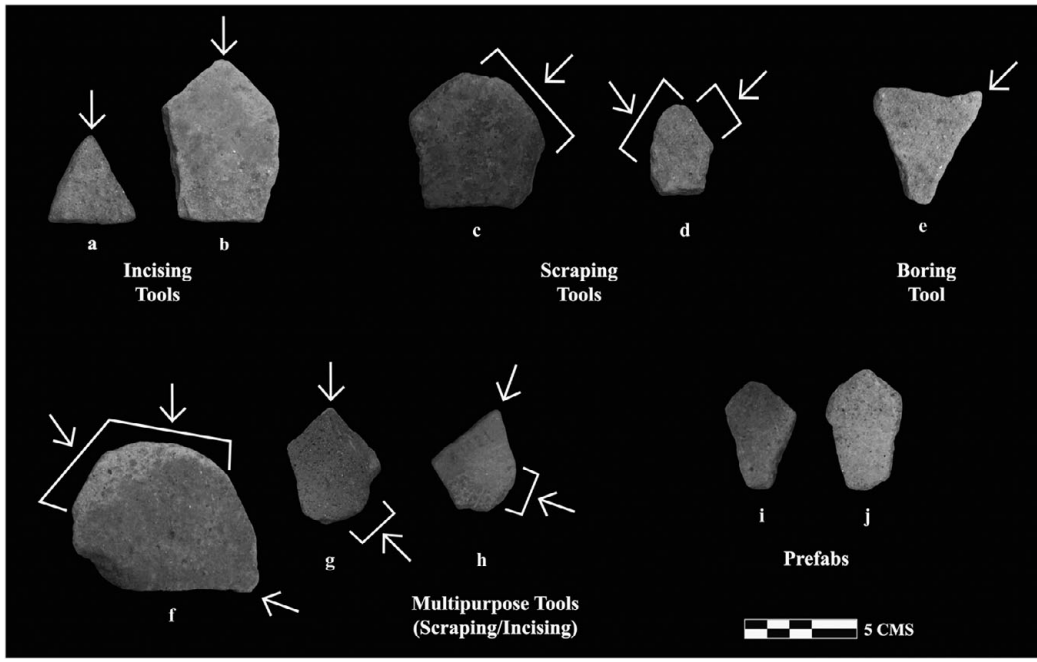


Figure 4. Selected ceramic production tools from SG 36, SG 52, and SG 54. (a:T2, b:T4, c:T6, d:T36, e:T21, f:T13, g:T32, h:T33, i:T8, j:T15.)

manufacture of new vessels as barriers between unfired pottery and open flames to reduce fire clouding and firing mishaps, as temper to improve the properties of clay, and as tools (Stanislawski 1969). Shaped ceramic production tools, first identified in the Maya Lowlands at K'axob, Belize (Lopez-Varela et al. 2002), are fragments of fired ceramic vessels used for production activities including smoothing, scraping, incising, polishing, and boring (Figures 4 and 5). Jordan analyzed all non-diagnostic ceramic fragments collected by the UAP from site core and household contexts. Of the 44 settlement groups excavated at Uxbenka, ceramic sherd tools were found only at SG 38, SG 52, SG 54 (Late Classic), and SG 60 (Early Classic). All tools from Late Classic household contexts (n = 39) were analyzed as part of this study. Use-wear analysis followed the methodology established by Lopez-Varela et al. (2002) for sherd tools at K'axob based on experimental studies. We collected data on weight, width, length, thickness, and hardness (using a Mohs Hardness Scale) for each ceramic tool (Supplemental Table 2). Using a 40x VWR dissecting microscope, we also recorded directionality and intensity of use-wear on the concave and convex sides of the tool as well as the edges and tips. The average length (42.79 mm) and average width (30.97 mm) of the tools are commensurate with the K'axob data. Of the 39 tools analyzed, 13 exhibited no evidence of use-wear. These may have been prefabricated tools (Figure 4i–j) or the sherds were too soft or porous (Mohs hardness of 3–4) to show use-wear. Most of the tools were made from Turneffe Unslipped and Remate Red ceramic groups, and the paste characteristics are consistent with finished products found in the settlement groups at Uxbenka. Many of the expedient tools were used for more than one activity (Figure 4f–h). A tool not identified in the K'axob sample is a rounded type that likely functioned similar to a gourd scraper (Figure 4c; Reina and Hill 1978:23). See Table 2 for a summary of use-wear data and inferred activities.

Polishing Stones

Waterworn chert, quartz, and sandstone pebbles were found at SG 4, SG 36, SG 38, SG 52, SG 54, and SG 62 (Figure 5). Hammond (1975:363) notes the presence of pot polishers at Lubaantun. Unlike those from Uxbenka, the manuported pebbles from Lubaantun are primarily sandstones and siltstones. The pebbles at Uxbenka

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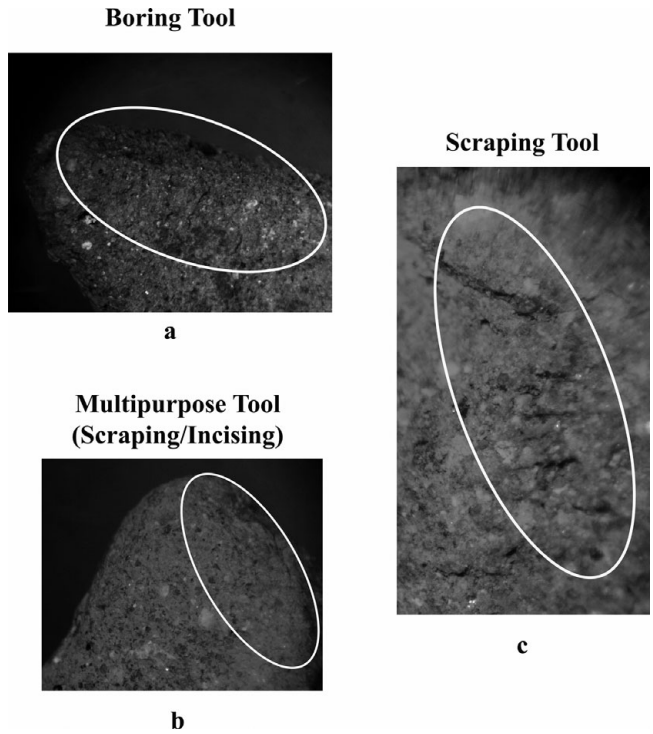


Figure 5. Microwear on select ceramic tools. (a:T21, b:T33, c:T36.)

likely came from the nearby Rio Blanco, and were transported to habitation areas for use in household activities. In pottery production, such stones are used for smoothing a vessel (when the clay is still wet) or polishing it (when the clay is at the leather-hard stage; Shepard 1980:66). Among tools associated with ceramic production, polishing stones have been documented across the Maya region (Deal 1998; Freter 1996; Halperin and Foais 2010; Reina and Hill 1978; Thompson 1958). They also can be used for activities unrelated to ceramic production, such as smoothing plaster, and caution is necessary in assigning pebbles to a potter's toolkit (Geib and Callahan 1988). In this case, use-wear, pebble size, and association with other pottery production tools suggest that waterworn pebbles at Uxbenka were used for smoothing and polishing ceramic vessels.

The material, weight, hardness, length, width, thickness, direction of wear, intensity of wear, and surface coverage were recorded for each stone tool (Supplemental Tables 3 and 4; Supplemental Figure 1). All analyses were performed by the first author to eliminate the effects of intraobserver error. Two types of polishing stones were identified for each household: rounded rectangular stones and rounded pebbles of varying sizes. The rounded rectangular polishing stones (Figures 6a, c, f) had an average length of 60.43 mm, average width of 23.67 mm, and average thickness of 16.05 mm. The most intense evidence of use is seen on the distal ends, with some parallel and oblique striations on the long sides. This type of use-wear on ground stone is consistent with ceramic production, particularly vessel smoothing. According to a Highland Maya potter, "only the ends of the stones were used for smoothing while the sides of the flat stones might be used to form the inside of a vessel rim" (Deal 1998:40–41). The smaller pebbles exhibit use-wear on all facets and were likely used for polishing (Figures 6b, d–e, g–i; Herr and Stinson 2005:68).

The Finished Products

In the absence of primary production locations, archaeologists have used the abundance and distribution of ceramic vessel forms to identify

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Table 2. Use-Wear and Inferred Activities for Ceramic Production Tools.

Tool #	SG	Context	Geometric Shape	Ceramic Group	Use-Wear (Concave)	Int.	Use-Wear (Convex)	Int.	Edge Wear	Int.	Tip Wear	Int.	Inferred Activity (s)
T1	38	Feature 1	Rounded/Pentagon	Remate	S/Multi	L	S/Multi	M	S	M	R	H	Incising/Scraping
T2	38	Fill	Triangle	Turneffe	N		No				R/S		Incising
T3	38	Fill	Pentagon	Remate	N		S/Multi	M	N		No		Polishing
T4	38	Feature 1	Rounded/Triangle	Remate	N		No		U		R		Incising
T5	38	Fill	Triangle	Turneffe	N		No				R	M	Incising
T6	38	Feature 1	Rounded/Triangle	Turneffe	N		S/Uni	L	S	H	No		Scraping
T7	38	Fill	Triangle	Hondo	U		U		N		R	M	Incising
T8	38	Feature 1	Pentagon	Turneffe	N		N		N		N		None
T9	38	Feature 1	Rounded	Turneffe	N		N		S	L	N		Scraping
T10	38	Feature 1	Pentagon	Triunfo	S/Uni	H	N		N		U		Smoothing
T11	38	Feature 1	Pentagon	Remate	N		N		N		N		None
T12	38	Feature 1	Rounded	Turneffe	N		N		N		N		None
T13	38	Fill	Rounded	Turneffe	N		U		S	M	R	M	Scraping/Incising
T14	38	Feature 1	Pentagon	Remate	S/Multi	L	N		No		R/S	M	Boring
T15	38	Feature 1	Pentagon	Remate	N		N		No		N		None
T16	38	Feature 1	Triangle	Remate	N		N		No		R/S	H	Incising
T17	38	Fill	Pentagon	Turneffe	N		N		U		N		None
T18	38	Feature 1	Triangle	Turneffe	N		N		No		R/S	H	Incising
T19	38	Feature 1	Triangle	Turneffe	N		N		No		N		None
T20	38	Feature 1	Triangle	Turneffe	N		N		No		R	M	Incising
T21	38	Feature 1	Triangle	Remate	N		U				R/S	H	Boring
T22	38	Feature 1	Triangle	Turneffe	N		N						None
T23	38	Feature 1	Rounded	Turneffe	N		N		S	M	R	M	Scraping/Incising

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Table 2. Continued

Tool #	SG	Context	Geometric Shape	Ceramic Group	Use-Wear (Concave)	Int.	Use-Wear (Convex)	Int.	Edge Wear	Int.	Tip Wear	Int.	Inferred Activity (s)
T24	38	Feature 1	Pentagon	Turneffe	S/Multi	M	N		S	M			Scraping
T25	38	Feature 1	Triangle	Turneffe	N		N		N		N		None
T26	38	Feature 1	Pentagon	Turneffe	N		N		N		No		None
T27	38	Feature 1	Triangle	Remate	N		N				R/S	M	Incising/Boring
T28	38	Feature 1	Triangle	Turneffe	N		N		N		R		Incising
T29	38	Fill	Rounded	Remate	N		N		S	M	R	M	Scraping/Incising
T30	38	Fill	Triangle	Turneffe	N		N		N		N		None
T31	38	Fill	Triangle	Turneffe	N		N		S	M	S	L	Scraping/Incising
T32	54	Fill	Rounded/Pentagon	Turneffe	N		N		S	M	S	M	Scraping/Incising
T33	54	Fill	Rounded	Turneffe	N		N		S	M	S	M	Scraping/Incising
T34	54	Fill	Pentagon/Triangle	Turneffe	N		N		N		N		None
T35	54	Fill	Rounded	Turneffe	N		N		S	M	N		Scraping
T36	52	Feature 1	Rounded/Pentagon	Remate	N		N		S	M	N		Scraping
T37	52	Feature 1	Pentagon	Remate	N		N		N		N		None
T38	52	Feature 1	Rounded/Triangle	Remate	N		N		S	M	U		Scraping?
T39	52	Feature 1	Rounded/Pentagon	Turneffe	N		N		N		N		None
N	No		Multi	Multidirectional	L		Low		S		Striations		
Y	Yes		Uni	Unidirectional	M		Moderate		R		Rounding		
U	Unclear		Int	Intensity	H		High						

Table 3. Abundance of Finished Products by Volume (SG Sherd Counts/Weights above the Mean Are Highlighted in Gray).

SG	Settlement Type	Volume (m^3)	Ceramic Count	Count/Volume	Ceramic Weight (g)	Weight/Volume
Utilitarian Production						
36	2	5.984	985	164.61	14,654	2,448.864
38	2	7.801	1,712	219.46	27,045	3,466.863
52	2	2.892	447	154.57	7,454	2,577.455
54	3	10.739	821	76.45	1,4854	1,383.183
62	3	6.542	716	109.47	11,589	1,771.477
60	3	32.31	969	30	30,324	938.533
Specialized Production						
37	3	13.611	1,151	84.56	24,158	1,774.888
No Evidence of Production						
39	2	6.6	196	29.7	3,060	463.6364
53	2	3.048	28	9.19	1,172	384.5144
18	2	8.88	321	36.15	5,421	610.473
13	2	4.172	146	35	1,226	293.8639
22	2	8.916	223	25.01	6,200	695.3791
29	3	4.6	71	15.43	1,164	253.0435
44	3	3.803	133	34.97	1,742	458.0594
5	3	9.312	227	24.38	4,824	518.0412
3	4	2.412	229	94.94	3,684	1,527.363
42	4	8.784	207	23.57	2,978	339.0255
43	3	1.02	23	22.6	202	198.0392
9	3	1	46	46	1,404	1,404
10	2	5.7715	308	53.37	2,212	383.2626
			Total	**1,289.4**		**21,890**
			Mean	**64.472**		**1,094.5**

ceramic production locations (e.g., Stark 2007). On their own, abundance data are problematic because they can be indicative of increased consumption or differential discard behavior rather than production. High sherd densities and concentrations of particular vessel forms or wares are more reliable indicators of ceramic production (Stark and Garraty 2004:126). Analyses of sherds from across the Uxbenka settlement area indicate that households with production tools have higher densities of finished products and an unusually high relative frequency of a particular vessel form type. To determine if households with production tools also had a greater abundance of finished products, we considered the total number and weight of sherds relative to the volume of excavated material. This quantitative measure provides complementary estimates of the number of pots at each settlement group (Rice 2010:261–264). All settlement groups with production tools produced an abundance of ceramics well above the mean (Table 3). The only settlement group with higher-than-average numbers of finished products without evidence of ceramic production is SG 3, a Type 4 settlement group. It is possible that the high-status residents used greater quantities of vessels, but this hypothesis warrants further investigation.

It is unlikely that the greater abundances of ceramic sherds at settlement groups with production tools are due to higher rates of consumption. Relative frequencies of vessel forms indicate higher quantities of particular vessel classes for SGs 38, 52, and 54. For each settlement group, diagnostic ceramics were classified according to primary vessel form based on the classification of vessel forms at Seibal (Sabloff 1975): serving vessels (bowl/dish), jars, unknown/other (e.g., appendage). Each sherd also was assigned to a ceramic group (defined in Hammond 1975) based on surface treatment. Both SG 38 and SG 54 focused on the production of jars. SG 38 likely produced unslipped (Turneffe ceramic group) jars while SG 54 produced red-slipped (Remate Red ceramic group) jars. SG 52 was involved in the production of Remate Red

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serving wares (Figure 7). It is unclear if each settlement group produced all vessel forms for their household, or if they specialized in a single form and traded for others. This issue will be addressed by future petrographic analyses on the Uxbenka assemblage. The data on vessel forms at each group are unlikely to be the result of different consumption practices because each settlement group was of a similar size and status.

Spatial Distribution of Producing Households

SGs 36, 52, and 54 are clustered in the southwest periphery of Uxbenka (see Figure 2). The spatial arrangement of production households is instructive for three reasons. First, the location of these households on the periphery of the site is consistent with Fry's (2013:76) proposal that "production locations were dispersed in lower-density occupation areas at the edge of major sites," possibly due to the proximity of resources (e.g., clays and tempers) or the pollution (smoke) associated with open firing. Households with evidence of ceramic production at Copán, Honduras, were strategically located near clay sources (Freter 2004:99). The southwest periphery of the Uxbenka settlement area is situated on *chik lu'um* soils, which are "poorly-drained oxidized red soils" (Culleton 2012:95) with a very high clay content. This characterization of *chik lu'um* clays is consistent with macroscopic observations of ceramic paste properties. Future work will focus on geological sampling to determine if the clay sources near producing households were indeed used for pottery production. The nearby Rio Blanco, a major water source, also would have been useful to potters. Second, all potters at Uxbenka belong to lower-status households. In both Chanal and Aguacatenango, domestic potters were of lower to middle socioeconomic status (Deal 1998). According to Deal (1998:26), "for wealthier households there was no economic pressure on the women of the household to learn pottery making." Third, the presence of an Early Classic potting household in the same spatial location as the Late Classic household suggests continuity in locale and toolkit for this activity at Uxbenka.

Household Modes of Production and Archaeological Correlates

Most discussions of ceramic production in Mesoamerica use the classification schemas proposed by Van der Leeuw (1977), Peacock (1982), Rice (1987), or Santley et al. (1989). These divide production into four (or more) main categories based on the amount of time devoted to craft production (i.e., part-time vs. full-time) and whether production takes place within the household or in a designated, nonresidential workshop. These classes are useful but the distinction between household and workshop industries is not as relevant to utilitarian pottery production in the Maya Lowlands because no evidence of pottery production workshops has been found (Rice 2009). Therefore, we follow the classification proposed by Costin (1991) as a means to frame our discussion.

For our purposes, a specialist is a potter who produces more vessels than he or she consumes, regardless of intensity of production (Costin 2001; Rice 1991). Since it is unlikely that utilitarian vessel production was sponsored by elites for their own use within the political economy, the distinction between independent and attached production is not germane to this case (Costin 2001:276). We follow Hirth (2009:21) and use the term "intermittent crafting," because the distinction between part-time and full-time activities does not accurately reflect time allocation of household activities in agrarian societies. Intermittent crafting means that potters produce vessels during only part of the year, dependent on weather conditions and time allocated to other household activities such as subsistence (Arnold 1985). The following is a review of household production, individual (household) specialization, and community specialization, the modes most relevant to Lowland Maya utilitarian ceramic production. It should be noted that McKillop (2002) documented evidence of nondomestic, specialized production of vessels for salt production at coastal sites in southern Belize. Clearly defining the boundaries of the modes of production and assigning archaeological data to them can be a difficult task because all three modes occur within residential contexts and ethnographic data indicate that considerable variability can exist within each (Arnold

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2008). Other types of specialization (e.g., workshops and attached specialization) are not described.

Household production, also called domestic production, occurs when potters produce vessels solely for their own use or that of their household. This mode of production is occasional, not influenced by market demand, and leaves few material traces (Rice 1987). Although this type of production undoubtedly occurred in the past, it is difficult to identify archaeologically because the ceramic assemblages of producing and nonproducing households are similar in composition and density (Santley et al. 1989:108). Furthermore, household potters often use expedient, multipurpose tools, and any evidence of production is intermixed with residential debris (Arnold 1991).

Individual (household) specialization occurs "when autonomous individuals or households produce for unrestricted local consumption" (Costin 1991:8). This type of specialization is most similar to the household industry category, in which consumers are often members of the potters' communities (Rice 1987; Santley et al. 1989). Household specialization is still an intermittent activity, but more frequent than domestic production. Among the Tzetzal Maya, Deal (1998) distinguishes between part-time, elementary specialization and full-time, artisan specialization. Both produced limited vessel forms, but elementary specialists produced vessels more frequently and for people outside the household. Differentiating these types of production based on the archaeological record may not be possible. Household specialization results in higher vessel frequency and more tools than household production; production debris is intermixed with residential debris but more visible in the archaeological record. This is the most common mode of production at Matacapan (Santley et al. 1989) and probably also at Lubaantun (Hammond et al. 1976), Colha, and Kichpanha (Iceland and Goldberg 1999), given that these sites were self-sufficient in ceramic production and show evidence of limited distribution. Household specialization also may have occurred at Copán (Freter 1996) and in some households at Caracol (Chase and Chase 2014).

Community specialization occurs when "an autonomous individual or house-based production units, aggregated within a single community, produce for unrestricted regional consumption" (Costin 1991:8). Community specialization is common among contemporary Mesoamerican potters (Deal 1998; Reina and Hill 1978), and it was probably at least one of the modes of production at Tikal and Palenque. Ethnographic and archaeological evidence suggest that community specialists often focus their production on a particular vessel form. Homogeneity in paste groups for a particular vessel form is further evidence of this mode of production. Some researchers have suggested that community specialization may occur when a site is close to a high-quality raw material source, as has been documented among lithic producers at the site of Colha (Shafer and Hester 1991). Community specialization may also arise in response to growing population and a greater demand for utilitarian vessels.

Ethnographic documentation indicates that the intensity and scale of domestic production is based on the economic needs of community residents. Household specialization is most common among potters in Mesoamerica, although production solely for household consumption and community specialization for regional consumption are also present (Arnold 1985; Arnold 1991; Deal 1998; Reina and Hill 1978; Stark 1985). Due to the abundance and availability of natural resources used for producing pottery in the Maya Lowlands, ceramic production was possible at every ancient Maya site (Foias and Bishop 2007; Freter 1996, 2004; Hammond et al. 1976; Howie 2012; Iceland and Goldberg 1999). Although each polity could have been self-sufficient, community specialization did occur (Fry 1979; Rands and Bishop 1980; Scarborough and Valdez 2003; Schafer and Hester 1991). Like ceramic production in modern villages across Mesoamerica, modes of domestic production among the ancient Maya probably varied spatially and temporally and may have even occurred simultaneously, particularly at larger sites.

Discussion

Archaeological interpretations of the organization of pottery production often rely on less-than-ideal datasets, particularly in the Maya Lowlands (Rice 1987). In the absence of primary firing features, archaeologists must rely on

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tools and finished products to make inferences about the organization of craft production. At Uxbenka, households participating in ceramic production were clustered near one another, used a similar repertoire of production tools, and focused production on a particular vessel class. The location of production households may have been determined by the presence of natural resources (e.g., clays or water) or the pollution of the open firing process. The clustering of production households and shared production toolkits could also be indicative of workgroups (Deal 1998). The current data indicate that three (and potentially eight) households were involved in utilitarian pottery production. Nonetheless, the absence of evidence in other settlement groups at Uxbenka does not necessarily indicate absence of production, due to the often ephemeral nature of domestic ceramic production.

In studies of residential production, it is important "not to conflate scale and intensity" (Feinman 1999:85) when assessing production organization. The intensity of production refers to the amount of time potters spend on their craft. The scale of production is characterized by the size and composition of the production unit (Costin 1991). More recent discussions of production stress the importance of decoupling these two aspects of scale (Arnold 2015:4–5; Costin 2001). We have no way of knowing how many potters participated in production at Uxbenka; nonetheless, given that production occurred within the household we can infer that the production units were composed of kin-based groups consistent with ethnographic reports from across Mesoamerica. Residents of lower-status households, such as those at Uxbenka, tend to learn craft production within the family context, while higher-status households interact with a broader range of personnel (Hayden and Cannon 1984).

Following Hirth's (2009) characterization of household craft production, potters at Uxbenka were intermittent crafters who also farmed the surrounding landscape. There is no evidence of significant multi-crafting, and the high-quality agricultural land surrounding Uxbenka (Culleton 2012) suggests that pottery production was not a risk-management strategy to subsidize household subsistence (Hirth 2009). Given that it is impossible to reconstruct time allocation in the past, it is perhaps more useful to consider craft production in terms of product specialization rather than economic specialization. According to Rice (2010:357), this approach "distinguishes specialists, or individuals having an occupational (or task, or process) specialty or special skill, from the existence of economic specialization in the context of the 'self-sustenance' of a domestic unit (group or community)." Taken together, the data indicate that at Uxbenka during the Late Classic period, some level of residential-based product specialization took place in which the producing household focused on particular functional classes.

The data we have presented, together with information on ceramics from other polities, allow us to better understand the regional economy of southern Belize during the Late Classic. Leventhal (1992) proposed the existence of a southern Belize tradition based on the absence of vaulted architecture and limited masonry superstructures, the use of natural topography in construction (modified hills), ballcourts enclosed by walls, numerous carved monuments, and inconsistent lunar series content on carved monuments. More recent evaluations, based primarily on epigraphic evidence, indicate that the four major centers in southern Belize were largely independent (Braswell and Prufer 2009:52). Pusilha, Uxbenka, and Nim li Punit all have emblem glyphs suggesting some level of political independence; inscriptions on over 60 carved monuments never mention the other polities in the region (Braswell and Prufer 2009). The epigraphy is instructive but only provides insight on elite interactions. Given that all four major polities in southern Belize are located less than 47 km from one another, it is possible that nonelite residents of these polities interacted with one another independent of their elite rulers, either through direct interaction or marketplace exchange (Masson and Freidel 2012).

The pottery of Pusilha is significantly different stylistically and technologically from the other major centers, suggesting interaction with sites outside of southern Belize, most likely the southwestern Petén (Bill and Braswell 2005).

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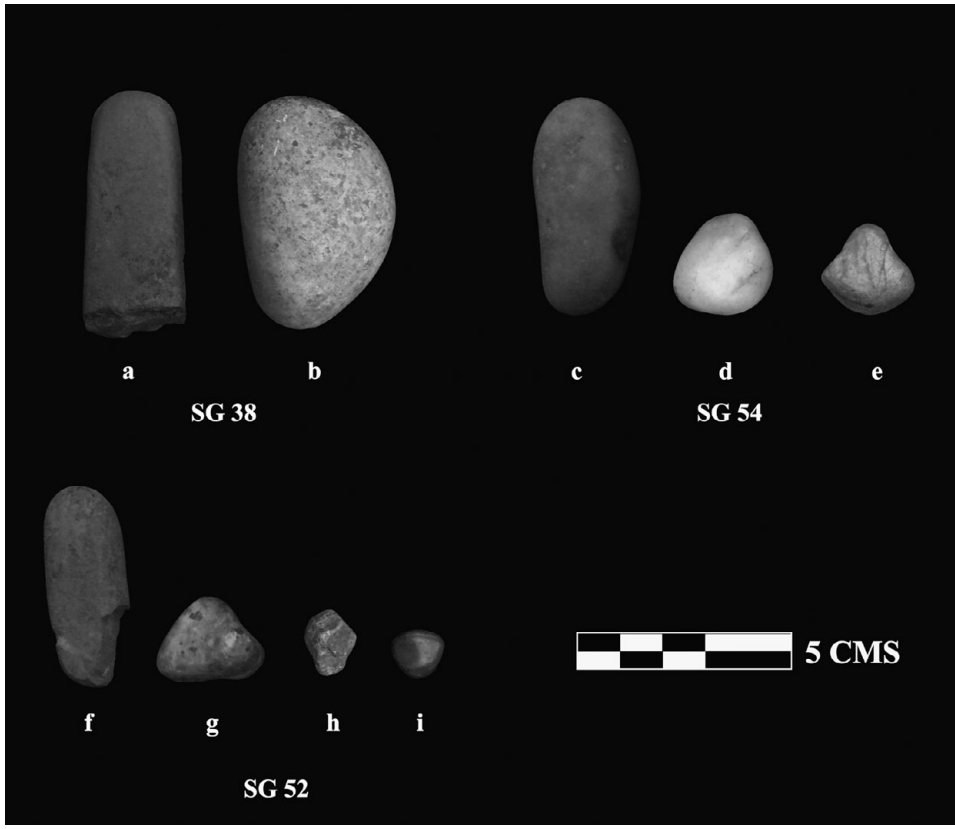


Figure 6. Waterworn pebble tools from SG 36, SG 52, and SG 54. (a:L2, b:L3, c:L5, d:L19, e:L10, f: L11, g:L12, h:L13, i:L20.)

As a result, Pusilha is not considered in our discussion of regional production and distribution. Uxbenka, Nim li Punit, and Lubaantun share the same ceramic groups originally identified by Hammond (1975), although differences exist in abundance of types, vessel form, and technology (Fauvelle et al. 2012:Figure 6; Hammond 1975; Jordan and Prufer 2014). For example, Hondo group ceramic materials that were likely produced at Nim li Punit (based on abundance) are virtually absent at Lubaantun and Uxbenka, while sherds of the coarse-tempered Puluacax group—a southern Belize tradition—are abundant at Uxbenka and Lubaantun but less common at Nim li Punit (Supplemental Table 1). Turneffe Unslipped jars, the most abundant ceramic and form group, display different forms in different polities. The most abundant jar form at Lubaantun is the vertical-neck jar, a form rarely found at Uxbenka, where jars have little or no neck. The majority of sherds at Lubaantun are tempered with limestone (60 percent), while very few sherds at Nim li Punit (6 percent) contain limestone (Fauvelle et al. 2012:56). The ceramic pastes at Lubaantun and Uxbenka are most similar, although Uxbenka sherds are also tempered with crystalline calcite; the different vessel forms suggest to us that different social units were involved in their production. INAA analysis of Lubaantun ceramic materials indicate utilitarian and polychrome vessels were produced using similar raw materials recovered within 6 km of the site core (Hammond et al. 1976).

If potters residing in southern Belizean Maya sites participated in community specialization, the finished products should be widespread across southern Belize, reflecting unrestricted regional distribution of goods. The exact opposite appears to be the case, indicative of household specialization and intrapolity distribution of finished products. The general lack of economic

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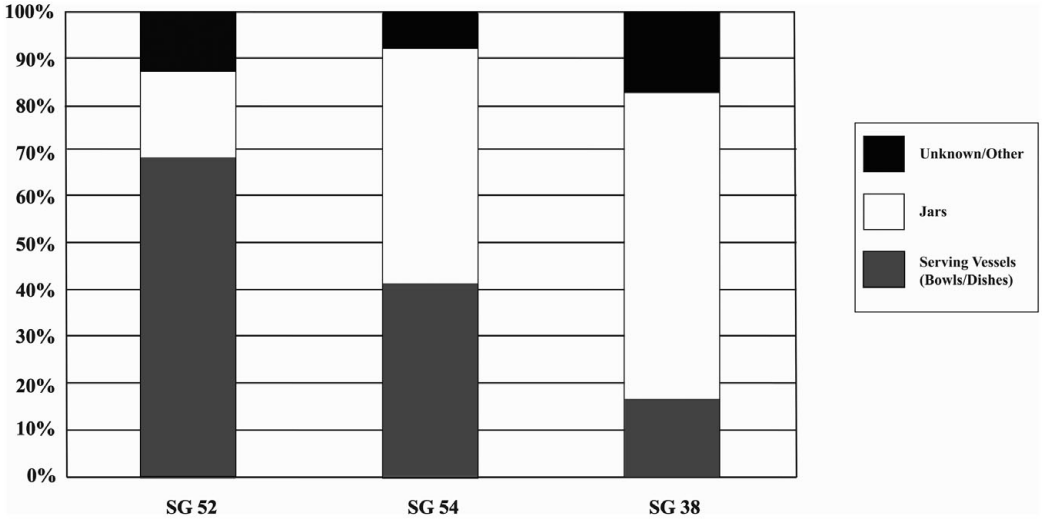


Figure 7. Relative frequency of vessel forms from SG 36, SG 52, and SG 54.

interaction between Lubaantun and Nim li Punit is further supported by differential access to and proportions of obsidian at the two sites (Daniels and Braswell 2014). Nonetheless, some exchange certainly existed, as evidenced by the small number of Hondo group ceramic sherds from Nim li Punit that are found at Uxbenka and Lubaantun. Further, ceramic vessels and salt were likely traded between inland and coastal sites (McKillop 2002). Nevertheless, the data suggest that a vibrant, intraregional market system, in which ceramic vessels were exchanged on a regular basis in large quantities, did not exist in Late Classic southern Belize. At the same time, mechanisms were in place for the acquisition of nonlocal items, as evidenced by the presence of obsidian and granite in the assemblages of all three polities (Nazaroff and Prufer 2011). There is not enough evidence to characterize the organization of production at Lubaantun and Nim li Punit, although indications exist that they were also self-sufficient in terms of domestic pottery production. Our work at Uxbenka supports Hammond et al.'s (1976:166–167) assertion that both polychrome and utilitarian vessels were produced locally using similar raw material sources. All available data indicate that the polities of southern Belize had independent domestic economies during the Late Classic period despite their proximity to one another and relative isolation from other polities.

We used ethnographic data from Mesoamerica to contextualize this discussion and provide some explanation for the patterns of ceramic production and consumption observed in Late Classic southern Belize. Self-sufficiency and household specialization are potentially related to three factors: widely available natural resources, high-quality agricultural lands, and small population sizes. Each major polity used different clays and tempers, presumably located within close proximity (Arnold 1985). Pottery is no longer commonly produced in southern Belize today, but in the 1920s villages produced their own pottery using locally available materials (Thompson 1930). This tradition continued until at least the 1960s (Hughes-Hallett 1972, 1974). Ancient Maya potters accessed the same lands as groups today and would not have had to travel far for clays and tempers. In Highland Guatemala, community specialization is often linked to a lack of high-quality agricultural lands. Ceramic production is a means for potters to supplement household income and trade for comestibles. Uxbenka, Lubaantun, and Nim li Punit are all located on well-drained, high-relief features on the Toledo Bed, composed of interbedded sandstones and mudstones (Culleton 2012; Prufer et al. 2015). The geology of this region, combined with high annual rainfall rates, makes southern Belize an extremely fertile region of the Maya Lowlands. Today, nearly every household in

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Santa Cruz village participates in subsistence farming (Baines 2015). Community specialization and subsequent exchange with other polities as a risk management strategy may not have been necessary in regions with abundant and fertile farmland. The polities of southern Belize are much smaller than those where community specialization has been inferred from the archaeological record (e.g., Tikal and Palenque) or documented ethnographically (e.g., Amatenango). Hammond (1975) suggested that Lubaantun had no more than 3,000 inhabitants and probably many fewer. Uxbenka has been estimated to have a Late Classic population of 3,427 based on an estimate of 5.5 persons per household, which stands in stark contrast to polities such as Tikal with population estimates of 49,000 inhabitants (Haviland 1969:429). The conditions of self-sufficiency and household specialization are the likely result of a combination of widespread suitable clays for pottery production, an abundance of suitable agricultural land that did not require community specialization as a risk management strategy, and small population sizes that kept demand low.

Conclusion

The data from Uxbenka demonstrate the utility of investigating domestic pottery production in the absence of primary production locales. This has significant implications for the study of household economic organization in low-density urban settings. It is necessary to use multiple lines of evidence, including spatial data, use-wear on production tools, and analysis of finished products to identify households engaging in ceramic production. If archaeologists can identify more than one household participating in ceramic production, then some inference can be made about the organization of production. This case study highlights the importance of considering craft production within the social, political, and environmental context of the potter (Costin 1991). Utilitarian vessel production in southern Belize occurred somewhere on a continuum between household production and household specialization. Although the evidence from Uxbenka cannot be directly applied to Lubaantun or Nim li Punit, it is unlikely that community specialization existed in southern Belize during the Late Classic period. The lack of larger-scale community specialization could be due to the widespread availability of high-quality clays and tempers, low population densities resulting in less demand, or very productive agricultural lands that did not require residents to turn to craft production to subsidize the household.

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Data Availability Statement. The artifacts discussed in this article were excavated by the UAP, directed by Keith M. Prufer. Excavation reports are on file with the Belize Institute of Archaeology and are available from either author upon request. The analyses and interpretations form part of Jillian M. Jordan's doctoral research. The data are available from the first author by request.

Supplemental Materials. Online supplemental materials are linked to the online version of this paper, which is accessible via the SAA member login at http://dx.doi.org/10.1017/laq.2016.3. These include the following files:

Supplemental Table 1. Relative Frequencies of Major Ceramic Groups at Uxbenka, Lubaantun, and Nim Li Punit.

Supplemental Table 2. Ceramic Production Tools.

Supplemental Table 3. Waterworn Pebble Tools.

Supplemental Table 4. Use-Wear on Waterworn Pebble Tools.

Supplemental Figure 1. Surface Descriptions for Waterworn Pebble Tools.

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