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**POTTERY AND PRACTICE IN THE LATE TO TERMINAL
CLASSIC MAYA LOWLANDS: CASE STUDIES FROM
UXBENKÁ AND BAKING POT, BELIZE**

by

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DISSERTATION

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DEDICATION

For my sister, Jenna, who did not get the chance to live her dreams.

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ABSTRACT

This study examines interaction networks among non-elite potters at Uxbenká and Baking Pot, Belize during the Late to Terminal Classic Period (AD 600-900).

Approaches to non-elite communities often assume that spatially distinct architectural groups are synonymous with social groups. While residential proximity surely influences interaction, social relations extend beyond neighbors so equating proximity with interaction simplifies the complex everyday lives of the Maya. Framed within a communities of practice theoretical framework, the goals of this study are threefold: (1) to understand pottery production practice among non-elite potters, (2) to identify communities of practice and (3) to evaluate community interaction through sharing of knowledge and practice across spatial and social boundaries. Ceramic analyses investigate practice at multiple steps in the manufacturing process from resource acquisition to final product appearance, as part of a chaîne opératoire (Lemonnier 1986, 1993). Microscopic analyses focus on attributes that are not visible to the naked eye, generally exhibit a restricted geographic distribution, and are a proxy measure for close interpersonal relationships. Two primary research questions drive this work: 1). Do communities of practice correspond to spatial zones (neighborhood, district, and/or

polity) commonly identified using spatial analyses? and 2). Does location affect patterns of information sharing? The scale of interaction between non-elite potters in two discrete regions of the Maya lowlands varies from intrapolity interaction in southern Belize to intraregional interaction in the Belize River Valley. Pottery distribution in these two regions can also be characterized in a similar fashion. The difference in both pottery production and consumption is likely due to unique historical trajectories of the two regions and their population densities in the Late to Terminal Classic Period.

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CHAPTER 1

INTRODUCTION

What is a community? Is it defined by practice or by place? Ancient and modern communities alike are comprised of multiple members linked together by a common element that can include kin, ethnic, or economic affiliations. Although communities are diverse and complex, most can be characterized by two primary elements: physical proximity and interaction among its members. Archaeological approaches to community often emphasize place and infer interaction based on physical proximity. People tend to build their homes near the people that they interact with most often, generally their kin, and the settlement pattern analysis provides a reliable method for identifying communities in the archaeological record (Ashmore 1981; Harris 2014; Kolb and Snead 1987; Wiseman 2015; Smith 2010). Other approaches emphasize interaction by evaluating communities of identity (Eckert et al. 2015), communities of consumption (Mills 2016), and the historically situated, dynamic, and multiscalar aspects of community (Isbell 2000; Varien and Potter 2008; Yaeger and Canuto 2000). My approach uncouples practice from place, and emphasizes the former, to gain a more nuanced understanding of community. This study focuses on potter interaction as a proxy for community interaction at two polities in the Late to Terminal Classic (AD 600-900) in the Maya lowlands: Uxbenká and Baking Pot, Belize (Figure 1.1). Interaction networks among crafts producers cannot account for the full range of interpersonal relationships in complex societies but this study is an effort to move beyond purely spatial concepts of community interaction.

When potters create ceramic vessels, their actions are not random. Pottery production involves a series of choices based on shared norms learned within communities of practice. According to Lave and Wenger (1991:98), “a community of practice is a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice.” They are groups of people who engage in a similar learning environment and shared experience (Gosselain 2008b; Lave and Wenger 1991; Wenger 1998). Communities of practice are active, heterogeneous, and not necessarily synonymous with communities as geographic locales.

The goals of this study are threefold: (1) to understand pottery production practice among non-elite potters, (2) to identify communities of practice and (3) to evaluate community interaction through sharing of knowledge and practice across spatial and social boundaries. Ceramic analyses investigate practice at multiple steps in the manufacturing process from resource acquisition to final product appearance, as part of a *chaîne opératoire* (Lemonnier 1986, 1993). Microscopic analyses focus on attributes that are not visible to the naked eye, generally exhibit a restricted geographic distribution, and are a proxy measure for close interpersonal relationships. A microscale consideration of ceramic attributes provides a proxy measure for interaction because craft production is learned within a community of practice. In contrast, decorative styles and styles of form are highly visible attributes that are not necessarily indicative of interpersonal interactions, but may be easily copied (Carr 1995). The variation in low and high visibility attributes reflects interaction between people and aids in the identification of communities of practice in the Late Classic Maya lowlands.

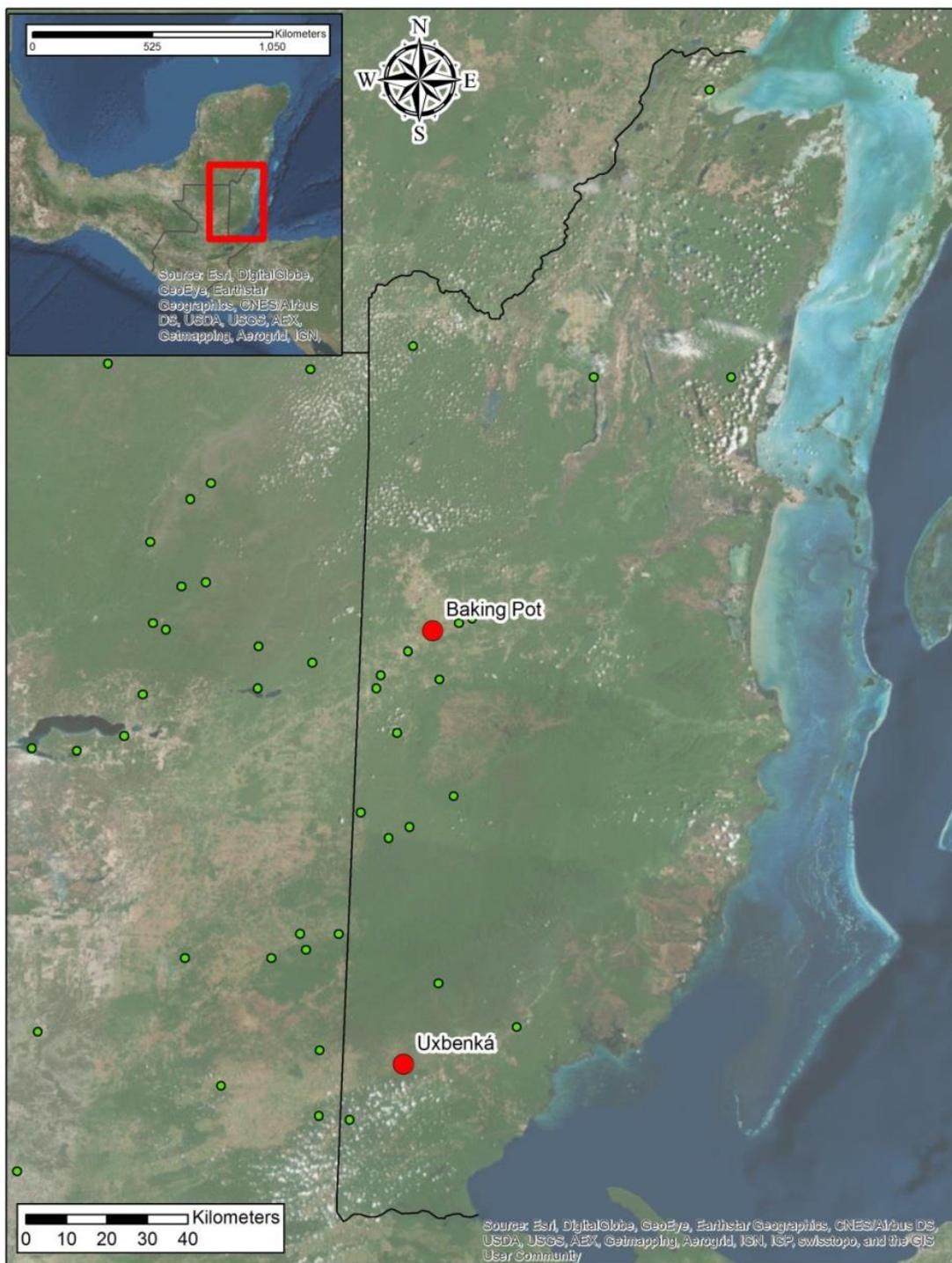


Figure 1.1. The Location of Baking Pot and Uxbenká. (Map by A. E. Thompson)

Two primary research questions drive this work:

1). Do communities of practice correspond to spatial zones (neighborhood, district, and/or polity) commonly identified using spatial analyses? This question is addressed through macroscopic and petrographic analyses of previously excavated ceramics from non-elite households at Baking Pot and Uxbenká, Belize. Analyses primarily focus on unslipped jars and monochrome bowls because they were produced by non-elite, household potters (Ball 1993; Rice 2009). The case studies were selected because they are both medium-sized polities that reached their apogee in the Late Classic Period, have nearly identical population estimates for this time period, and have previously and independently identified spatial units (e.g. neighborhoods) (Hoggarth 2012; Prufer et al. 2017). They differ in longevity of occupation, location, and degree of interaction with other polities, providing the opportunity to examine differences in practice relative to larger political and economic processes (Braswell and Prufer 2009; Helmke and Awe 2012; Hoggarth 2012; Hoggarth et al. 2014; Prufer et al. 2011; Prufer et al. 2017; Thompson et al. 2018).

The Maya lowlands is a unique region in which to investigate non-elite interaction through a detailed study of material culture. Despite over a century of archaeological inquiry, neighborhood studies in the Maya lowlands have lagged behind other areas (India and Valley of Mexico [Aztec], for example) because of the lack of texts addressing commoner activities (Arnauld et al. 2012). After early pioneering settlement studies (Ashmore 1981, Bullard 1960, Willey et al. 1965), renewed interest in neighborhood studies in Mesoamerica is due in large part to the work of Michael Smith (2010) and colleagues (i.e. Arnauld et al. 2012). What most of these studies have in common is an

explicit focus on spatial analyses in which neighborhoods, districts, and/or polities are identified as nested areas of interaction based on a set of strictly defined spatial parameters. Meaning is attached to these spatial units based on ethnographic analogy or comparison to other regions for which spatial and social data are available. This study seeks to first understand the relationship between potters *then* map the interaction onto previously identified spatial units

2). *Does location affect patterns of information sharing?* The comparative nature of the study affords the opportunity to compare interaction networks in two discrete regions and assess the effects of social environment on practice in the Maya lowlands. Baking Pot is centrally located along the Belize River, a major riverine transportation and trade route connecting the Caribbean Sea to inland Guatemala. Polities in the densely populated Belize River Valley engaged in well-documented interaction with other polities in the region as well as the larger centers of Caracol and Naranjo outside of the Belize Valley (Garber 2004; Helmke and Awe 2012; Helmke and Awe 2016a,b; Hoggarth 2012; Reents-Budet et al. 2005). Uxbenká is peripherally located in southern Belize along an overland trade route (Prufer et al. 2017). The region is sparsely populated and inter- and extra- regional interaction are poorly understood due in large part to the lack of archaeological research compared to the Belize Valley (Braswell 2017; Braswell and Prufer 2009; Hammond 1975; Prufer et al. 2011). Carved stelae at Uxbenká have been systlitically linked to Tikal (Wanyerka 2009). The presence of Belize Red pottery, and hieroglyphic texts carved into a jade pectoral at Nim Li Punit (Braswell 2017), also link the southern Belize region to the Belize River Valley. The second research question

considers how everyday practice differs among contemporary, non-elite Maya people and how community is shaped by larger regional dynamics.

This dissertation follows the hybrid format rather than the traditional monograph format. It is composed of an introduction, three previously published or unpublished co-authored manuscripts, a discussion and conclusion. Chapter 2, Chapter 3, and Chapter 4 are independent manuscripts that address the first research question at Uxbenká (Chapter 2 and Chapter 3) and Baking Pot (Chapter 4). The discussion (Chapter 5) compares the two polities to address the second research question and discusses avenues for future research. The remainder of this chapter provides background information on the Late Classic Maya lowlands including how other scholars have approached interaction and a summary of pottery production, distribution, and consumption studies in the region. A detailed discussion of theoretical approaches to pottery production is also included in the introduction and portions are summarized and applied in subsequent chapters. Similarly, a lengthier regional background for both Uxbenká and Baking Pot is included in the introduction and summarized in subsequent chapters. The introduction concludes with a brief discussion of the methodological approach to pottery production and an overview of the organization of the dissertation.

Approaches to Understanding Late Classic Interaction in the Maya Lowlands

Interactions characterize Maya society at all levels, though the nature, scale, and intensity of these interactions are debated. This dissertation evaluates material evidence for interaction among potters living in the hinterlands surrounding the Baking Pot and

Uxbenká polities. However, the inhabitants of these communities did not exist in a vacuum. Much of the work conducted on Lowland Maya interaction emphasizes elite relationships between polities at various scales (Braswell and Prufer 2009; Foias 2013; Garber 2004; Helmke and Awe 2012; LeCount and Yaeger 2010; Martin and Grube 2008; Rice 2004). A growing body of literature on commoner interaction at the level of the polity largely focuses on spatial analyses (Arnauld et al. 2012; Chase 2016; Lemonnier 2012; Prufer et al. 2017; Smith 2011; Thompson et al. 2018).

Political Organization and Elite Interaction

The Lowland Maya political landscape consisted of numerous polities that differed in architectural elaboration, spatial extent, and population density. Each polity was organized hierarchically, though the Maya never constituted a single, unified political entity (Martin and Grube 2008). The Late Classic Period (c. 600-800 AD) was a time of significant population expansion, increase in monumental construction, proliferation of hieroglyphic texts and marked growth of hinterland communities. Previously unoccupied regions began to infill and new polities were founded. It was also the height of artistic sophistication when artisans carved and painted complex designs on pottery, stucco, jade, bone and other media. The differentiation between elite and non-elite is most pronounced during this time period; elites lived in large, architecturally complex palaces while commoners lived in smaller structures in the hinterlands of the site core (Sharer and Traxler 2006). Most studies emphasize the division between elite and non-elite though some scholars suggest that a middle class, comprised of artisans, merchants and lesser elites, may have emerged during this time period (Chase and Chase 1996).

Much of what is known about lowland Maya political organization comes from epigraphic and iconographic evidence on carved monuments and architecture, from inscriptions and decoration on craft objects such as carved jade, marine shell, bone and polychrome ceramic vessels, and from the construction and layout of architectural complexes (Foias 2013; Inomata and Houston 2001a, 2001b; Martin and Grube 2008). Though variable, polities across the Maya region share similar site configurations and construction techniques, iconography, writing styles and ceramic vessel forms indicative of communication and interaction, but the degree to which each site was affiliated with others remains a point of contention.

The core of the issue lies in the debate between centralized or decentralized organization. This, in turn, affects the political and economic interconnectedness of different polities and degree of interaction between them. The most oft cited models make use of different lines of evidence to argue for centralization (Martin and Grube 2008), a cycling of dynastic capitals (Rice 2004), periods of both centralization and decentralization (Iannone 2002; Marcus 1998), or widespread decentralized, heterarchical organization (Crumley 1995; Scarborough et al. 2003; Scarborough and Valdez 2013). In general, the favored explanatory model is based largely on the type of evidence used and the polity and/or region in which the study takes place. Researchers working at large sites with numerous hieroglyphic texts tend to argue for centralized organization while those working at smaller sites, or in regions with only smaller sites and with few to no texts, argue for decentralization (LeCount and Yaeger 2010).

Martin and Grube's (2008) comprehensive study of hieroglyphic texts argues for the presence of two superstates, Tikal and Calakmul, and a series of other powerful

polities that were able to exert control over other polities. They see interaction stemming from the constant “flow of goods and services from lord to overlord” and “numerous patron-client relationships and family ties, in which major centers vied with one another in enmities that could endure for centuries” (Martin and Grube 2008:22). This approach does not, however, address how much power lords had over their subordinates or the nature of their interactions and it cannot be used at polities with few or no hieroglyphic texts (LeCount and Yaeger 2010: 28). The Belize Valley lacks an abundance of hieroglyphic texts and the many texts in southern Belize do not mention relationships between the polities rendering reliance on this model insufficient in both study areas. Marcus’s (1998) dynamic model is the most cited and applied because it allows for both spatial and temporal variability. The reasons for such fluctuation between centralized and decentralized organization include the inability of rulers to maintain power over long periods of time and the “diminishing role (of kinship) in the struggle for power” (Iannone 2002:71). McAnany (1995) suggests that the dynamic model may be the result of the interplay between kinship and kingship. The result is shifts between decentralized, heterarchically organized, independent polities and centralized, hierarchically organized ancient states. Interaction between polities will vary based on the primacy of kingship or kinship. The concept of heterarchy (Crumley 1995; Prufer et al. 2011; Scarborough et al. 2003) is often applied to the small and medium sized polities of Belize, excluding Caracol (Chase and Chase 1992).

What these models have in common is their emphasis on the elite sector of society, due in large part to the primacy of texts and a focus on monumentality in evaluating relationships. Texts, however, do not discuss the relationship between elites

and commoners and texts alone are “insufficient for fully reconstructing economic, social, and political workings of those polities on the ground, which necessarily entails synthesizing data from all sectors of society” (LeCount and Yaeger 2010: 28).

Furthermore, most polities located in Belize do not have many hieroglyphic texts rendering it impossible to understand elite interaction based solely on these data (Houk 2015). The next section addresses approaches to understanding non-elite interaction in the absence of texts.

Evaluating Non-Elite Interaction

Many discussions of political organization either ignore the non-elite people that comprised the majority of Lowland population or consider them a passive, homogeneous group whose lives were dictated by the control, or lack thereof, that the upper levels of society exerted on them (Lohse and Gonlin 2007; Robin et al. 2010). Because non-elite material culture did not include inscriptions, what we know about their interaction is derived largely from the archaeological record and ethnographic analogy. One of the goals of this dissertation is to consider commoner populations as active participants in Maya society. It is generally assumed that while the larger political climate undoubtedly influenced interaction writ small, non-elite potters actions were not controlled by elites (Ball 1993; Rice 2009) and they were free to choose how to make ceramic vessels and from whom they learned and interacted.

Early research in the Maya lowlands focused on large-civic ceremonial centers and the trappings of elite life; however, more recently, researchers have devoted considerable effort documenting and defining settlement patterns, particularly after the pioneering efforts of Gordon Willey in the mid-twentieth century (Ashmore 1981;

Bullard 1960; Fash 1983; Willey et al. 1965). Household archaeology grew out of settlement pattern studies and these have focused attention on the non-elite segment of ancient Maya society (Freter 2004; LeCount and Yaeger 2010; McAnany 1995; Robin 2003, 2004; Webster and Gonlin 1988; Wilk and Ashmore 1988; Wilk and Netting 1984; Yaeger and Canuto 2000). Ashmore and Wilk (1988:4) define the household as a group of people who share a physical space (the house) and engage in a variety of activities including production, consumption, intergenerational transmission of wealth and property, and reproduction. Households are important spaces for economic and social activities; they are the primary interaction space and the locus for production and reproduction of learning and practice (Bowser 2000, Braun 1983; Robin 2003; Webster and Gonlin 1988; Weissner 1983; Wilk 1988; Wilk and Netting 1984).

These early studies focused on the identification of a house through settlement survey and associated artifacts (e.g. utilitarian ceramics, lithic implements, groundstone) and more recent studies focus on how households articulate with one another to form a community (Peuramaki-Brown 2012; Robin 2012; Yaeger 2000 a,b). Yaeger and Canuto (2000:3) argue that archaeological studies of community should take an interactional approach in which relationships are emphasized and state, “instead of seeing the community as the basis for social interaction and reproduction, a practice or agent-oriented approach views all social institutions, including the community, as socially constituted.” One method for addressing intercommunity interaction and the relationships among the inhabitants of households, and the primary approach used in the Maya lowlands, is spatial analysis.

One view of lowland Maya settlement patterns describes them as low-density agrarian-based urbanism. This type of urbanism is characterized in the Maya region by a central core composed of monumental architecture surrounded by dispersed settlement, likely due to the importance of farming in these communities (Awe et al. 2014; Fletcher 2009, 2012; McAnany 1993b; Robin 2003, 2012). Bullard's (1960) division of architectural remains into household clusters, minor centers, and major centers marked the first attempt to make sense of social organization through spatial analyses. Researchers across the lowlands implemented settlement pattern studies with different goals ranging from understanding regional patterns of settlement (Willey et al. 1965) to creating population estimates (Haviland 1969, 1972). These studies coalesced into the seminal *Settlement Pattern Archaeology* volume (Ashmore 1981), which sought to integrate the body of knowledge on method and theory concerning settlement pattern analysis in the Maya lowlands.

More recent spatial approaches to non-elite organization focus on documenting neighborhoods, which are socially and spatially important units, cross-culturally (Arnauld et al. 2012; Isendahl and Smith 2013; Prufer et al. 2017; Smith 2010, 2011, 2014; Smith and Novic 2012; Smith et al. 2015; Thompson et al. 2018). A neighborhood is comprised of multiple households and is characterized by "considerable face-to-face interaction and is distinctive on the basis of physical and/or social characteristics" (Smith 2010: 53). Neighborhoods are considered ubiquitous and fundamental to low-density, urban environments that characterize many early agrarian societies (Fletcher 2009; Isendahl and Smith 2013). Even more encompassing is the district, which is composed of multiple neighborhoods and administrative, political, communal-religious architecture; they are

not defined solely on the basis of interaction, but rather, have elements of top-down planning (Chase 2016; Smith 2010; Thompson et al. 2018). Evaluations of Maya hinterlands often identify neighborhoods and districts based on the clustering of households that are separated from other households by space or other landscape features such as topographic changes or waterways. The relationship between the inhabitants of these spatial groupings is assumed. While people living within the same neighborhood certainly interacted with one another regularly, this approach does not capture the broad and often complex relationships that exist both within and among communities. The largest spatial grouping is the polity, which is defined based on decreasing density of households away from the site core. Interaction between polities, as discussed above, is generally limited to elite relationships. These spatial patterns are important to understanding social organization, but do little to further our understanding of interaction within and between these spatial clusters (Chase and Chase 2012; Smith 2010).

Pottery Production, Distribution and Consumption in the Maya Lowlands

Elites and commoners used a wide variety of ceramic vessels in their everyday lives as well as for rituals, feasts, and offerings. Late Classic population estimates and the ubiquity of pottery in both elite and non-elite contexts indicate that production, and subsequent distribution, occurred regularly across the lowlands. Unslipped jars were used to store dry and liquid goods as well as for cooking while monochrome, bichrome, and polychrome bowls and dishes were used for serving food in a variety of social settings (LeCount 1996, 2001; Reents-Budet 1994; Rice 2009). The interaction networks above

provide the framework in which to understand Lowland Maya pottery because “any assessment of the role of pottery production in a political or domestic economy requires systematic attention to these diverse categories of products, producers, contexts, and consumers” (Rice 2009:119).

According to Rice’s (2009: 188) comprehensive review, “existing interpretations of the organization of Late Classic Maya pottery production propose that this activity was decentralized, major political centers were primarily consumers rather than producers of pottery, and little evidence exists for elite control. Unfortunately, these studies also seem to convey the idea that Maya pottery was either a monolithic, undifferentiated commodity or a gallimaufry of goods produced by unorganized, independent artisans isolated from market forces.”

However, reflecting the variability in Late Classic political and economic organization, the reality of ancient Maya pottery production is much more complicated. In general, all Late Classic Maya pottery is considered to be hand built, earthenware (fired below 950°C), fired without the use of formal kilns. Most studies dichotomize between elite, polychrome pottery production and non-elite, utilitarian vessel production (see Ball 1993). While household potters likely did not participate in painting vessels with courtly scenes or hieroglyphic texts, they probably constructed the vessels prior to decoration (Rice 2009). The extent of shared knowledge among these presumed distinct groups of potters has not been thoroughly investigated. While it is certainly likely that elaborate polychromes with hieroglyphs and courtly scenes moved in elite circles as part of the

political economy, the mechanisms behind the production and distribution of less elaborate polychromes and unslipped vessels remains largely unknown.

Production

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 1978, 1985, 2015, 2018; Deal 1998; Feinman 1999; Feinman and Nicholas 2007; Freter 1996, 2004; 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 (Howie 2012; Rice 2009), where domestic craft production may have been a means to diversify household production and mitigate against risk (Hirth 2009:13-32).

We know very little about pottery production due in large part to the lack of primary production areas in the archaeological record. At Lubaantun, located 13 km northeast of Uxbenká, 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). The nature of ceramic production in the Belize Valley has not been widely explored though LeCount (2010) proposes that Mount Maloney pottery was produced in the vicinity of Xunantunich due to the abundance of that type there relative to other

polities in the region. Sunahara's (2003) petrographic study of pottery from sites across the Belize Valley indicates that all polities participated in ceramic production. Evidence for a palace workshop at Buena Vista del Cayo suggests that production involved multiple recipes operating simultaneously at a single polity during the Late Classic Period (Reents-Budet et al. 2000a).

Natural resources suitable for pottery production are widely available across the Maya lowlands so each polity could have, and likely did, produce ceramic vessels (Angelini 1998; Bartlett 2004; Bartlett et al. 2000; Becker 1973; Bruhns 1987; Freter 1996, 2004; Fry 1979; Halperin and Foias 2010; Hammond et al. 1976; Howie 2012; Iceland and Goldberg 1999; LeCount 2010; Lopez Varela et al. 2002; MacKinnon et al. 1999; Rands and Bishop 1980; Reents-Budet et al. 2000a, b; Straight 2010). However, few studies have specifically addressed the acquisition of clay and temper using geologic prospection. The majority of the Maya lowlands is underlain by marine limestones so archaeologists are inclined to assume geologic homogeneity *within* a given region. Most of the geologic literature for the region is lacking in detail so sampling is imperative. The few studies that address resource acquisition by geologic testing indicate that clay sources are heterogeneous at the subregional level and that a careful consideration of the local landscape can aid in intraregional or site-specific studies of pottery production. Few studies focus on the issue of intraregional geologic variability in the Maya lowlands. Bartlett et al. (2000) used the information to understand Formative Period pottery production and distribution at K'axob, while Howie (2012) focused on Terminal Classic to Postclassic production at Lamanai. The data from K'axob indicate that Formative Period potters preferred carbonate temper for unslipped vessels while slipped vessels

exhibit more variability and all of these resources were locally available on a homogeneous limestone plain (Angelini 1998; Bartlett 2004; Bartlett et al. 2000). Howie's (2012) consideration of both geologic sourcing and ceramic petrographic analysis indicates that potters were using a variety of locally available clays and tempers to produce both utilitarian and fine wares at Lamanai during the Terminal Classic to Postclassic transition. Five different local paste-making traditions could be tied to the landscape around Lamanai and the majority of the analyzed assemblage was produced locally, though different clays, tempers, and processing were used simultaneously. These two studies highlight the importance of geologic sourcing to identify locally produced pottery and document variability in raw materials collection and processing in the vessel production process.

Most studies, however, assume that potters use locally available resources without collecting geologic samples and comparing them to finished products. While ethnographic data worldwide support this assumption (Arnold 1985), archaeologists addressing these issues should always collect and analyze locally available clay and temper material. It is interesting that there is very little evidence tying the production of polychrome vessels to the landscape given the amount of attention these vessels receive from scholars. This is particularly true of production studies that employ NAA. These studies assume provenance based on the Criterion of Abundance (Bishop et al. 1982), though the addition of Primary Standard Sequences (PSS) and/or iconographic imagery linking vessels to a particular site (or artisan) provides a compelling argument in some cases (see Rice et al. 2009 for a more complete discussion). A notable exception is Hammond et al.'s (1976) NAA study of ceramics and clays from Lubaantun. Presumed

locally produced pottery grouped well with locally derived clay sources. However, a Belize Red sherd (likely manufactured in the Belize River Valley) and a Fine Orange sherd (likely manufactured in the Pasión region of Guatemala) also grouped well with locally derived clay sources. Other Belize Red samples, however, were chemically similar to those of the Belize Valley. While this study attempted to match pottery to clay using NAA, it suggests that chemical sourcing of clays can provide ambiguous results concerning provenance. The lack of a “match” between pottery and raw materials using chemical analyses is likely due to the fact that the Maya processed raw materials prior to making ceramic vessels (Arnold et al. 1999; see Howie [2012:179-195] for a discussion of INAA of pottery and clay sources at Lamanai).

Firing is the most precarious step in the vessel manufacture process though it is often overlooked by researchers. An understanding of firing technology can provide insight into the skill of the potter, organization of production, and demand (Becker 2013). No unequivocal evidence for primary pottery firing locales exists in the Maya lowlands though evidence for many techniques (e.g. pit kilns), absent built kilns, has been identified in other parts of Mesoamerica (Becker 2013: 16). Polychromes may have been fired in saggar kilns in which “a decorated vase was placed inside another large pot (a saggar) with the fire built around its exterior” (Rice 2009: 120). Experimental studies show that polychrome vessels could also be fired using open firing (Becker 2013). Possible kilns have been identified at Cuello (Bruhns 1987) and K’axob (Lopez Varela et al. 2002) in Belize. Postclassic (AD 800-1200) Plumbate pottery is thought to have been fired in kilns due to its extremely hard, vitrified surface (Shepard 1948), though direct evidence remains elusive (Becker 2013: 17).

Distribution and Consumption

All households, both elite and non-elite, consumed utilitarian ceramic vessels in the form of monochrome-slipped bowls and unslipped jars. Most studies of Classic Period ceramic distribution focus on polychrome vessels. The movement of these vessels is documented in the hieroglyphic record as tribute among elites as part of the political economy (Masson and Freidel 2012:457). Utilitarian vessels are generally thought to be distributed locally, though some vessels did travel long distances (Howie 2012). Early distribution studies combined some kind of compositional data and fall-off analyses. Rands and Bishop (1980) used chemical and petrographic data to determine that Palenque consumed pottery from a wide area. Pottery produced in the vicinity of Palenque drops off in frequency a short distance from the site, is present 10 to 40km away, and is completely absent at sites 40-60km away (Rands and Bishop 1980: 42) indicative of regional distribution of locally produced wares. A similar pattern of local production and distribution for utilitarian vessels was identified at Tikal (Fry 1979). Hammond et al.'s (1976) NAA study of pottery and clays from Lubaantun suggest a much narrower zone of distribution perhaps due to the smaller size of the polity (West 2002). More recent examinations confirm these early studies (Fry 2013; Howie 2012).

The mechanism by which utilitarian vessels made their way from producers to consumers is still debated for the Late Classic Period. Some scholars have argued for a redistributive system (e.g. Ball 1993) controlled by elites, though Masson and Freidel (2012:457) argue "that non-market top-down redistributive systems could not have placed significant quantities of non-local goods into the hands of a majority of ordinary households." Population estimates for the Late Classic Period suggest that redistribution

alone is unlikely to account for the movement of utilitarian pottery (Fry 2013). More recent studies apply a distributional approach (Hirth 1998) to artifacts recovered from both elite and household contexts in the absence of direct physical evidence of a marketplace. This approach “focuses not on the location, form, or spatial configuration of the marketplace but on the frequency and distribution of the material remains procured through exchange by primary consumption units (households, palaces, civic-ceremonial entities, etc.)” (Hirth 1998:451) and has been used successfully across Mesoamerica to infer marketplace exchange. This approach is often applied to long-distance trade items like obsidian, marine shell, and jade though the distribution of ceramic vessels and figurines has also been used to infer the presence of market exchange (Cap 2015; Masson and Freidel 2012).

Market exchange exists on a continuum from centralized to decentralized exchange resulting in a different pattern of commodity distribution; however, all types are free from the sociopolitical control of elites that is characteristic of redistribution. Market exchange would result in homogeneity of household assemblages between households because everyone would have access to marketplace items. For example, all households, regardless of wealth or status, would have access to imported pottery. Redistribution, on the other hand, “produces heterogeneity between households in the types and quantities of resources they procure and a distribution of high-value and imported items that parallels existing social hierarchies” (Hirth 1998:455). Cap (2015:402) suggests that the location of a marketplace within the site core is indicative of elite management of at least the space, if not the activities occurring within the space.

Few studies provide direct physical evidence of a Classic Period marketplace (Cap 2015; Dahlin et al. 2007; Dahlin et al. 2010; Terry et al. 2004). Cap (2015) has argued for the presence of a marketplace at Buena Vista del Cayo in the Upper Belize Valley. She suggests that the spatial distribution of artifacts, analyses of soil chemistry, and architectural features in the East Plaza, a large and easily accessible space, indicate that this area likely served as a marketplace. The Buena Vista del Cayo marketplace is relevant to this study as it is coeval with the occupation of households analyzed from Baking Pot. Though Cap (2015) determined that household items of stone and organic goods, not ceramic vessels, were exchanged at the market, this study suggests that a market economy was in place in the Belize Valley in the Late Classic Period. Sunahara's (2003) petrographic study of pottery from eight sites in the Belize Valley suggests regional distribution of locally produced pottery, perhaps due to a market economy, and "participation in distribution spheres for sites in the Belize Valley differed depending on their scale, complexity, and access to resources (142)". Work conducted in Group D at Uxbenká focused on identifying a market through phosphate testing and artifact distribution, though these analyses proved inconclusive (Ebert et al. 2010).

To summarize, previous studies of pottery production in the Late Classic Maya lowlands indicate that pottery production was likely the domain of household potters. Some polities, particularly larger ones such as Tikal, may have participated in community specialization focused on a particular form or ware. It is likely that household potters produced all types of pottery but elites were responsible for the decoration of elaborate polychromes, perhaps as part of attached specialization associated with the royal court.

Every polity could have supported pottery production due to the widespread distribution of clays and tempering material. The mechanism by which pottery moved from producer to consumer is debated, although marketplace exchange was likely in place by the Late Classic Period, at least in some locations.

Theorizing Learning, Interaction, and Communities of Practice and Their Application to Ancient Maya Craft Production and Social Boundaries

Settlement pattern and household studies have advanced our understanding of lowland Maya social organization and the character of hinterland relationships though less is known about intracommunity interaction. How do we understand ancient Maya social organization if we acknowledge that spatial units were complex and overlapping? How does practice crosscut spatial boundaries? Here, I use a communities of practice theoretical approach coupled with Carr's theory of artifact design and concepts of technological style (Carr 1995; Hegmon 1992; Lave and Wenger 1992; Lechtman 1977). My approach to understanding shared practice in dynamic, heterogeneous Lowland Maya communities is similar to previous studies (Robin 1999, 2003; Yaeger 2000b; Yaeger and Canuto 2000), but differs in its explicit focus on information exchange within these communities by examining potters' choices.

This framework has been successful in investigating social boundaries in middle-range societies but is rarely used in complex societies (Bamforth and Finlay 2008; Crown 2014; Habicht-Mauche et al. 2006; Joyce 2012; Minar and Crown 2001; Stahl 2013; Stark et al. 1998; Stark et al. 2008; see Hendon 2010; Joyce et al. 2014; Munson 2012 for

use in Mesoamerica). It is only within the past few decades that anthropologists and archaeologists have begun to acknowledge the processes by which knowledge is acquired and transmitted in studies of craft production (Bamforth and Finlay 2008; Crown 2002, 2007a, 2007b, 2014; DeBoer 1990; Gosselain 1998, 2008a, 2008b, 2010, 2011; Hayden and Cannon 1984; Herbich 1987; Herbich and Dietler 2008; Herhahn 2006; Joyce 2012; Minar 2001; Sassaman and Rudolphi 2001; Stark et al. 2008; Wallaert-Petre 2001, 2008).

Traditional Approaches to Social Boundaries

Investigations into social boundaries have primarily focused on the use of decorative style (Hegmon 1992; Neimann 1995; Weissner 1989; Wobst 1977) to convey information about inclusion and exclusion. Early studies used designs on ceramics to create temporal and social groupings, divide culture areas, and create chronologies. Building on these ideas and using ethnographic analogy, researchers began to address transmission of knowledge between potters with reference to learning and residence but viewed pottery production as passive and performed according to norms. That is, potters' choice was all but removed from the equation (e.g. Hill 1970; Longacre 1970). The adoption of Information Exchange Theory (Wobst 1977) and debate over the meaning of style (Sackett 1977; Weissner 1983) shifted the way that archaeologists theorized style, moving research forward by considering style as an active choice, either by individuals or groups. Style as an indicator of social boundaries is supported by numerous ethnographic studies (Bowser 2000; DeBoer 1990). However, some researchers have noted that attributes of decorative style "are poor indicators of cultural identity" (Stark et al. 1998), as social boundaries are permeable, decoration is often made in response to consumer demand, and decorative attributes can be copied by members of other social groups

(Friedrich 1970; Walt 1990). My approach primarily focuses on technological style (Lechtman 1977), which is an equally worthwhile and perhaps better option for evaluating social boundaries, particularly for undecorated, utilitarian vessels (Peelo 2011; Stark et al. 1998). Most importantly, style, whether decorative or technological, reflects “choice between equally viable options” (Gosselain 1998: 82). These choices are not random but are based on shared norms (Gosselain 2008) learned within a community of practice.

Situated Learning and Communities of Practice

Communities of practice are valuable analytical units because learning occurs through interaction within a community (Lave and Wenger 1991; Sassaman and Rudolphi 2001). This framework, originally developed to explore shared practice in contemporary society, examines the relationship between community and practice through the integration of mutual engagement, joint enterprise, and shared ways of doing (Lave 1993, 2008; Lave and Wenger 1991; Roddick and Stahl 2016; Wenger 1998). Situated learning theory holds that learning is historically, socially, and culturally constituted and that it is an active participatory process within communities of practice. Communities of practice are groups of people who engage in a similar learning environment and shared experience. They are dynamic, heterogeneous, and not necessarily synonymous with community as a geographic locale (Wenger 1998).

Membership can vacillate during any given time and new generations ensure transformation though they may retain core aspects of the community as it is not a simple task to significantly change a community of practice. Different communities of practice can form a constellation of practice, a group of participants “too broad, too diverse, or too

diffuse to be usefully treated as single communities of practice” (Wenger 1998: 126-27), when the participants share historical roots, have related enterprises, belong to the same institution, face similar conditions, have members in common, share artifacts, have geographical relations of proximity or interaction, have overlapping styles or discourses, or compete for the same resources. Material culture acts as “a focus for the negotiation of meaning” (Wenger 1998: 58) within a community of practice. Ceramic assemblages are ideal material correlates for examining information exchange because craft manufacture is a learned process (Minar and Crown 2001) and vessels are used in a variety of social contexts. Ceramics can also reflect potters involvement in a community of identity (Eckert et al. 1995) in which the outward appearance of a ceramic vessel can signal affiliation within a larger sphere of identity.

Legitimate Peripheral Participation and Learning Frameworks

Legitimate peripheral participation is a useful concept for understanding learning and the process of full integration into a community. A learner will work with an expert with “limited responsibility” (Lave and Wenger 1991: 14) until they acquire the necessary knowledge and skill to be full participants. According to Lave and Wenger (1991: 29), “we mean to draw attention to the point that learners inevitably participate in communities of practitioners and that mastery of knowledge and skill requires newcomers to move toward full participation in the sociocultural practices of community.” This concept is particularly instructive for archaeological studies of craft production because it situates the craft production community within the greater society. By definition, it requires us to recognize that craft production does not occur in a vacuum; it is shaped by the artisans’ society (Bamforth and Finlay 2008). This is

particularly true of the production steps necessary to manufacture a vessel because they are “embedded in social and economic systems” (Gosselain 1998: 90), a concept often ignored in more traditional ceramics studies that largely focus on typologies and/or decoration.

Though the concept of legitimate peripheral participation is applicable to any learning framework, it is necessary to know and understand the framework in order to apply it to studies of interaction in the archaeological record. This important aspect is often not considered in archaeological studies of craft production but has gained attention in recent years (Bamforth and Finlay 2008; Crown 2014; Minar and Crown 2001). Learning frameworks vary greatly from imitation with no communication to directed instruction in apprenticeships (Crown 2007; Deal 1998; Hayden and Cannon 1984; Shennan 2009; Wallaert-Petre 2001). They consist of practices that may include imitation, verbal instruction, hands-on demonstration, and self-teaching by trial and error (Schiffer and Skibo 1987: 597). The type of learning framework can have significant effects on patterns of material culture recognizable in the archaeological record. For example, when potters learn through imitation and experimentation, there will be more variability in final products. When they learn through verbal instruction, there will be less variability (Wallaert-Petre 2001, 2008). Furthermore, the learning framework can have an effect on the rate of change across generations (Crown 2014).

Ethnographic Data on Learning Frameworks among the Maya

Ethnographic evidence suggests that the majority of crafts learning in contemporary Maya communities, and indeed many traditional communities, occurs through imitation and observation with no formal instruction (Arnold 2008; Crown

2007a,b; Deal 1998; Minar and Crown 2001; Hayden and Cannon 1984). I assume this type of learning framework for ancient Maya household potters based on ethnographic correlates. Learning frameworks among contemporary Maya potters all involve interaction but they do so in slightly different ways, which are evident in patterns recognizable in finished products. That is, not all pottery producing communities share knowledge in the same manner and households within the same community may share knowledge differently. Thus, we should not expect all ancient Maya communities to be identical.

Hayden and Cannon (1984) addressed learning in three Highland Maya communities as part of the Cohox Ethnoarchaeological Project: Chanal, Aguacatenango, and San Mateo Ixtatan in the Mexican state of Chiapas. Most of the potters in their study learned within the Kin Extensive Mode in which learning takes place with a variety of kin not necessarily from coherent residential units (but still cooperating households). Status difference translated into different learning frameworks among the groups in which residents of lower status households tended to learn craft production within the family contexts while higher status households learned from a broader range of personnel (Hayden and Cannon 1984:351). Simply assuming that all learning occurs solely within the household precludes archaeologists from recognizing these important interactions.

Deal (1998:27-37) provides more detail on the Cohox Ethnoarchaeological Project. Though production occurred primarily within the household in both Chanal and Aguacatenango, different learning frameworks resulted in different community styles. In Chanal, considered by Deal to be more traditional, learning occurred through verbal exchange and informal work groups, which did not result in a shared community style but

discernable microtraditions were evident among work groups. Archaeologically, this type of learning should result in homogeneity of tools and finished products. In Aguacatenango, learning involved watching and experimentation, which resulted in more variation in finished products. In some villages, household interaction formed communities of practice while in others communities of practice were larger and formed through interaction at the neighborhood level, often by non-kin teachers and students. Other ethnographic studies reference internal variation between modern Maya communities though not always involving craft production (Wilk and Ashmore 1988; Arnold 1985; P. Arnold III 1991; Wilk and Netting 1984). However, taken together, these studies indicate that variation in intracommunity information sharing should be considered the norm and archaeological studies need to specifically address this in order to understand intracommunity social boundaries.

Process-Oriented versus Final Product Learning

While learning most often occurs through interaction with a more experienced potter, potters are also known to copy styles (DeBoer 1990). In general, highly visible attributes are copied (e.g. decoration) while aspects of ceramic technology are invisible and cannot be copied without instruction. Thus, a distinction needs to be made between information transmission that occurs through face to face interaction or through copying of the final product. According to Van Hoose (2008: 25), “*process-oriented learning* involves imitation of the entire suite of behaviors and actions that result in the production of the desired artifact.” The transmission of knowledge concerning technological ceramic attributes is more likely to occur through process-oriented learning. *Final product learning*, on the other hand, “involves copying a performance (or product) without

reference to the actions or behaviors that went into its formation. Merely viewing an aspect of the product, like the shape of a painted decoration, may be sufficient for high-fidelity replication” (Van Hoose 2008: 24). It is necessary to consider both learning modes to understand multiscale interaction at the intracommunity level, and to distinguish between communities of practice and communities of identity.

Theory of Artifact Design

Carr’s (1995) theory of artifact design provides the framework for understanding interaction through an examination of ceramic attributes. Carr organizes attributes hierarchically according to visibility, manufacturing decisions, and production sequence. According to Carr (1995: 173), “the hierarchy of processes and constraints that determine an artifact’s attributes and design somewhat parallels and can be linked to the hierarchy of attributes that is defined independently by their relative visibility, decision order, and production order.” This study organizes ceramic attributes by their level of visibility.

Low visibility attributes are not visible to the naked eye and generally exhibit a restricted geographic distribution. These attributes are indicative of process-oriented learning and are a proxy measure for interpersonal relationships. *High visibility attributes* are clearly visible on the final product and have a broad geographic distribution. Decorative styles and styles of form are highly visible attributes that can be copied by other artisans; that is, these attributes are not necessarily indicative of interpersonal interactions (though they can also be transmitted by process-oriented learning). The variation in low and highly visible traits is “a direct manifestation of the transmission of information between people” (Van Hoose 2008: 9). In order to use the theory of artifact design, there must be a uniformity of raw materials and a lack of significant artifact exchange to reduce other

factors that could affect variability in the material culture (Carr 1995:179). These conditions are met in this study. Both the Belize Valley and southern Belize have a relatively homogeneous intraregional geology (see Appendix B) providing potters with similar raw materials. Furthermore, though unslipped jars are exchanged long distances the majority are exchanged at the local level (Rice 2009).

Vessel Manufacture as a Learned Process

Vessel manufacture can be limited by geologic and ecological constraints (see Arnold 1985). However, potters who have access to the exact same resources still create pots differently. That is, choice exists and these choices are dictated by a variety of factors (Berg 2007; Bleed 2001; DeBoer 1990; Gosselain and Smith 2005; Lechtman 1977; Schiffer and Skibo 1987, 1997; Sillar and Tite 2000). The concept of technological style is a useful one for understanding the vessel manufacture process. It is recognizable because it is repeated (Lechtman 1977). According to Lechtman (1977: 6),

“technological behavior is characterized by the many elements that make up technological activities- for example by technical modes of operation, attitudes towards materials, some specific organization of labor, ritual observances- elements which are unified nonrandomly in a complex of formal relationships. It is the format or ‘package’ defined by these relationships that is stylistic in nature, and it is the style of such behavior, not only the rules by which any of its constituent activities is governed, that is learned and transmitted through time.”

Technological style (Lechtman 1977) is considered best for investigations of intracommunity information exchange because it results in “ingrained motor habits that

are difficult to change, and are therefore conservative within communities and lineages of artisans who learn from one another” (Van Hoose 2008: 13).

Attributes of form include: body shape, appendages, remodeling, and details of proportion (thickness of wall, base and rim, location of handles, relative size, neck height, rim diameter, and curvature). Attributes of style include: type of surface treatment (e.g. slipping or burnishing), decoration, and design complexity. Nearly all of these attributes are visible on material culture in the archaeological record (with the exception of aspects like scheduling). Communities of practice exist at every step of the manufacturing process and are not necessarily identical. For example, an entire neighborhood may share information about the location of resources but learning how to manufacture a vessel occurs at the household level. Thus, identifying multiple and overlapping communities of practice requires a consideration of the entire process.

My approach is largely informed by ethnographic and ethnoarchaeological data. Deal (1998) suggests that ceramic microtraditions “are patterned according to technological, formal, and stylistic aspects. Technological aspects include:

1. The location and accessibility of various resources (i.e. clays, tempers, pigments, and fuels) and their relative quality;
2. Formulas for paste ingredients that specify which tempers and clays to use and in what amounts;
3. Instructions on production techniques, including the degree of grinding of clays and tempers, use of various potting tools, forming and finishing procedures, and kiln construction;

4. Scheduling of when to collect materials, prepare pastes, form, dry, and fire vessels, as well as lengths of times for aging clays, drying and firing;
5. Measures to ensure production efficiency, such as the use of wasters to prevent fire marks on vessels, and the reuse of leftover materials and fuels” (Deal 1998: 32-33).”

The first three aspects of technology discussed by Deal (1998) are addressed in this study. Unfortunately, a consideration of scheduling cannot be fully considered in an archaeological study and the absence of primary firing features precludes a detailed analysis of his fifth technological aspect. This study focuses on paste recipe which is the combination of resources acquisition and raw materials processing (Table 1.1). These data are used to determine if paste recipe corresponds to overall vessel form, rim form, and color in order to identify communities of practice.

Paste Recipe

Differences in ceramic paste composition are not simply due to ecological constraints but reflect the choices involved in resource acquisition and processing (Gosselain 1998). By considering the recipe (Joyce 2012), rather than simply the mineralogical elements within the paste or slip, I seek to understand potters’ choice in vessel manufacture. These choices are learned and variation could be due to a variety of factors including vessel function, restricted access to resources, or preferences in materials processing, among others. Conceiving of paste recipes as a series of choices is necessary for a nuanced understanding of information sharing at the intracommunity level (Cordell and Habicht-Mauche 2012; Howie 2012).

Attribute	Research Questions	Visibility Level	Learning Mode	Geographic Distribution
Paste Recipe				
Resource Acquisition	Where did potters procure raw materials (clay, temper, fuel, water)? How did potters share (or not share) information on resource acquisition?	Low	Process-Oriented	Restricted
Raw Materials Processing	Did potters process natural clay (e.g. levigation, sieving, rock removal, add temper)? How did potters share (or not share) information on processing?	Low	Process-Oriented	Restricted
Styles of Form				
Vessel Form	Does paste recipe correspond with overall vessel form (restricted orifice jar, unrestricted orifice jar, monochrome bowl/dish)?	High	Process-Oriented or Final Product	Restricted or Broad
Rim Form	Does paste recipe correspond with rim form?	High	Process-Oriented or Final Product	Restricted or Broad
Color	Does paste recipe correspond with vessel color on monochrome serving wares (black versus red)?	High	Process-Oriented or Final Product	Restricted or Broad

Table 1.1. The Ceramic Attributes and Research Questions Considered in this Study.

Resource Acquisition. While resource selection is certainly influenced by environment (e.g. cultural ecology), potters nearly always have a choice of which clays to use. An oft-cited and important contribution by Arnold (1985) is his assertion, based on ethnoarchaeological fieldwork among the Highland Maya, that potters rarely travel more than 7 kilometers for clays but will travel much further to procure slips and paints. Indeed, this seems to be a universal, with some variation in actual distances. Some communities share sources, some communities keep them a secret, and some exhibit internal variability. For archaeologists, raw materials sources should be close to the production locale. Gosselain (1998) suggests that clay location should not be viewed in strictly spatial and/or geologic terms. Rather, clay sources will be located within a potter's place of experience or "the territory within which potters and/or members of their communities live, carry out activities, and develop social interactions" (70). This idea has been developed more recently in terms of a potter's taskscape (Arnold 2018; Ingold 2000; Michelaki et al. 2012, 2015). For Maya household potters, these places of experiences or taskscape will be near their homes, particularly those where pottery production occurs. Potters may find clay sources in the course of performing other activities (e.g. digging for building material or while farming) but once a suitable clay source has been identified, the information is relayed to other potters through process-oriented learning.

Raw Materials Processing. Even if potters are sharing information about the location of raw materials, they may process them differently. In terms of clay processing, potters can do a variety of things to the clay to get desired performance characteristics, including crushing of clays, slaking the clay, adding temper, wedging, kneading,

levigating, and winnowing. Not all potters within a single community process their clays in the same way and these similarities tend to pattern at the micro or intracommunity level. For example, in southwest Niger, “clay processing recipes seem to be widely perceived and used as technical expressions of social and/or community identity” (Gosselain 2008a: 71) and these patterns often exist at a scale not normally addressed in archaeological studies. Similar intracommunity patterns exist among modern Maya potters (Deal 1998). Thus, a consideration of raw materials source and clay processing are necessary in the evaluation of paste recipe.

Styles of Form

Vessel form is often only considered in tandem with function (e.g. cooking and food preparation, storage, and serving). While this is certainly important, and clay selection and processing can and do vary based on desired performance characteristics for a given form (Schiffer and Skibo 1987), other aspects of form are relevant to this study. Ethnographic data suggest that potters (and consumers) often identify the products of a particular potter based on form. For example, in Tlaxcala, Mexico, Kempton (1981) found that when asked, people classify vessels based on their function, stress presence/absence of appendages, and focus on overall shape (the ratio of height to width) and neck position. These classifications varied based on the informants’ age, sex, occupation, and socioeconomic status. For example, males tend to classify vessels based on overall shape while women focused on handles. Reina and Hill (1978) found that both potters and consumers could identify regional production locales based on the form of tinaja, or water jar. Hayden and Cannon (1984) found that vessel form and rim form were the most useful attributes in determining patterns of intracommunity style in Chanal. A

potter can copy vessel form (final product learning) but these attributes are often the result of ingrained motor skills gained via process-oriented learning. These data, in tandem with other low-visibility attributes, will aid in our understanding of Lowland Maya vessel form and test the hypothesis that form is indicative of a community of practice.

Integrating Communities of Practice and Spatial Boundaries

Ethnographic evidence clearly shows that pottery production communities of practice do not always have discrete boundaries that are synonymous with other types of boundaries (e.g. kinship, ethnic, linguistic, religious, spatial; Gosselain 1998, 2008). However, vessel manufacture and decoration are not done alone, and “what is transmitted is rarely imputable to a single person but corresponds to shared norms of a particular group, be it a family, a local socioprofessional grouping, the potters of a whole district, or some other grouping” (Gosselain 2008: 160). The Maya region is an ideal place to explore these ideas because there is ample evidence, both ethnographic and archaeological, for strong residential units. These residential units maximize cooperation within the group, which “creates very discrete learning pools which have the greatest potential to produce stylistically different crafts” (Hayden and Cannon 1984: 351). In addition, there is considerable diversity among and between settlements in the Late Classic Maya lowlands. According to Robin (2003:318), “even between communities lying only a few km apart, the historical trajectory, and the social, political, and economic organization of commoner settlements can be quite different” (Robin 2003: 318). Thus, it is necessary to employ an approach capable of capturing this diversity. In order to eliminate issues that arise when assuming that craft production is learned only within

household-oriented kin groups (Longacre 1970; Hill 1970; Hayden and Cannon 1984), I emphasize proximity over relatedness. Similarities in low-visibility attributes, shared via process-oriented learning, are indicative of interpersonal interaction. By evaluating the extent and nature of shared ceramic traits, it is possible to identify interaction networks within a single Maya polity and/or region. I now turn to a discussion of the two regions used in this study.

Regional Background

Baking Pot in the Belize River Valley and Uxbenká in southern Belize reached their apogee during the Late Classic Period, though they had very different developmental histories. At their peak, both polities supported a population of approximately 3,000 to 5,000 individuals (Hoggarth 2012; Prufer et al. 2017). Both polities were comprised of monumental architecture surrounded by spatially perceptible residential units. However, the similarities between the two polities end with population size and spatial configuration. Baking Pot was established in the Middle Preclassic (700-400 BC) and was abandoned at the start of the Early Postclassic (AD 1000). It was subsequently reoccupied around AD 1250 (Hoggarth et al. 2014). Uxbenká was occupied for a much shorter time period beginning sometime around the Late Preclassic/Early Classic transition (c. AD 100) until the Late Classic Period (AD 800) (Prufer et al. 2017). Differences between the two polities extend to larger, regional political and economic relationships. Baking Pot is located in the densely populated Belize Valley where there is ample evidence of intraregional interaction between polities. Uxbenká, on the other hand, is located in sparsely populated southern Belize where interaction between polities was relatively minimal.

Baking Pot and the Belize River Valley

The Belize River Valley (Figure 1.2) is one of the most extensively studied regions in the Maya lowlands (Aimers 2002; Awe 1992; Awe et al. 2014; Awe et al. 2015; Bullard 1960; Chase and Garber 2004; Ebert 2017; Fedick 1988; Garber 2004; Hoggarth 2012; Horn 2015; LeCount 1996; Peuramaki-Brown 2012; Willey et al. 1965; Yaeger 2000a). Archaeologists divide the Belize River Valley into two subregions. Upper Belize Valley sites are located in “the upland area characterized by hills and steep slopes above (west of) the convergence of the Macal and Mopan Rivers in western Belize,” while central Belize Valley polities are located in an area that “consists primarily of broad alluvial flatlands and bordering hills that occur along the western sector of the Belize River from the juncture of the Macal and Mopan to an area south of the modern capital of Belmopan, where the river begins its descent into the low-lying marshy swamps and savanna that stretch another 30 km to the Caribbean Sea” (Chase and Garber 2004: 1-3). More recent archaeological work in the eastern Belize River Valley, from Belmopan to the Caribbean Sea, indicates that settlement is clustered near the Belize River and extends from the Preclassic to Colonial Period (Harrison-Buck et al. 2013). Baking Pot is located on the southern bank of the Belize River on alluvial flatlands in the Upper Belize Valley.

Helmke and Awe (2012) consider the Belize River Valley a subregion of the Maya lowlands and note that it is bordered by the much larger sites of Caracol, Naranjo, and Lamanai to the south, west and north. The major sites in the central Belize Valley are Baking Pot, Blackman Eddy, and Lower Dover. Many polities, including Baking Pot, are

located close to the Belize River due to the economic importance of this major transportation route from the Caribbean Sea.

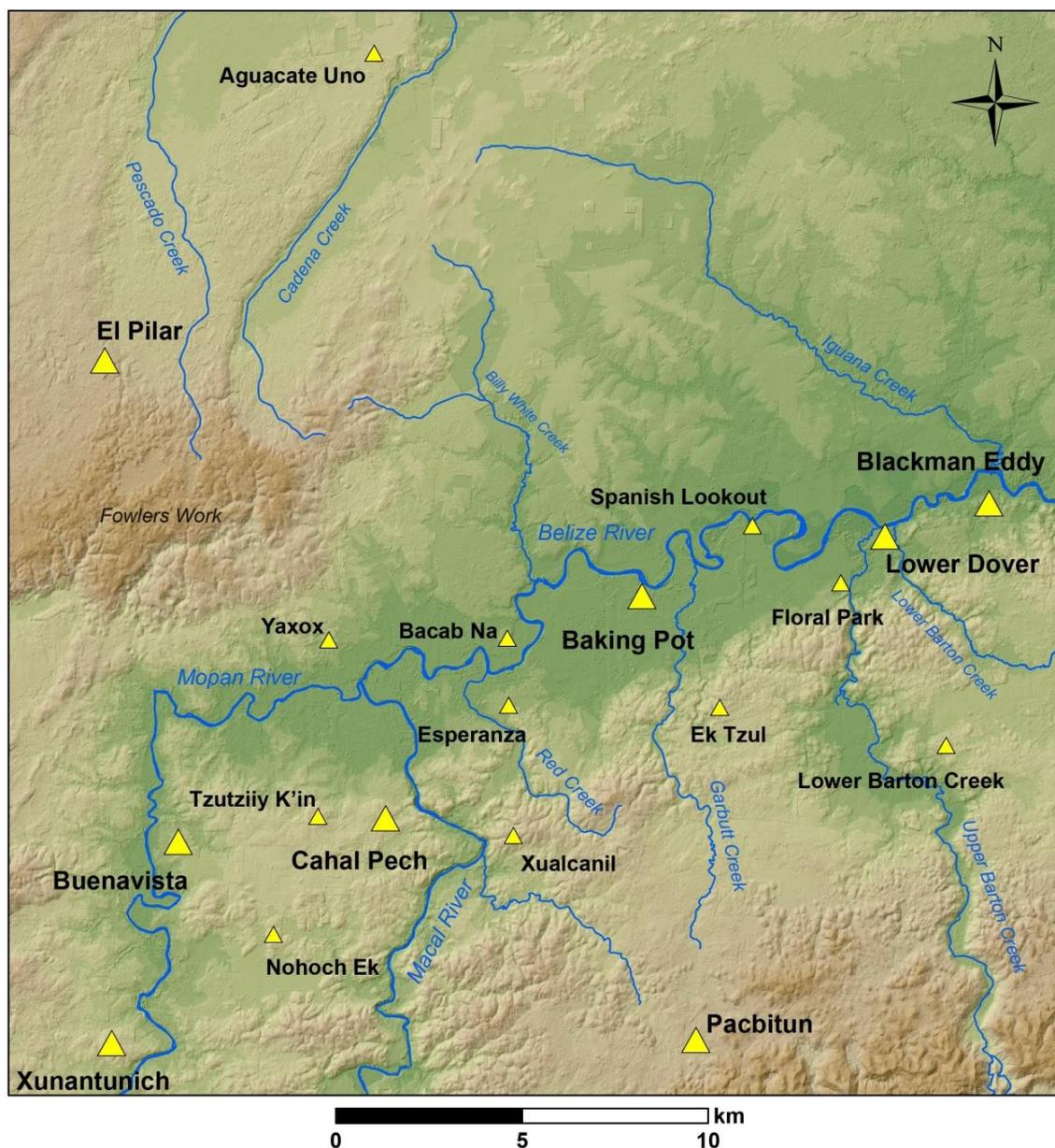


Figure 1.2. Archaeological Sites in the Upper Belize River Valley. The large yellow triangles denote major centers and the small yellow triangles denote minor centers (Map by C. Ebert; Helmke et al. 2016).

By the Late Classic Period, settlement density in the Belize Valley was at its peak and the landscape began to infill “with a clear focus on prime well-drained uplands, regardless of proximity to either centres or the Belize River” (Fedick and Ford 1990: 26). The major centers of the Belize Valley “exhibit (to varying degrees): 1). Nucleated monumental epicentre, 2) pyramidal temple structures, 3) eastern triadic temples (such as E-group-like configurations), 4) royal palatial groups, 5) ballcourts, 6) monuments such as stelae and altars (some of which were carved), 7) intrasite processional *sacbeob* (causeways), or ‘vias’, 8) *sacbe* termini groups, and 9) in some cases royal tombs” (Helmke and Awe 2012: 62-64).

Decades of research demonstrate the dynamism of settlement in the region. Early polities such as Baking Pot continued to thrive into the Late Classic Period (Hoggarth 2012; Hoggarth et al. 2014), Xunantunich experienced a florescence (LeCount et al. 2002), and Lower Dover was established (Guerra and Awe 2017). Taschek and Ball (2004: 204) consider the three major polities of the upper Belize Valley (Buena Vista del Cayo, Cahal Pech and Xunantunich) to be “components of a single, dynamic, functional system having readily identifiable and sensible social, political, ideological, and ceremonial roles and relationships”. Most researchers, however, consider the Belize Valley polities as independent entities with influence and power shifting between them over time. Driver and Garber (2004) note that the major centers of Xunantunich, Cahal Pech, Baking Pot, Blackman Eddy, and Camalote are located 9.9 kilometers from one another. Minor centers are located midway between major centers and were occupied “by rural families expressing agricultural success through precocious rural architecture” (Driver and Garber 2004:303). This model has been criticized for its static approach to

understanding political organization (Helmke and Awe 2012). When temporal data are included for polities in the Mopan-Macal Triangle for example, Actuncan, Buenavista del Cayo, and Xunantunich peaked at different times, Early Classic, Middle and Late Classic, and Terminal Classic, respectively (Helmke and Awe 2012). More recent data indicate that Actuncan had a significant Late Preclassic occupation (Mixer 2017:273). In contrast, Cahal Pech's development begins at the end of the Early Preclassic, and continues into the Late Classic period (Awe 1992).

Baking Pot consists of two groups of monumental architecture connected by a *sacbe* (Figure 1.3). The Belize Valley Archaeological Reconnaissance Project (BVAR) has conducted work at Baking Pot since 1992. Modern farming has disturbed or destroyed archaeological remains in the Baking Pot hinterland but the extensive land clearing made possible nearly 100 percent survey coverage (Ebert et al. 2016b). Conlon (1993, 1994) and Conlon and Ehret (2000, 2001) surveyed the central and eastern portion of the Baking Pot hinterland and Hoggarth and colleagues (2008) and Jobbova (2009) completed a survey of 9 km² around the site core. The most recent survey focused on the ditch system around the Bedran Group (Ebert et al. 2016b). According to Hoggarth (2012: 54),

“the settlement area at Baking Pot is comprised of 554 mounds arranged into 416 house groups spread over 9 km². Using the total numbers of house mounds, maximum population is estimated at approximately 3,047 people at the apogee of the Baking Pot polity in the Late to Terminal Classic periods. This estimate is based on a ratio of 5.5 individuals per mound but does not include the residential areas associated with the palace complex in Group B.”

This population estimate, however, needs to be reassessed given recently acquired lidar data for the Belize Valley. In spite of the latter, archaeological research indicates that occupation of Baking Pot began in the Middle Preclassic (Jenney Creek phase) and extended into the start of the Early Postclassic (New Town phase), albeit with a much smaller population (Hoggarth et al. 2014). Stylistic analysis of pottery suggests continuity in occupation from the Late Classic to the Postclassic (Aimers 2002; Willey et al. 1965) while direct AMS ^{14}C dating of burials from Baking Pot documents a hiatus in activity at that site during the Early Postclassic (cal AD 900–1200) with subsequent reoccupation in the Late Postclassic (cal AD 1280–1420; Hoggarth et al. 2014).

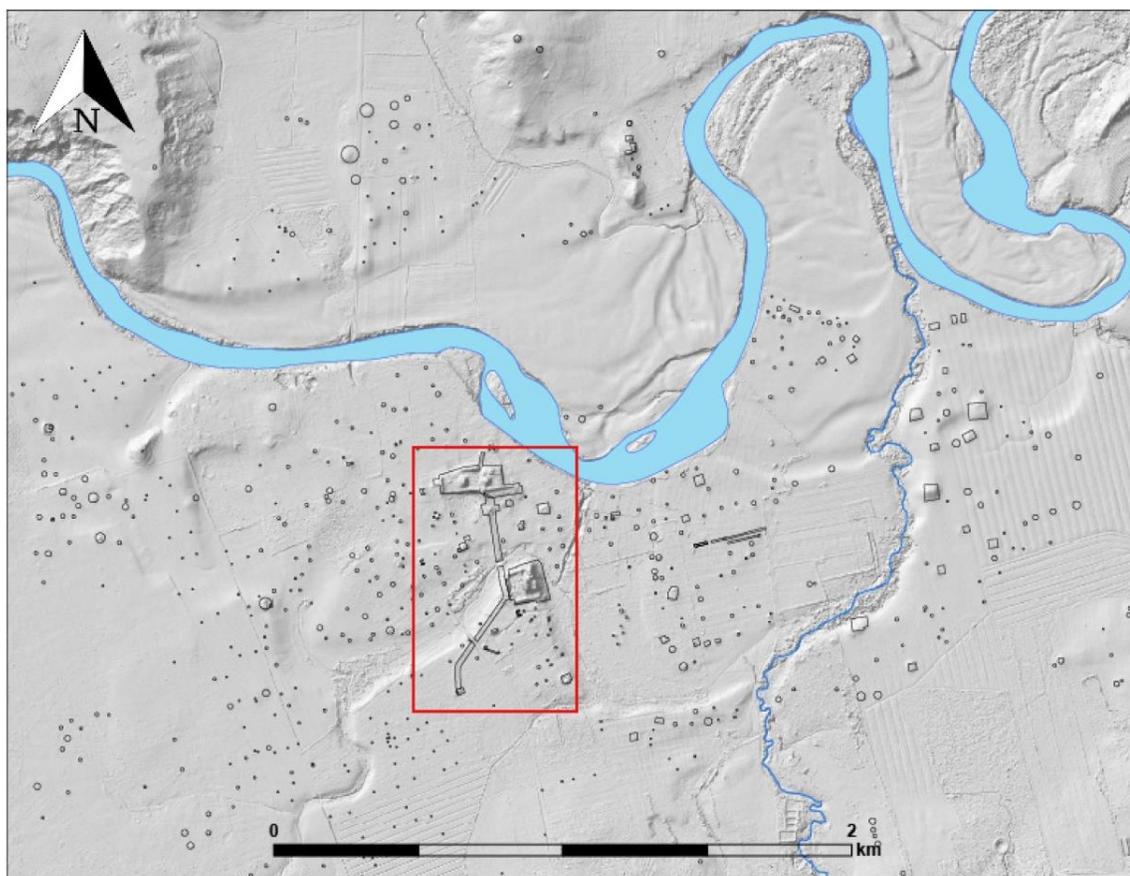


Figure 1.3 Map of Baking Pot with the Site Core Outlined in Red. (Map by C. Ebert)

Uxbenká and Southern Belize

Uxbenká is located in the Toledo District of Belize near the modern Mopan Maya village of Santa Cruz. It is one of five major inland centers located among the foothills of the Maya Mountains in the Toledo District. The four other major centers in the region, Pusilha, Xnaheb, Lubaantun, and Nim Li Punit, are located along a corridor running southwest to northeast in an area of highly fertile agricultural lands (Figure 1.4). Southern Belize has received less archaeological attention than other regions of the Maya lowlands (Leventhal 1990, 1992; Prufer et al. 2011). The “Southern Belize Region”, originally defined by Leventhal (1992), is roughly synonymous with the southern Toledo District and includes the Maya Mountain polities and those in the southeastern Petén (Dunham et al. 1989; Dunham and Prufer 1998; Prager et al. 2016; Prufer et al. 2011). The major sites in the region share many characteristics: the general lack of vaulted architecture and limited masonry superstructures, the use of natural topography in construction (modified hills), ballcourts enclosed by walls, an elite focus on carved monuments, and inconsistent lunar series content on carved monuments (Wanyerka 2009). Though these similarities are not contested, it is unlikely that southern Belize centers were not monolithic in nature. Rather, more current evidence, based primarily on epigraphic data, suggests that these were independent centers (Braswell and Prufer 2009), with different chronologies for core and settlement zones (Prufer et al. 2017). What is known about the archaeology of the region comes primarily from research at Pusilha, Uxbenká, Lubaantun, and Nim Li Punit, and sites in the Maya Mountains (Dunham and Prufer 1998; Prufer 2002). Work has also been conducted at Kaq’ru’ Ha’ (Novotny 2015), Xnaheb (Dunham 1990; Jamison 2001), and Ix Kuku’il (Thompson and Prufer 2016; Thompson et al. 2018).

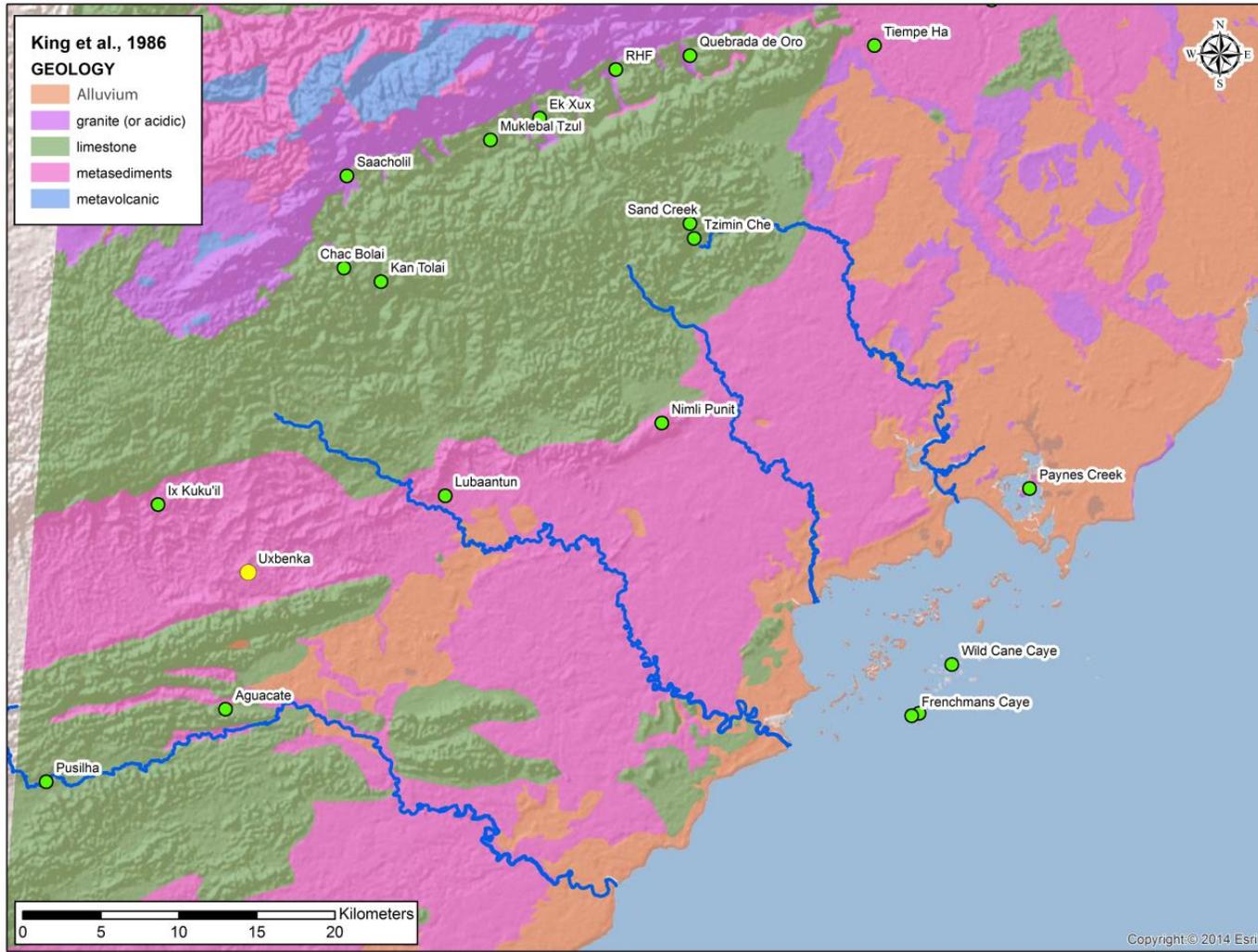


Figure 1.4. Archaeological Sites in Southern Belize. (Map by A.E. Thompson)

McKillop (1996, 2002) has conducted extensive work on coastal sites in the Toledo District. All of the major Maya centers in southern Belize flourished and reached their apogee during the Late Classic Period (AD 600-800). Epigraphic and artifactual evidence indicate that the polities were largely independent, both politically and economically (see Fauvelle 2012). They had ties to other regions of the Maya lowlands as evidenced by the presence of obsidian, jade/jadeite, marine resources, groundstone objects, and imported ceramics. None of the monuments make reference to other polities in the region and the idiosyncratic writing indicates regional insularity (Prager et al. 2014; Wanyerka 2009). The recent discovery of the “Wind Jewel Pectoral” in a tomb at Nim Li Punit indicates interaction with polities to the north in Belize (Cahal Pech or Caracol) or the eastern Petén (El Peru) based on hieroglyphic inscriptions (Braswell 2017; Prager and Braswell 2016). Prior to this discovery, the only evidence of interaction with the Belize Valley was the presence of imported Belize Red ceramic vessels (Braswell 2017; Hammond et al. 1976; Jordan and Prufer 2014).

The Uxbenká site core is comprised of nine groups of monumental architecture located atop modified hilltops (Figure 1.5). 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. 2017). 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. A settlement group (SG) is “defined as one or more architectural components confined to a single, isolated landform” (Kalosky and Ebert 2009:39; Kalosky and Prufer 2012). These

structures are dispersed over approximately 30 km² and extend as far as 3 km from the site core (Prufer et al. 2015). 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.

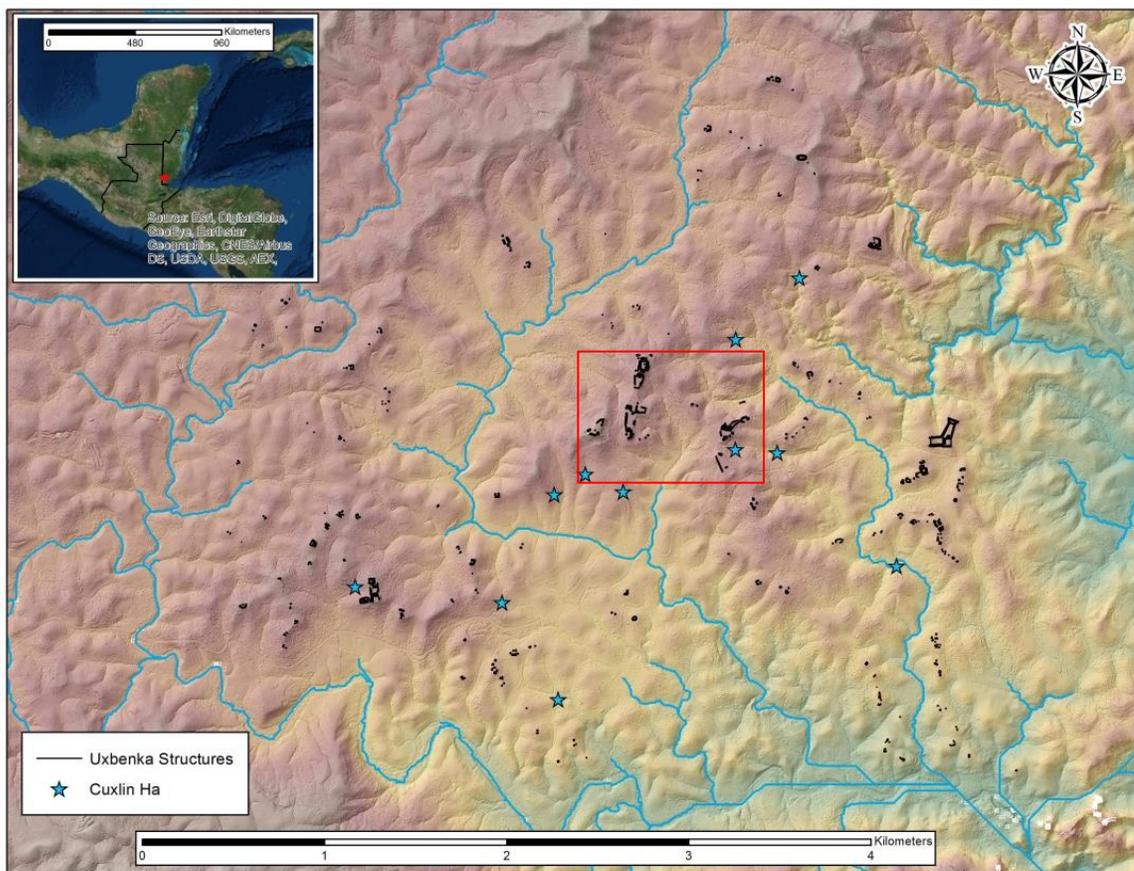


Figure 1.5. Map of Uxbenká with the Site Core Outlined in Red. (Map by A. E. Thompson)

The Late Classic population estimate for Uxbenká is 3,427 based on an estimate of 5.5 persons per household. Using Nearest Neighbor Analysis (NNA) and Kernel Density analyses, Thompson and Pruffer (2014; Pruffer et al. 2017) determined that the Uxbenká hinterland is divided into 15 neighborhoods and 3 districts. District centers were

identified “based on these criteria: (a) all contain larger than usual residential architecture and date to early phases in the history of the polity; and (b) all also have highly elaborated tombs in multiple structures, suggestive of strong descent group ties to their neighborhood” (Prufer et al. 2017: 59). Prufer et al. (2017) note that as the hinterland expanded in the Late Classic away from the trade route, households located on the outskirts of the settlement area were smaller and had less access to exotic trade goods and less elaborate burials.

Sample Selection and Methodological Approach

This study was conducted using previously excavated ceramic material from household contexts excavated as part of large, multidisciplinary projects. The Baking Pot ceramic assemblage was recovered from extensive horizontal excavations in a single settlement cluster as part of Hoggarth’s (2012) dissertation research with the Belize Valley Archaeological Reconnaissance Project (BVAR) to understand how households adapted to the Lowland Maya collapse. The Uxbenká ceramic assemblage was recovered from smaller excavations at households located across the polity as part of the Uxbenká Archaeological Project (UAP) to understand the growth and decline of the polity through a lens of Human Behavioral Ecology (Prufer et al. 2017). The Baking Pot ceramic assemblage in this study was recovered from nine structures (M90 and M91; M109, M110, and M111; M100 and M101; M181; M184) in five household groups in a single settlement cluster (i.e. neighborhood) (Figure 1.6).

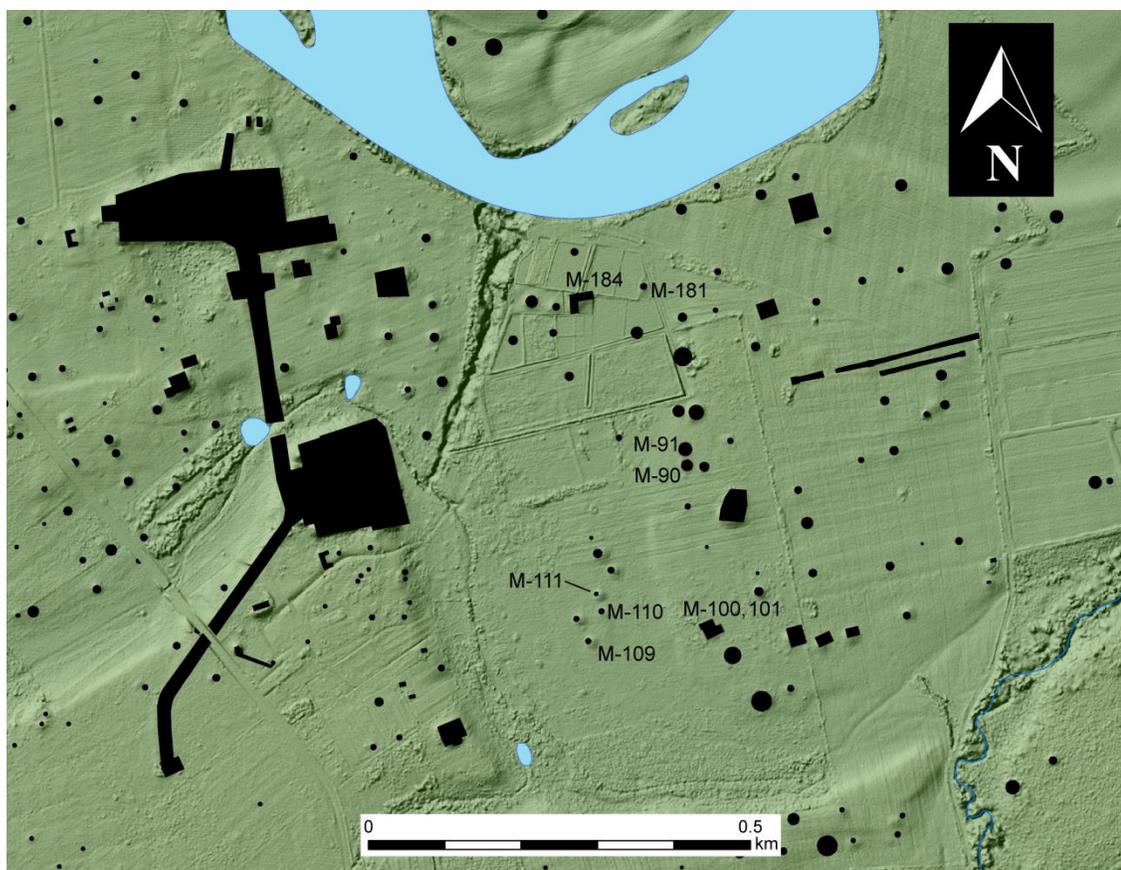


Figure 1.6. Map Showing Sampled Housemounds from Baking Pot. (Map by C.E. Ebert)

The Uxbenká assemblage was recovered from four households (SG36, SG38, SG52, and SG54) located in three different spatially defined neighborhoods (Figure 1.7). In addition, pottery production households were identified at Uxbenká (discussed in Chapter 2). It was not possible to address intrapolity interaction at Baking Pot because no pottery production households were identified and the entire sample was recovered from a single neighborhood.

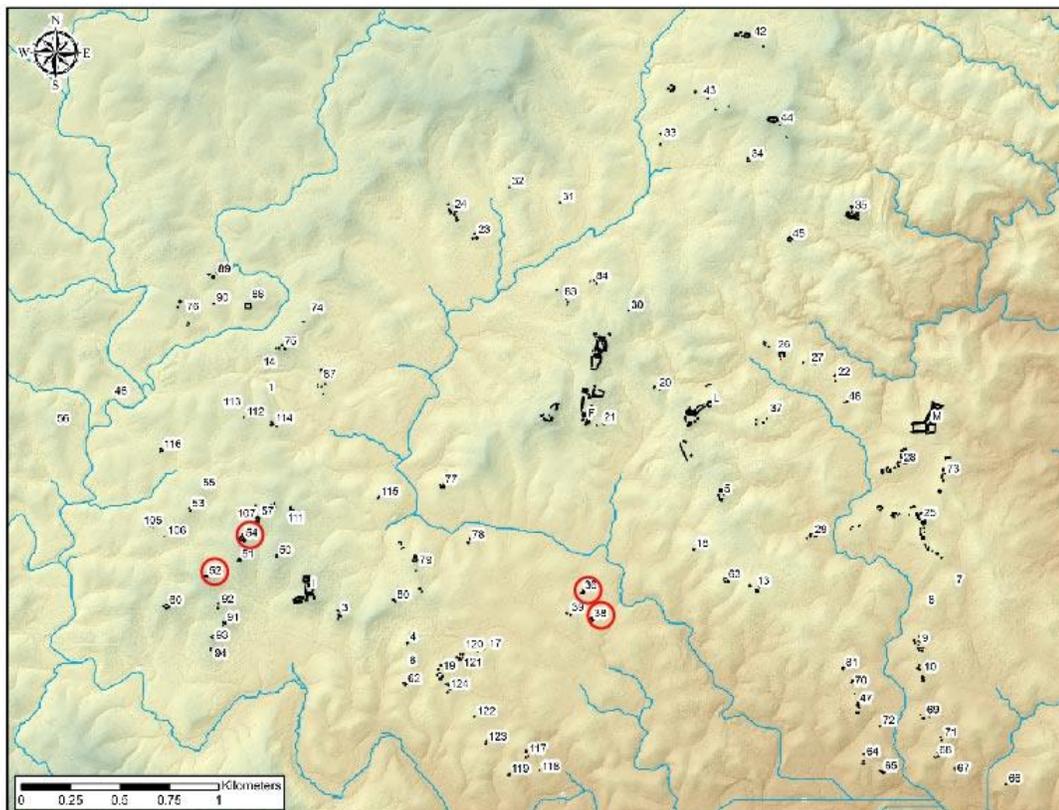


Figure 1.7. Map Showing Sampled Housemounds from Uxbenká. (Map by A.E. Thompson)

The ceramic sample from each site was recovered from similar household contexts and analyses focused primarily on utilitarian pottery. Both ceramic assemblages were sampled from mounds that were part of larger household groups (settlement group at Uxbenká); however, two of the households at Baking Pot are composed of only a single mound (M181, M184). The ceramic assemblages were recovered primarily from construction fill contexts. The petrographic sample from both Uxbenká and Baking Pot accounts for nearly 2 percent (1.8 percent for Uxbenká and 1.9 percent from Baking Pot) of the total Late to Terminal Classic ceramic sample which includes both diagnostic and non-diagnostic ceramics recovered from sample mounds (see Table 1.2 and Table 1.3).

	# Mounds	Status	Total Sherds	Total Diagnostics	Petrographic Sample	Percent Total	Percent Diagnostics
M90	2	High	3343		36	1.1	
M110	4	High	1081		29	2.7	
M100	2	Low	835		55	6.6	
M181	1	Low	972		7	0.7	
M184	1	Low	1051		17	1.76	
TOTAL			7282		144	1.9	

Table 1.2. The Baking Pot Petrographic Sample from Household Contexts.

	# Mounds	Status	Total Sherds	Total Diagnostics	Petrographic Sample	Percent Total	Percent Diagnostics
SG 36	4	Moderate	985	134	8	0.8	6
SG 38	2	Low	1712	269	22	1.2	8
SG 52	3	Moderate	447	116	20	4.5	45
SG 54	2	Low	821	269	20	2.4	7
TOTAL			3965	788	70	1.8	8.9

Table 1.3. The Uxbenká Petrographic Sample from Household Contexts.

The petrographic sample from Uxbenká accounts for between 6 percent (SG 36) and 45 percent (SG 52) of the Late to Terminal Classic diagnostic pottery. Unfortunately, the total count of diagnostic ceramics sampled from Baking Pot was lost to a corrupted hard drive. Additional information on the petrographic sample, including form and ceramic type designations, from Uxbenká is discussed in Chapter 3 and from Baking Pot is discussed in Chapter 4.

Petrographic analyses followed the descriptive system developed by Whitbread (1989) and discussed in more detail in Chapter 3 and Chapter 4 with reference to the

Uxbenká and Baking Pot sample, respectively. Interpretation of the petrographic data focused primarily on understanding the paste recipe (see Table 1.1). By conducting identical analyses on a similar ceramic assemblage excavated from coeval Late Classic households, it is possible to compare information sharing in the two regions. In addition, geologic samples (clay and rock) from both Uxbenká (Chapter 3) and Baking Pot (Chapter 4) were analyzed according to the descriptive system. The full petrographic descriptions of ceramic samples are presented in Appendix D (Baking Pot) and Appendix E (Uxbenká). Descriptions of the geological samples from both study areas are presented in Appendix C. The Uxbenká petrographic sample also includes whole and partially reconstructed vessels recovered from burials and caches in the site core (n=26). These samples were analyzed in full and the descriptions are presented in Appendix E; however, they are not fully discussed in this dissertation because they are beyond the scope of the project.

Organization of the Dissertation

This is a hybrid dissertation in which different aspects of pottery production and practice are addressed as three previously published or unpublished co-authored papers. Chapter 2, Chapter 3, and Chapter 4 address the first primary research question: *Do communities of practice correspond to the spatial zones (neighborhood, district, and/or polity) commonly identified using spatial analyses?*

Chapter 2 addresses pottery production at Uxbenká using macroscopic observations and microscopic analyses of ceramic and stone tools. 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. I 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 Uxbenká, Belize, during the Late Classic Period (A.D. 600–800). The analyses indicate that Uxbenká 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. I argue that this self-sufficiency is due to widely available resources, smaller population sizes, and the availability of high quality agricultural lands. Potters living in households in three distinct neighborhoods used a similar repertoire of tools indicative of shared practice across spatial boundaries. This paper is a co-authored work with Keith M. Prufer and is published in *Latin American Antiquity* (Jordan and Prufer 2017). The analyses for this chapter were conducted under the auspices of the Uxbenká Archaeological Project (UAP) directed by Dr. Keith Prufer. I completed all of the analysis and wrote the paper.

Chapter 3 presents an approach for evaluating intrapolity interaction in low-density, agrarian-based urban environments by analyzing locally produced pottery within a communities of practice theoretical framework. This type of urbanism, common in tropical environments, is characterized by low population densities and dispersed households surrounding a core of monumental architecture. The spatial layout consists of

architectural clusters, commonly identified as neighborhoods and districts, which are used to infer social organization among the non-elite populations living in dispersed households. While proximity surely influences interaction, I aim to understand how interaction networks extend beyond, or cross-cut, these spatial boundaries. This paper uses Uxbenká as a case study and builds on previous research at the site including information about the development and decline of polity (Prufer et al. 2017), the identification of pottery production households (Chapter 2; Jordan and Prufer 2017), and geospatial evaluation of neighborhoods and districts (Thompson et al. 2018) to evaluate the relationship between information exchange networks among non-elite potters and spatial units. Pottery samples recovered from household and site core contexts ($n=97$) and geologic samples ($n=12$) were analyzed using thin section petrography to determine how potters shared information about resource acquisition and raw materials processing (e.g. the paste recipe; Joyce 2012) across spatial boundaries. The data support the macroscopic finding reported in Chapter 2 and indicate that nearly all potters, regardless of neighborhood or district, produced unslipped jars and monochrome red serving vessels in the same way. Information about where to procure raw materials and how to process them was shared widely and information exchange occurred between households located in different neighborhoods and districts. This paper is a co-authored manuscript with Keith M. Prufer and Amy E. Thompson and will be submitted to *Journal of Archaeological Method and Theory*. The analyses for this chapter were conducted under the auspices of the Uxbenká Archaeological Project (UAP) directed by Dr. Keith Prufer. I completed all of the ceramic analyses and wrote the paper.

Chapter 4 addresses communities and constellations of practice in the Belize River Valley by considering resource acquisition, raw materials processing, and attributes of form on 144 rims of unslipped jars and monochrome bowls and dishes recovered from five households in the Baking Pot periphery. Petrographic analysis was employed to evaluate resource acquisition and raw materials processing to determine how potters interacted with their local landscape and how they shared information on clay and rock sources. Data derived from ceramic analyses are compared to clay samples collected for this study and the geologic literature. A total of thirty-two fabric groups were identified in the Baking Pot sample: six locally produced fabrics, twenty-two possibly locally produced fabrics, and six fabrics produced outside of the Belize River Valley. Vessels of possibly local and non-local provenance are briefly discussed but the majority of this chapter focuses on locally-produced pottery, which comprises 74.3 percent of the total petrographic sample. Vessel form and color are also evaluated on vessels of local provenance. By evaluating the extent and nature of shared ceramic traits, it is possible to identify interaction networks among potters in the Belize River Valley.

The data indicate that most potters conceived of and engaged with the landscape in a similar fashion and created technologically and morphologically similar ceramic vessels. However, while shared technological traditions certainly suggests some form of information exchange among potters, there is enough variability in paste recipe to argue against a single community of practice. I argue that potters were part of a constellation of practice. The shared historical roots, related enterprise, and geographical proximity are certainly enough to link communities of practice to form a constellation of practice in the BRV. They are linked by daily practice through a shared taskscape in which habitation,

farming, and resource acquisition occurred in the same location. This paper is a co-authored manuscript with Jaime J. Awe and Julie A. Hoggarth to be submitted to *Journal of Anthropological Archaeology*. The analyses for this chapter were conducted under the auspices of the Belize Valley Archaeological Reconnaissance Project (BVAR) directed by Dr. Jaime Awe and Dr. Julie Hoggarth. The sample was excavated as part of Dr. Hoggarth's dissertation research (2012). I completed all of the analysis and wrote the paper; Dr. Hoggarth assisted in the geologic survey.

Chapter 5 summarizes and synthesizes the data from Uxbenká and Baking Pot presented in the previous three chapters in order to address the second research questions: Does location affect patterns of information sharing? The data is then used to compare different scales of interaction among potters and how these social networks crosscut boundaries. The larger goal of this study is to compare interaction networks in two discrete regions of the Maya lowlands in order to assess the effects of historical trajectory and social environment on practice in the Maya lowlands. The data indicate that interaction networks among potters operate at different scales in southern Belize versus the Belize River Valley in west-central Belize likely related to different historical trajectories. The results demonstrate that while residential proximity surely influences interaction, social relations extend beyond conventionally cited spatial boundaries like the neighborhood or polity so equating proximity with interaction simplifies the complex lives of the non-elite Maya. Potters from Uxbenká and Baking Pot did not share information in the same way by virtue of being Maya. Rather, their unique historical trajectories and the sociopolitical milieu in which they operated resulted in different

interaction networks. The chapter concludes with a discussion of avenues of future research that build upon the research presented in this dissertation.

CHAPTER 2

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

Understanding the production of utilitarian vessels is critical to our interpretation of ancient Maya economies and can aid in evaluating non-elite, 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 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 Uxbenká 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 Uxbenká 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. 2000a; Rice 2009). Direct evidence for 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. 2000a; 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 clay, 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 Uxbenká, 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).

Uxbenká and Southern Belize

Uxbenká 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. Uxbenká, 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 radiocarbon dates (Culleton et al. 2012:1583–1585; Prufer et al. 2011:205–214) and ceramic cross-ties (Jordan 2014; Jordan and Prufer 2014; Prufer et al. 2017) indicate that Uxbenká 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, the Guatemala Highlands, and the Belize Valley (Dunham et al. 1989; Hammond 1975; McKillop 2009; Prufer et al. 2011).

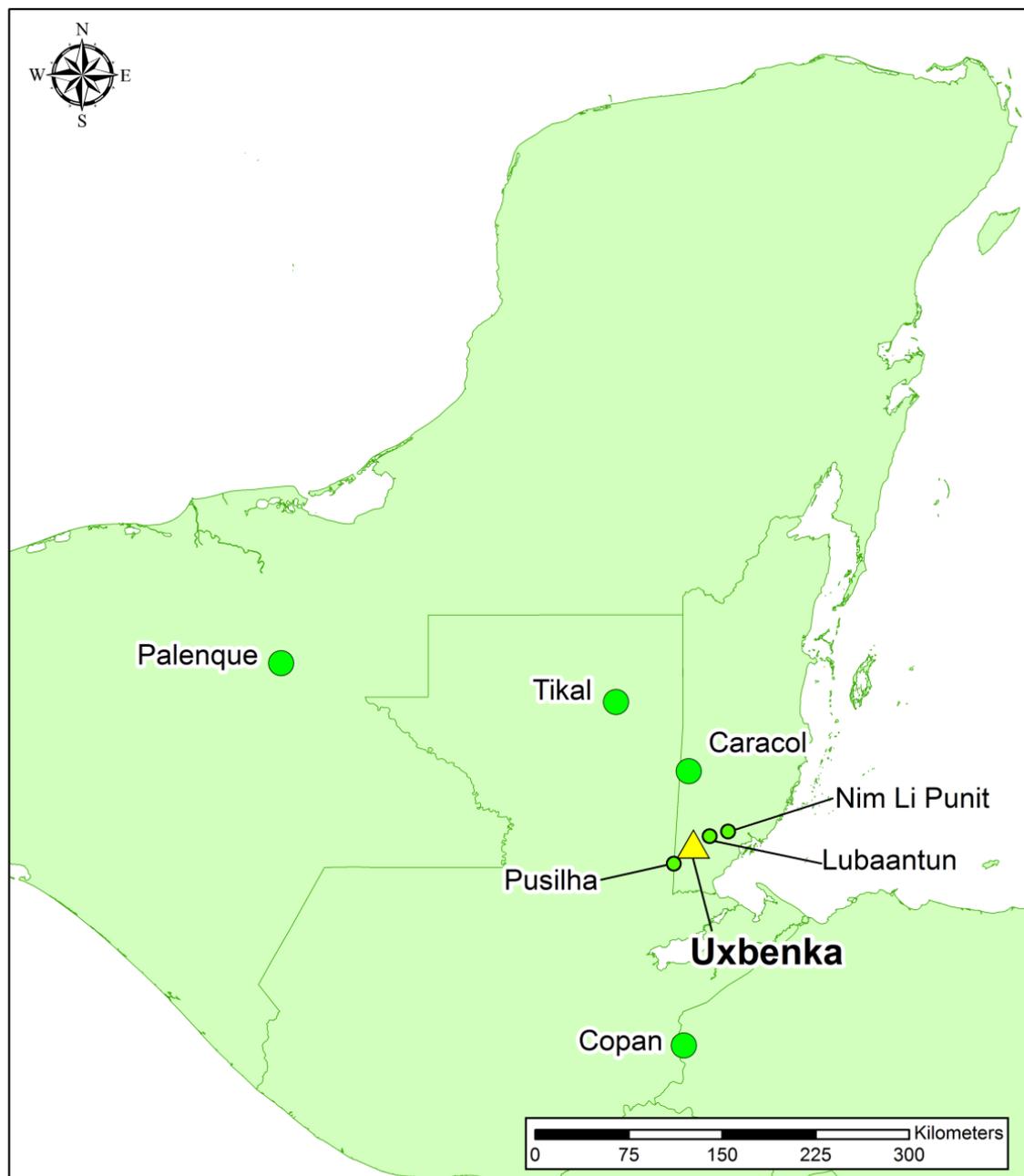


Figure 2.1. The location of Uxbenká. (Map by A. E. Thompson)

The Uxbenká Archaeological Project (UAP) began survey and excavation at Uxbenká in 2005. Excavation strategies focused primarily on building an absolute chronology to understand the founding and demise of the Uxbenká 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 are dispersed over approximately 30 km² and extend as far as 3 km from the site core (Prufer et al. 2015). Like many other Lowland Maya centers, the Uxbenká 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).

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				•	•

Table 2.1. Evidence for Ceramic Production at Uxbenká, by Settlement Group.

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.

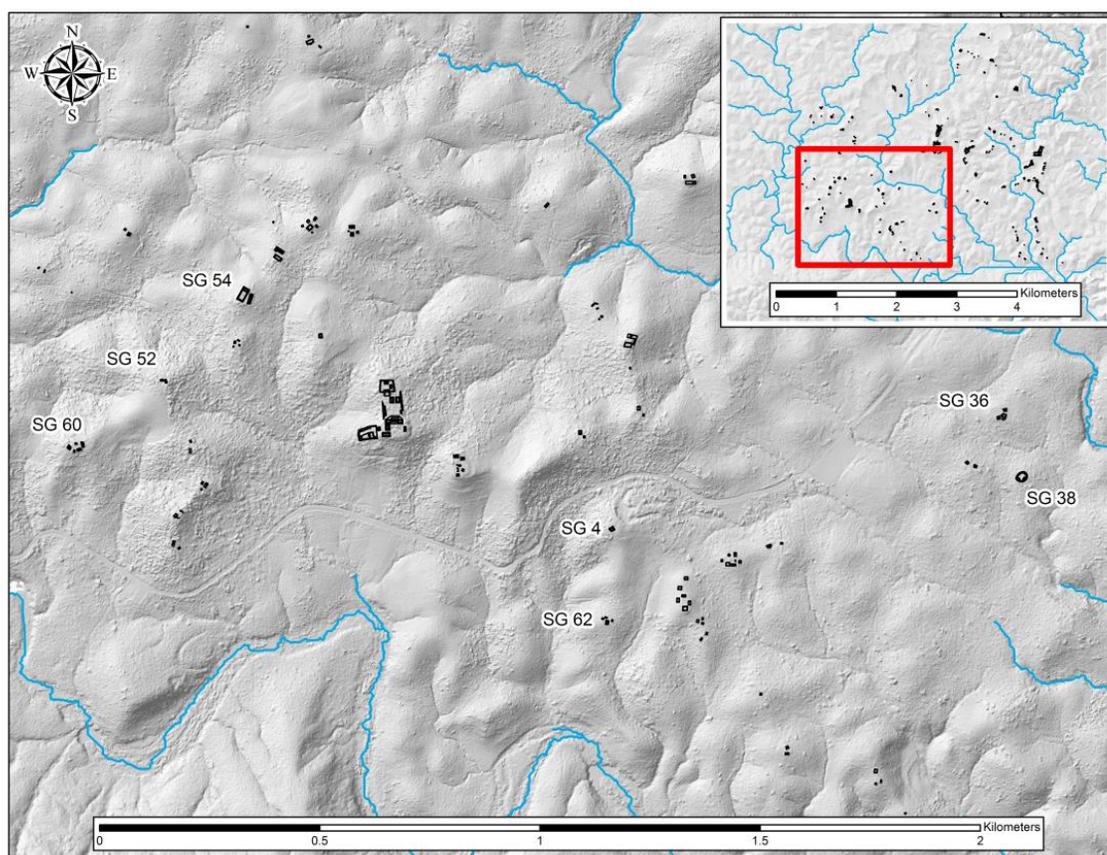


Figure 2.2. Uxbenká site core and location of SGs with evidence of ceramic production. (Map by A. E. Thompson)

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 are low to moderate status households (Types 1–3). Similar to settlement typologies at other Maya sites (Ashmore 1981), the settlement type designation at Uxbenká 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 Uxbenká represent domestic residences of single family units of varying sizes (Figure 3).

Lack of Firing Features at Uxbenká

We did not locate any primary firing features associated with the firing process. This is no surprise. At Uxbenká, as elsewhere in the Maya Lowlands, potters likely used the open firing method. Results from a refiring experiment show that locally produced Uxbenká ceramics were fired at a temperature of between 700 and 800°C, consistent with open firing (Rice 1987:156). Because Uxbenká 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 Uxbenká, potters probably fired clay vessels at low points on the landscape, away from 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 Uxbenká.

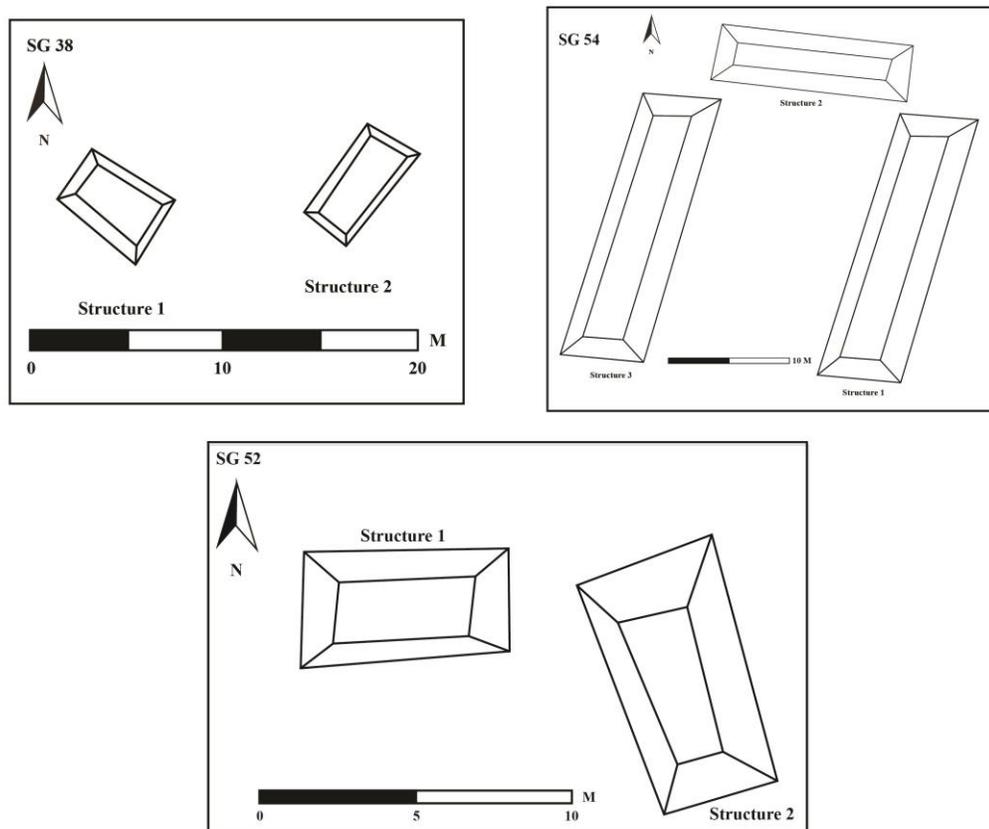


Figure 2.3. Plan view of SG 38, SG 52, and SG 54.

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 Uxbenká 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 Uxbenká.

Ceramic Tools

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

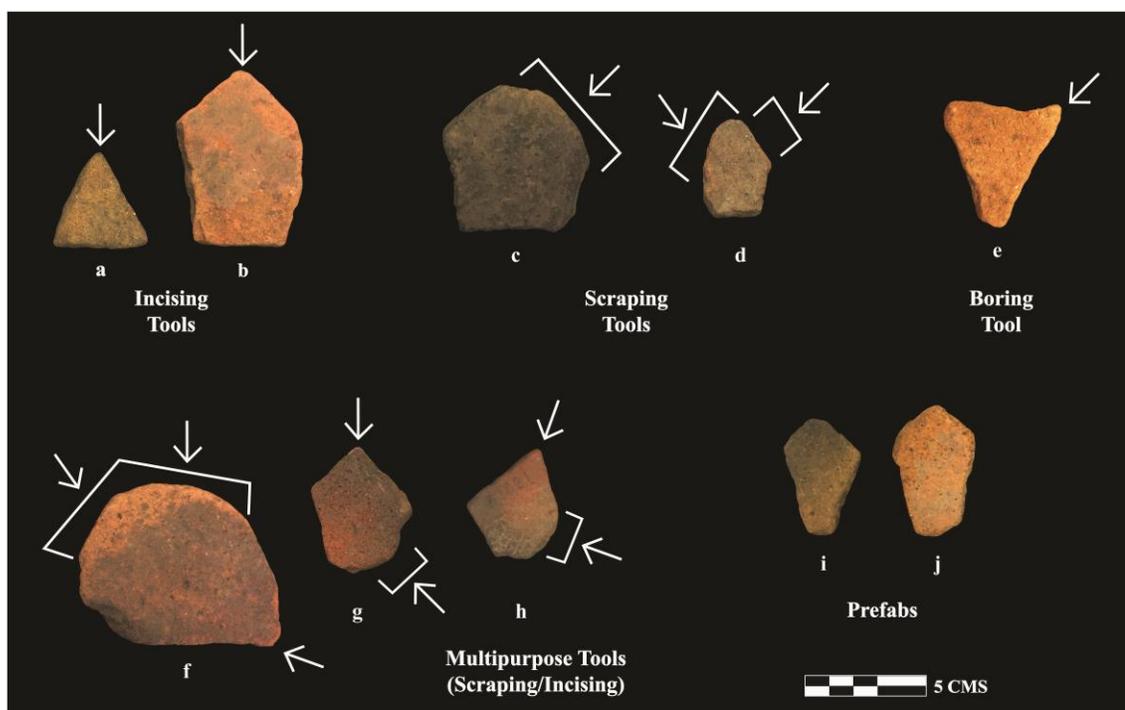


Figure 2.4. Selected ceramic production tools from SG 36, SG 52, and SG 54. (a:T2, b:T4, c:T6, d:T36, e:T21, f:T13,g:T32, h:T33, i:T8, j:T15).

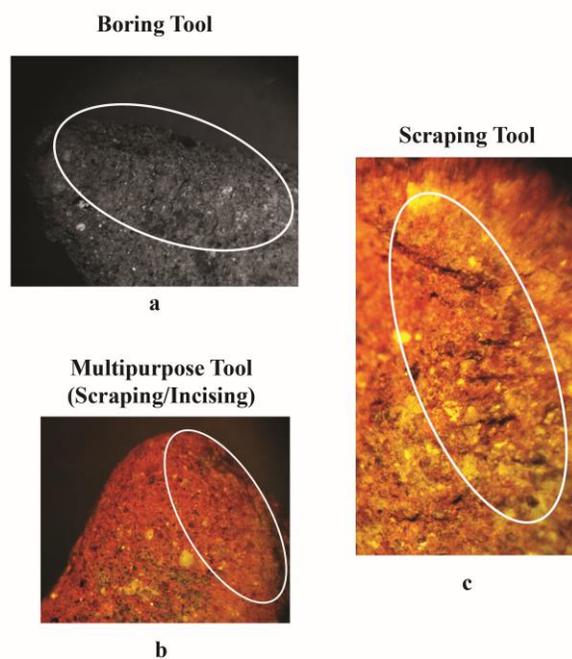


Figure 2.5. Microwear on select ceramic tools (a:T21, b:T33, c:T36.).

Tool #	SG	Context	Geometric Shape	Ceramic Group	Use Wear		Use Wear		Edge		Tip		Inferred Activity (s)
					(Concave)	Int.	(Convex)	Int.	Wear	Int.	Wear	Int.	
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		N				R/S		Incising
T3	38	Fill	Pentagon	Remate	N		S/Multi	M	N		N		Polishing
T4	38	Feature 1	Rounded/Triangle	Remate	N		N		U		R		Incising
T5	38	Fill	Triangle	Turneffe	N		N				R	M	Incising
T6	38	Feature 1	Rounded/Triangle	Turneffe	N		S/Uni	L	S	H	N		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		N		R/S	M	Boring
T15	38	Feature 1	Pentagon	Remate	N		N		N		N		None
T16	38	Feature 1	Triangle	Remate	N		N		N		R/S	H	Incising
T17	38	Fill	Pentagon	Turneffe	N		N		U		N		None
T18	38	Feature 1	Triangle	Turneffe	N		N		N		R/S	H	Incising
T19	38	Feature 1	Triangle	Turneffe	N		N		N		N		None
T20	38	Feature 1	Triangle	Turneffe	N		N		N		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
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		N		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 2.2. Use-Wear and Inferred Activities for Ceramic Production Tools.

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 6). Hammond (1975:363) notes the presence of pot polishers at Lubaantun. Unlike those from Uxbenká, the manuported pebbles from Lubaantun are primarily sandstones and siltstones. The pebbles at Uxbenká 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 Uxbenká 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 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).

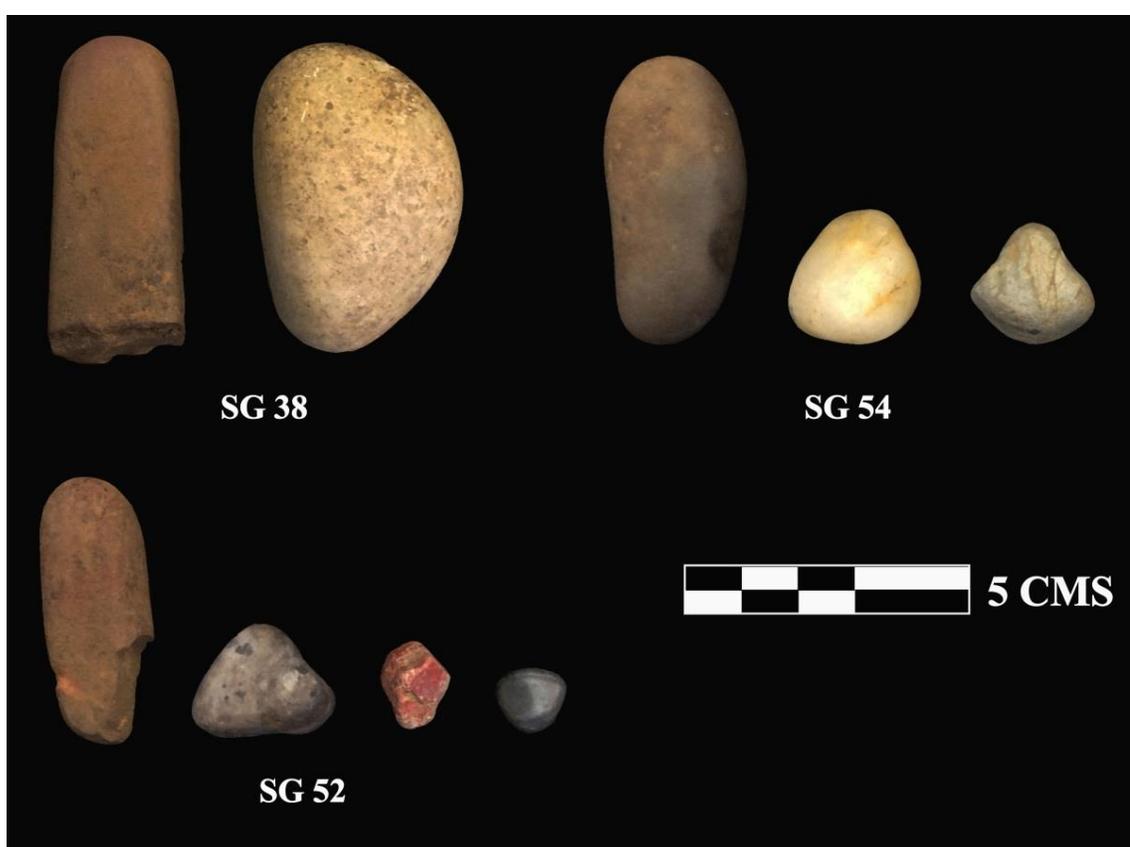


Figure 2.6. Waterworn pebble tools from SG36, SG 52, and SG54. (a:L2, b:L3, c:L5, d:L19, e:L10, f: L11, g:L12, h:L13, i:L20).

The Finished Products

In the absence of primary production locations, archaeologists have used the abundance and distribution of ceramic vessel forms to identify 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 Uxbenká 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 2015:261-264). 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 SG 38, 52, and 54.

For each settlement group, diagnostic ceramics were classified according to primary vessel form: serving vessels (bowl/dish), jars, unknown/other (e.g., appendage) based on the classification of vessel forms at Seibal (Sabloff 1975). 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 serving wares (Figure 7). It is unclear if each settlement group produced all vessel forms for their household, or if they specialized on a single form and traded for others. This issue will be addressed by future petrographic analyses on the Uxbenká assemblage. The data on vessel forms at each group is unlikely the result of different consumption practices because each settlement group was of a similar size and status.

SG	Settlement Type	Volume (m ³)	Ceramic Count	Count/Volume	Ceramic Weight (g)	Weight/Volume
Utilitarian Production						
36	2	5.984	985	164.61	14654	2448.864
38	2	7.801	1712	219.46	27045	3466.863
52	2	2.892	447	154.57	7454	2577.455
54	3	10.739	821	76.45	14854	1383.183
62	3	6.542	716	109.47	11589	1771.477
60	3	32.31	969	30	30324	938.533
Specialized Production						
37	3	13.611	1151	84.56	24158	1774.888
No Evidence of Production						
39	2	6.6	196	29.7	3060	463.6364
53	2	3.048	28	9.19	1172	384.5144
18	2	8.88	321	36.15	5421	610.473
13	2	4.172	146	35	1226	293.8639
22	2	8.916	223	25.01	6200	695.3791
29	3	4.6	71	15.43	1164	253.0435
44	3	3.803	133	34.97	1742	458.0594
5	3	9.312	227	24.38	4824	518.0412
3	4	2.412	229	94.94	3684	1527.363
42	4	8.784	207	23.57	2978	339.0255
43	3	1.02	23	22.6	202	198.0392
9	3	1	46	46	1404	1404
10	2	5.7715	308	53.37	2212	383.2626
Total				1289.43		21889.96
Mean				64.4715		1094.498

Table 2.3. Abundance of Finished Products by Volume (SG Sherd Counts/Weights above the Mean Are Highlighted in Gray).

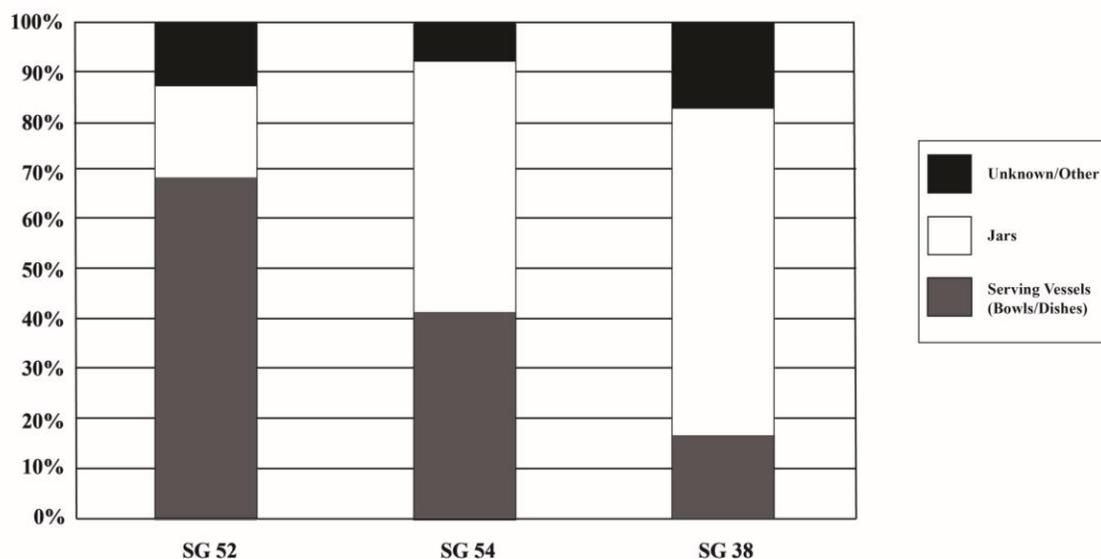


Figure 2.7. Relative frequency of vessel forms from SG 36, SG 52, and SG 54.

Spatial Distribution of Producing Households

SGs 36, 52, and 54 are clustered in the southwest periphery of Uxbenká (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 Copan, Honduras, were strategically located near clay sources (Freter 2004:99). The southwest periphery of the Uxbenká 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 Uxbenká 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 Uxbenká.

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 specifically defined, non-residential 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 like 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 non-domestic, 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 indicates that considerable variability can exist within each (Arnold 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 non-producing households are similar in composition and density (Santley et al. 1989:108). Furthermore, household potters often use expedient, multi-purpose 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’ community (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. This distinction can probably not be made in the archaeological record. 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 Copan (Freter 1996), and at 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 forms 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 and has been documented among lithic producers, particularly at the site of Colha (Shafer and Hester 1991). Community specialization may also arise in response to growing populations 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, 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 tools and finished products to make inferences about the organization of craft production. At Uxbenká, households participating in ceramic production are 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 Uxbenká 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 a potter spends 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 Uxbenká; 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, as is the case at Uxbenká, tend to learn craft production within the family contexts 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 Uxbenká were intermittent crafters who also farmed their surrounding landscape. There is no evidence of significant multi-crafting and the high-quality agricultural land surrounding Uxbenká (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 Uxbenká 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, Uxbenká, 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 non-elite 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). As a result, Pusilha is not considered in our discussion of regional production and distribution. Uxbenká, 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 Uxbenká, while sherds of the coarse-tempered Puluacax Group—a southern Belize tradition—are abundant at Uxbenká and Lubaantun but less common at Nim li Punit (Supplemental Table 4). Turneffe Unslipped jars, the most abundant ceramic and form group, display different forms between polities.

The most abundant jar form at Lubaantun is the vertical-neck jar, a form rarely found at Uxbenká 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 Uxbenká are most similar, although Uxbenká 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 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 both Uxbenká 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 non-local 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 Uxbenká 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, southern Belize in particular, 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. Uxbenká, 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 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. Lastly, the polities of southern Belize are much smaller than those where community specialization has been inferred in 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. Uxbenká 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 like 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

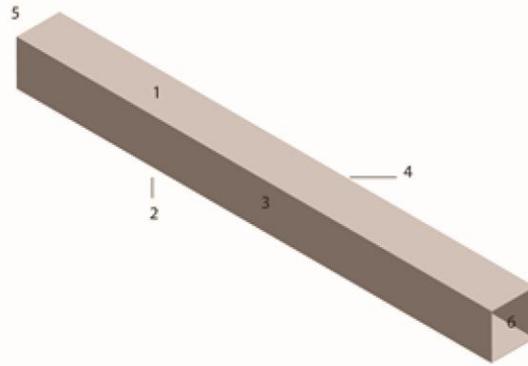
The data from Uxbenká demonstrate the utility of investigating domestic pottery production in the absence of primary production locales and is significant to the study of household economic organization in low-density urban settings. It is necessary to use multiple lines of evidence including spatial data, use-wear on production tools, and

analyses 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 Uxbenká 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.

**Supplemental Materials to Accompany
Identifying Domestic Ceramic Production in the Maya Lowlands: A Case Study
from Uxbenká, Belize**

Tool #	SG	Context	Ceramic Group	Geometric Shape	Complete	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Hardness
T1	38	Feature	Remate	Rounded/Pentagon	No	35.71	49.11	77.41	6.57	3.4
T2	38	Fill	Turneffe	Triangle	Yes	9.3	40.03	24.66	6.02	3.4
T3	38	Fill	Remate	Pentagon	Yes	13.84	45.98	37.86	9.05	5.6
T4	38	Feature	Remate	Rounded/Triangle	Yes	18.42	53.88	41.45	8.18	4.5
T5	38	Fill	Turneffe	Triangle	Yes	13.47	49.07	32.05	9.38	4.5
T6	38	Feature	Turneffe	Rounded/Triangle	Yes	27.03	63.41	62.1	7.4	5.6
T7	38	Fill	Hondo	Triangle	Yes	5.439	37.16	35.65	5.47	5.6
T8	38	Feature	Turneffe	Pentagon	Yes	6.735	49.05	31.41	4.59	3.4
T9	38	Feature	Turneffe	Rounded	Yes	10.626	46.34	27.04	7.28	4.5
T10	38	Feature	Triunfo	Pentagon	Yes	7.12	45.27	36.12	5.01	2.3
T11	38	Feature	Remate	Pentagon	No	20.796	73.01	49.85	6.15	4.5
T12	38	Feature	Turneffe	Rounded	Yes	12.56	49.74	33.23	7.31	4.5
T13	38	Fill	Turneffe	Rounded	Yes	57.36	62.27	79.48	11.51	5.6
T14	38	Feature	Remate	Pentagon	No	5.364	33.17	32.64	5.48	3.4
T15	38	Feature	Remate	Pentagon	Yes	9.978	55.3	34.88	5.22	3.4
T16	38	Feature	Remate	Triangle	Yes	9.641	34.61	50.55	5.88	3.4
T17	38	Fill	Turneffe	Pentagon	Yes	19.228	69.91	33.87	7.31	5.6
T18	38	Feature	Turneffe	Triangle	Yes	4.505	34.23	33.27	4.3	3.4
T19	38	Feature	Turneffe	Triangle	Yes	6.036	46.78	25.92	5.96	3.4
T20	38	Feature	Turneffe	Triangle	No	4.787	39.1	18.98	5.1	3.4
T21	38	Feature	Remate	Triangle	Yes	5.717	33.19	20.49	6.28	3.4
T22	38	Feature	Turneffe	Triangle	Yes	5.255	42.16	29.4	5.92	3.4
T23	38	Feature	Turneffe	Rounded	Yes	41.615	84.36	9.13	8.72	3.4
T24	38	Feature	Turneffe	Pentagon	Yes	11.883	46.29	30.86	9.16	4.5
T25	38	Feature	Turneffe	Triangle	Yes	5.267	40.34	20.72	7.45	3.4
T26	38	Feature	Turneffe	Pentagon	Yes	6.604	42.23	27.43	5.01	3.4
T27	38	Feature	Remate	Triangle	Yes	6.077	29.65	28.49	8.43	4.5
T28	38	Feature	Turneffe	Triangle	Yes	5.09	28.87	38.47	6.43	3.4
T29	38	Fill	Remate	Rounded	Yes	10.412	31.34	35.58	6.76	5.6
T30	38	Fill	Turneffe	Triangle	Yes	4.47	38.11	25.57	4.71	3.4
T31	38	Fill	Turneffe	Triangle	Yes	9.928	45.9	36.99	7.28	4.5
T32	54	Fill	Turneffe	Rounded/Pentagon	Yes	15.282	54.57	43.69	8	4.5
T33	54	Fill	Turneffe	Rounded	Yes	11.287	32.87	34.02	7.36	4.5
T34	54	Fill	Turneffe	Pentagon/Triangle	Yes	14.009	58.92	41.17	6.27	5.6
T35	54	Fill	Turneffe	Rounded	Yes	14.093	37.12	55.75	5.13	3.4
T36	52	Feature	Remate	Rounded/Pentagon	Yes	11.339	42.55	28.69	8.51	5.6
T37	52	Feature	Remate	Pentagon	Yes	7.342	35.76	32.02	7.25	4.5
T38	52	Feature	Remate	Rounded/Triangle	Yes	10.719	43.7	33.03	8.77	4.5
T39	52	Feature	Turneffe	Rounded/Pentagon	Yes	11.005	44.78	33.89	9.52	4.5

Table 2.4. Supplemental Materials 1: Ceramic Production Tools.

Surface Description (For Each Surface 1-6)

Direction of Wear: None, Parallel, Perpendicular, Oblique, Multiple, Polish

Intensity of Wear: Low, Moderate, High

Surface Coverage: 0-19%, 20-39%, 40-59%, 60-79%, 80-100%

Figure 2.8: Supplemental Materials 1: Surface Descriptions for Waterworn Pebble Tools.

Tool #	SG	Context	Material	Complete	Weight (g)	Length (mm)	Width (mm)	Thickness (mm)	Hardness	Inferred Activity
L2	38	Fill	Chert	No	38.052	61.61	24.65	14.75	7.8	Smoothing/Polishing
L3	38	Fill	Chert	Yes	94.987	54.44	35.59	35.57	7.8	Polishing
L4	36	Surface	Chert	No	65.468	39.94	38.38	29.4	7.8	Polishing
L5	54	Fill	Chert	Yes	42.103	55.8	26.82	18.11	7.8	Smoothing/Polishing
L6	54	Fill	Chert	Yes	3.5	19.76	11.71	10.03	7.8	Polishing
L7	54	Fill	Unknown	Yes	58.227	48.28	31.55	28.05	8.9	Polishing
L8	54	Fill	Quartz	Yes	14.683	25.09	21.49	19.68	7.8	Polishing
L9	54	Fill	Sandstone	Yes	3.415	23.84	12.39	12.34	4.5	Polishing
L10	54	Fill	Chert	Yes	8.465	23.03	22.71	15.01	8.9	Polishing
L11	52	Feature	Chert	No	13.469	50.94	17	14.86	4.5	Smoothing/Polishing
L12	52	Feature	Chert	Yes	9.377	22.81	16.33	12.94	7.8	Polishing
L13	52	Feature	Chert	Yes	2.737	17.49	13.13	11.05	7.8	Polishing
L20	52	Feature	Chert	Yes	1.4	13.48	12.86	5.98	8.9	Polishing
L18	4	Fill	Sandstone	Yes	33.947	73.58	26.19	16.48	3	Smoothing/Polishing
L19	4	Fill	Quartz	Yes	6.975	22.43	17.69	13.34	7	Polishing

Table 2.5. Supplemental Materials 2: Waterworn Pebble Tools.

Ceramic Group	Uxbenka	Lubaantun	Nim Li Punit
Turneffe	16	53	42
Remate	43	24	34
Puluacax	25	14	1
Belize	6	1	7
Zacatal	5	8	3
Palmar	0	0	0
Hondo	5	0	12
Fine Paste System	0	0	1

Table 2.7. Supplemental Materials 4: Relative Frequencies of Major Ceramic Groups at Uxbenká, Lubaantun, and Nim Li Punit (%) (Comparative data from Fauvelle et al. 2012: Figure 6 and Hammond 1975).

CHAPTER 3

INCORPORATING PRACTICE INTO NEIGHBORHOOD AND DISTRICT STUDIES IN LOW-DENSITY URBAN ENVIRONMENTS

Low-density, agrarian-based urbanism is a common form of urbanism worldwide, particularly in tropical forested regions like Mesoamerica and Southeast Asia. This type of urbanism is characterized by low population densities and dispersed households that allow for agricultural pursuits within the boundaries of the settlement area. Polities range in size and complexity but each contains an internally homogenous and repetitious spatial layout (Fletcher 2009). Understanding social organization and integration in these urban environments relies primarily on analysis of settlement patterns and architectural elaboration (Isendahl and Smith 2013). Extensive comparative research between modern and ancient cities, and among ancient urban environments spanning time and location, indicate that internal spatial divisions are a common, cross-cultural similarity (Smith 2010, 2011). How researchers divide urban environments into smaller, often nested subdivisions, and the meaning assigned to these spatial units, has important implications for understanding intrapolity organization and interaction.

Two spatial divisions in particular, the neighborhood and the district, provide insight into the organization of low-density urban environments and intrapolity interaction. Neighborhoods are clusters of households defined by physical proximity and face-to-face interaction. Districts, often composed of multiple neighborhoods and administrative architecture, are not defined solely on the basis of interaction, but rather, have elements of top-down planning (Smith 2010). Spatial and architectural data provide a reliable method for identifying and comparing social organization in urban

environments (Prufer et al. 2017). However, interaction networks often extend beyond, and cross-cut, spatial boundaries. Understanding how people interact beyond spatial boundaries in ancient cities is difficult, especially in locations where interactions among non-elite people were not recorded in texts (Smith and Novic 2012).

This paper presents a complementary approach to spatial analysis that investigates the production of locally produced craft objects to reconstruct intrapolity interaction networks. Urban environments support a group(s) of people who are responsible for craft production. Information about where to procure raw materials and how to manufacture craft objects is shared within existing social networks and these networks often extend beyond household, neighborhood, and district boundaries. This case study focuses on pottery production at Late Classic (AD 600-800) Uxbenká for several reasons. Uxbenká is a medium-sized lowland Maya polity located in the Toledo District of southern Belize (Figure 3.1). The Maya lowlands is an ideal region to apply practice approaches to intrapolity organization because of the long history of settlement pattern and household studies (Ashmore 1981; Ashmore and Wilk 1984; Bullard 1960; Freter 2004; LeCount and Yaeger 2010; McAnany 1995; Robin 2003, 2004; Webster and Gonlin 1988; Wilk and Ashmore 1988; Wilk and Netting 1984; Willey et al. 1965; Yaeger 2000) and recent, well-developed spatial studies of districts and neighborhoods (Arnauld et al. 2012; Chase 2016; Hutson 2016; Prufer et al. 2017; Smith 2010; Smith and Novic 2012; Thompson et al. 2018). The site of Uxbenká has been the focus of over a decade of extensive pedestrian survey, remotely sensed lidar analysis, and household excavations across the polity. Previous research identified clearly defined neighborhoods and districts using

geospatial statistical methods (Prufer et al. 2015; Prufer and Thompson 2016; Thompson et al. 2018).

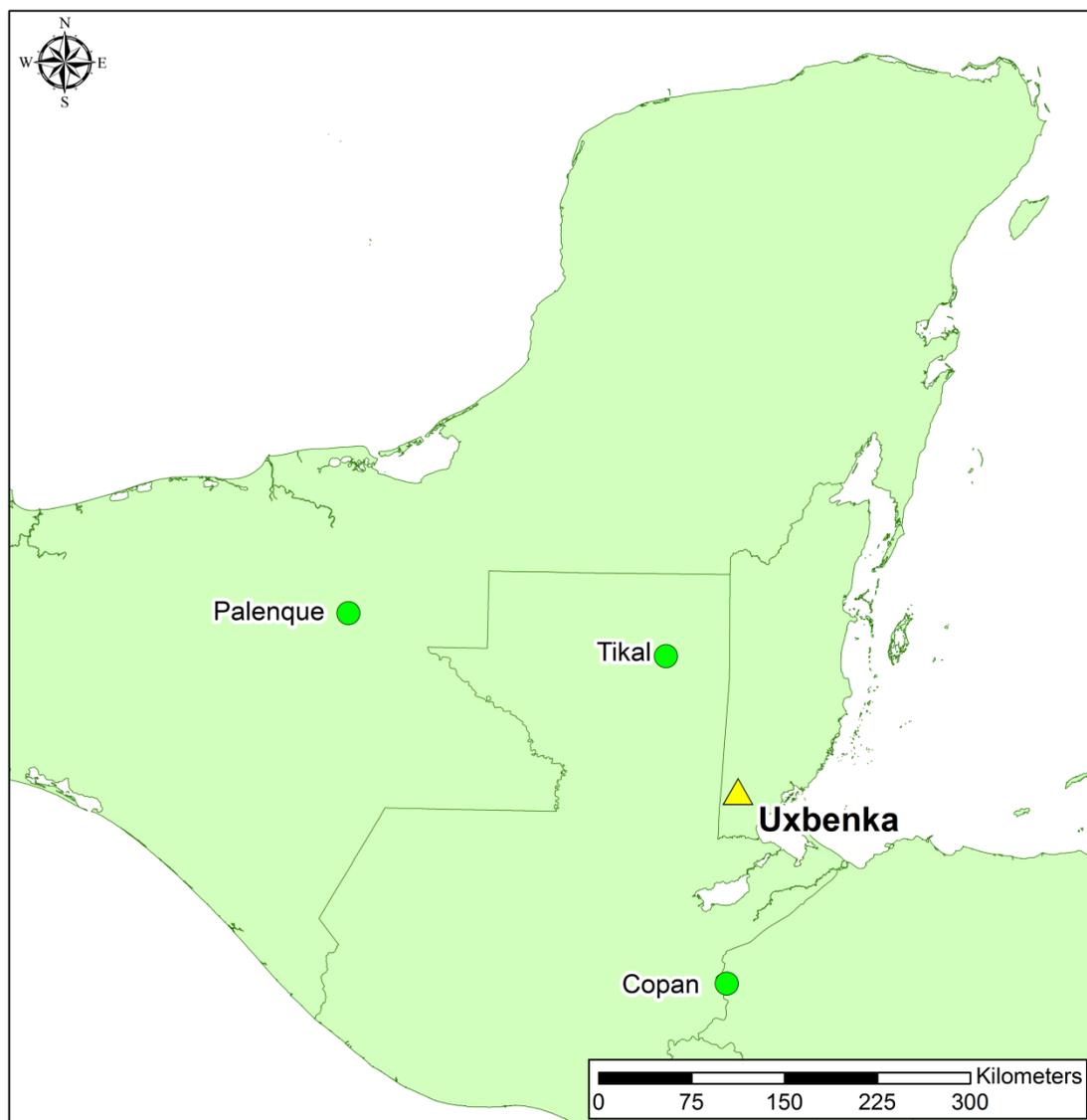


Figure 3.1. The Location of Uxbenká in the Maya Lowlands. (Map by A.E. Thompson)

Analyses of household artifact assemblages identified at least three Late Classic households located in the southwest periphery of the settlement area that participated in

pottery production (Jordan and Prufer 2017). Pottery in the Maya lowlands was likely produced by household potters independent of elite involvement and provides an additional line of evidence with which to evaluate social organization via bottom-up processes. Due to the lack of primary production locations (e.g. firing locales; see Becker 2013), this characterization of pottery production based is based on other lines of evidence such as distribution studies (Fry 1979, 1980; Hammond et al. 1976; Rands and Bishop 1980). Uxbenká is not the only polity where pottery production has been studied in conjunction with spatial analysis. The focus of these studies is often large and complex polities with long occupation sequences such as Copan (Freter 1996, 2004), Palenque (Rands and Bishop 1980), and Tikal (Becker 1973; Fry 1979, 1980). Uxbenká, on the other hand, is located in a less densely occupied area of the Maya Lowlands and supported a relatively small population (~3,500 people; Prufer et al. 2017: 60) providing a less complicated archaeological setting with which to evaluate intracommunity interaction in low-density urban environments.

This study evaluates intracommunity interaction by examining local pottery production as a series of choices learned within a community of practice, which are groups of people who engage in a similar learning environment and shared experience (Gosselain 2008; Lave and Wenger 1991; Roddick and Stahl 2016; Wenger 1998). Communities of practice can, but need not be, synonymous with community as a geographic locale (e.g. Kolb and Snead 1997). Pottery samples recovered from household and site core contexts ($n=97$) and geologic samples ($n=12$) were analyzed using thin section petrography to determine how potters shared information about resource acquisition and raw materials processing (e.g. the paste recipe; Joyce 2012) across spatial

boundaries. Similarities in microscopic attributes reflect learning networks and act as proxies for intrapolity interaction networks.

The data from Uxbenká indicate that nearly all potters, regardless of neighborhood or district, produced unslipped jars and monochrome red serving vessels in the same way. Locally produced polychrome serving wares were likely produced within the same community of practice but differ in terms of raw materials processing for functional reasons related to the construction of thinner-walled ceramic vessels. Information about where to procure raw materials and how to process them was shared widely and information exchange occurred among households located in different, non-contiguous neighborhoods. The theoretical and methodological approach discussed in this dissertation provides an independent method for evaluating intracommunity interaction and bottom-up social organization in low density urban agrarian environments.

Neighborhoods and Districts in Low Density Urban Agrarian Environments of the Maya Lowlands

The spatial layout of lowland Maya polities, like other low-density urban environments in tropical environments, is characterized by a central site core composed of monumental architecture surrounded by households of varying sizes and architectural elaboration (Ashmore 1981). Hereditary elites lived in the site core, which also functioned as an administrative center and place for public gatherings. Households were dispersed across a vast area and there is a considerable amount of space between them to allow for agricultural pursuits (Isendahl and Smith 2013; Fletcher 2009; Figure 3.2). Food production likely consisted of gardens (Dunning and Beach 2010; Ford 2008;

Graham 1999) or constructed agricultural terraces (e.g. Chase et al. 2011) located near households that were controlled by non-elites via bottom-up organization (Isendahl and Smith; Netting 1993).

Dispersed households are grouped together into larger spatial units called neighborhoods and districts. These spatial units are common features in both ancient and modern urban environments and exhibit different types of social organization that provide insight into intracommunity interaction networks. Scholars have long recognized that dispersed households were organized into larger spatial groupings (Ashmore 1981; Bullard 1960; Willey et al. 1965). However, the recognition that these spatial units are analogous to neighborhoods and districts is a relatively recent avenue of study in the Maya lowlands (Smith 2010, 2011). A neighborhood is defined as “a residential zone that has considerable face-to-face interaction and is distinctive on the basis of physical and/or social characteristics” (Smith 2010:53). They are ubiquitous in urban and semi-urban environments and include settlements with a deep history and those that formed rapidly (Smith et al. 2014). Neighborhoods are often composed of members that belong to a specific group which can include ethnic groups, social classes, religions, or occupations (Smith 2010:150).

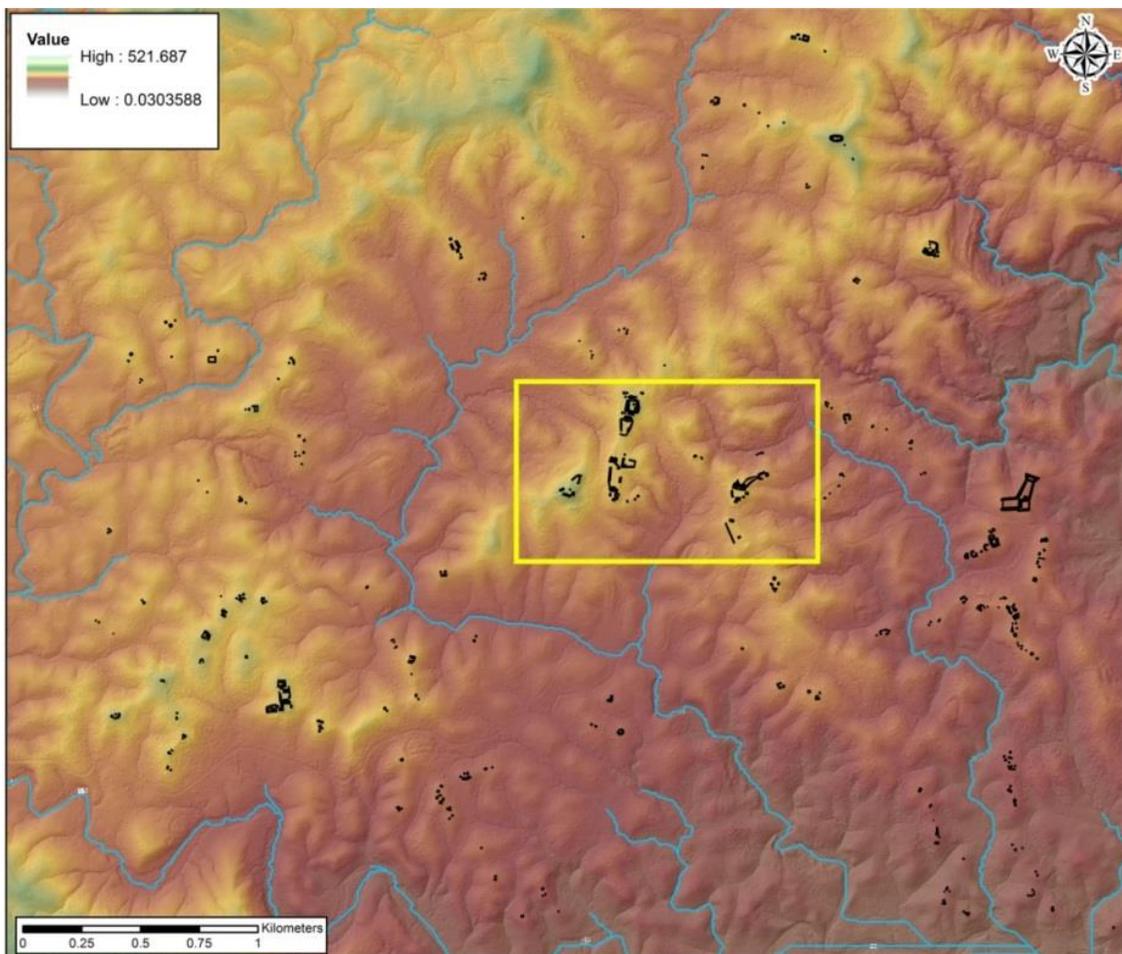


Figure 3.2. Map of the Uxbenká polity showing Site Core (in the yellow box) surrounded by dispersed households. The shading is in reference to elevation (high elevation in yellow, low elevation in red). (Map by A.E. Thompson)

A district, often composed of multiple neighborhoods, is “a residential zone that has some kind of administrative or social identity within a city” (Smith 2010:140). There are two kinds of districts: administrative and social, though the categories can be overlapping. Administrative districts, formed via top down processes, “are large residential zones that serve as administrative units within cities” (Smith 2010:140). They do not necessarily have to contain civic buildings. However, the presence of monumental architecture distant from a site core but containing public spaces including markets,

ballcourts, or funerary temples is the primary means to identify districts due to its visibility (Prufer et al. 2017; Chase 2016). This is certainly the case at Uxbenká where districts are defined based on the presence of monumental architecture and public gathering areas (i.e. open plazas and ballcourts) (Thompson et al. 2018). Social districts, on the other hand, “are large residential zones, identifiable from patterns of interaction or social characteristics, which do not serve as administrative units” (Smith 2010:140). They are difficult to identify in ancient cities because they lack civic architecture and are defined based on intangible characteristics.

There are many methods for neighborhood and district identification though most include spatial analyses via ArcGIS or similar program in addition to a consideration of cultural and natural boundaries that would inhibit direct interaction, and the use of historical documents if available (Hendon 2012; Smith and Novic 2012). In the Maya region, spatial and geographic data are used exclusively because information about non-elites was not recorded in hieroglyphic texts. This study builds on the body of data collected on neighborhoods and districts in the Maya lowlands and uses these spatial zones as the foundation to investigate intracommunity interaction. Most studies of low-density agrarian urban environments focus on the independence of household farmers as a contributing factor to the resiliency and sustainability of this type of urbanism (Fletcher 2009; Isendahl and Smith 2013). However, a majority of day-to-day activities of the non-elite Maya occurred in the absence of elite involvement. Craft production was likely organized at the household level and these enterprises can provide important information about interaction and bottom-up social organization.

Evaluating Intracommunity Interaction among Household Pottery Producers

Households are important locations for economic and social activities. They are the primary space for interaction and the locus of production and reproduction of learning and practice (Bowser 2000, Braun 1983; Robin 2003; Webster and Gonlin 1988; Weissner 1983; Wilk 1988; Wilk and Netting 1984). The household, as both a physical space and a social unit, is where a great deal of craft production occurs. However, information about craft production is also transmitted beyond the boundaries of the household. Ethnographic studies indicate that learning can occur between kin that do not live in the same residential unit and can occur between kin and non-kin at the neighborhood level or between residents of different neighborhoods (P. Arnold 1991; Deal 1998; Hayden and Cannon 1984). Furthermore, residents of lower status households tend to learn craft production within family contexts while higher status households learned from a broader range of personnel (Hayden and Cannon 1984:351). While the household is the primary social unit among the Maya, variation in intracommunity information sharing is documented in ethnographic studies and archaeological research must employ an approach capable of capturing diversity in social organization.

Ethnographic and archaeological studies have traditionally focused on attributes of decorative style to convey information about inclusion and exclusion to evaluate interaction and social boundaries (Bowser 2000; DeBoer 1990; Hegman 1992; Neimann 1995; Wobst 1977; Weissner 1989). Archaeological studies that seek to understand interpersonal interaction have shifted focus to include the examination of technological attributes because decorative style can be unreliable as an indicator of interaction.

Decoration is often made in response to consumer demand and decorative attributes can be copied by members of other social groups (Friedrich 1970; Stark et al. 1998).

Technological style, which reflects a potter's choice of raw materials and how these materials are used to create a ceramic vessel (Lechtman 1977), is a more suitable option for evaluating social boundaries among potters living in the same urban environment. It is not dictated by environmental constraints but rather reflects relationships between artisans and the choices that they make regarding vessel construction. According to Lechtman (1977:6), technological style "is the format or 'package' defined by these relationships that is stylistic in nature, and it is the style of such behavior, not only the rules by which any of its constituent activities is governed, that is learned and transmitted through time." Furthermore, considering technological style allows for the examination of undecorated, utilitarian vessels that are abundant in household contexts at Uxbenká (Peelo 2011; Stark et al. 1998).

The importance placed on decorative style versus technological style has played out in lowland Maya ceramic studies since the 1960s within the framework of the type: variety system of ceramic classification (Smith et al. 1960; Willey et al. 1967; summarized in Rice 2013). Technological attributes associated with vessel fabrication [texture, temper material, hardness, porosity, and color (Rice 2013:19)] and attributes associated with surface finish [presence/absence of a slip, smoothness, luster/matte finish, and color (Rice 2013:19)] are generally combined into a single ware category. The outward physical appearance is often elevated as the most important attribute, and characteristics of fabrication are lumped together into broad categories. Paste composition can and does cross-cut stylistic and formal types (Deal 1998:59-60; Howie

2012:139-178; Rice 1976:542-543). Emphasizing decorative attributes over technological ones can obscure important information about pottery production and distribution. For example, vessels identical in outward appearance can be produced in completely different regions (Howie 2012), so reliance on style, and even form, alone may not provide adequate insight into the complexity of pottery production in a complex society like the Maya. Moreover, because this study focuses on intracommunity interaction, it is unlikely that the outward physical appearance of a ceramic vessel will differ dramatically between different groups of pottery producers living in the same urban environment. This is especially true at the smaller polities like Uxbenká.

Thus, this study focuses on attributes of technological style. Intracommunity interaction and social boundaries are evaluated within the situated learning and communities of practice theoretical framework. The framework, originally developed to explore shared practice in contemporary society, examines the relationship between community and practice through the integration of mutual engagement, joint enterprise, and shared ways of doing (Lave 2008; Lave and Wenger 1991; Wenger 1998). Situated learning theory holds that learning is historically, socially, and culturally constituted and that it is an active participatory process within communities of practice. Communities of practice are groups of people who engage in a similar learning environment and shared experience. According to Joyce (2012:151), “a particular way of doing things is learned within a community of practice, and reproduced by community members as they enact their own practices. Because of the repetition of practices in a certain manner learned by and reproduced by community members communities of practice persist in time.” This framework has been successful in investigating social boundaries in middle-range

societies but is rarely used in complex societies (Bamforth and Finlay 2008; Crown 2014; Habicht-Mauche et al. 2006; Joyce 2012; Joyce et al. 2014; Minar and Crown 2001; Stark 2008; Stark et al. 2008; Stahl 2013).

Pottery production as a proxy for interaction at Uxbenká is evaluated in terms of two lines of evidence: (1) where potters physically reside [discussed in the following section], (2) and how potters learn to make ceramic vessels via face-to-face interaction. Information transmission can occur through direct interaction or through copying of the final product. Information about vessel construction (i.e. resource acquisition, raw materials processing, forming and firing vessel) is transmitted by process-oriented learning which involves a learner directly observing the pottery production process (Van Hoose 2008: 25). Technological attributes are low-visibility attributes that cannot be seen by observing a finished ceramic vessel (Carr 1995). Final product learning, on the other hand, occurs when a potter learns how to produce certain aspects of a ceramic vessel (i.e. decorative attributes) from observing a finished product (Van Hoose 2008: 24).

This study focuses primarily on low-visibility attributes because they are indicative of face-to-face interaction among potters. Pottery production is a multi-step process and each step of this process involves a series of choices. These choices are not random but are based on shared norms (Gosselain 2008) learned within a community of practice (Gosselain 1998; Hegmon 1998; Lechtman 1977; Lemonnier 1986, 1993). Similarities in low-visibility attributes, shared via process-oriented learning, are indicative of interpersonal interaction. Not all aspects of the pottery production are necessarily transferred from an experienced potter to a learner in a wholesale fashion. By breaking down the pottery production process, and considering resource acquisition and

raw materials processing separately as part of a paste recipe, it is possible to identify multiple communities of practice within a single community.

The Uxbenká Case Study

The Southern Belize Region

Uxbenká is medium-sized polity located in the Toledo District of southern Belize in the modern Mopan Maya community of Santa Cruz (Figure 3.3). The “Southern Belize Region”, as originally defined by Leventhal (1990, 1992), is roughly synonymous with the Toledo District. The region has received less archaeological attention compared to other regions of the Maya lowlands (Leventhal 1990, 1992; Prufer et al. 2011). Most archaeological work has been conducted at four centers located along a corridor running southwest to northeast in the foothills of the Maya Mountains: Pusilha (Braswell et al. 2005; Prager 2013), Uxbenká (Prufer et al. 2011; Prufer et al. 2017), Lubaantun (Hammond 1975), and Nim Li Punit (Braswell 2017; Fauvelle et al. 2012, 2013). More recently, survey and excavations have been conducted at Kaq’ru’ Ha’ (Novotny 2015) and Ix Kuku’il (Thompson and Prufer 2016; Thompson et al. 2018). The larger sites in the region share major characteristics: 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 (Leventhal 1992).

Polities in the Maya Mountains (Dunham and Prufer 1998), the southeastern Petén (Laporte 2001, 2007), and on the coast of the Caribbean Sea (McKillop 2004), along with those discussed above are part of the greater southern Belize region (Prager et

al. 2014) also referred to as the Maya Mountains region (Novotny 2015). Previous research indicates that pottery production likely occurred at each polity and locally produced ceramic vessels did not circulate widely in the region (Fauvelle et al 2012; Hammond et al. 1976; Jordan and Prufer 2017). Other items, however, likely did circulate via market exchange. McKillop's work in coastal southern Belize suggests that salt cakes, and/or salted fish or meat, were traded inland via marketplace exchange. In return, coastal people may have received non-local pottery (McKillop and Aoyama 2018:10950).

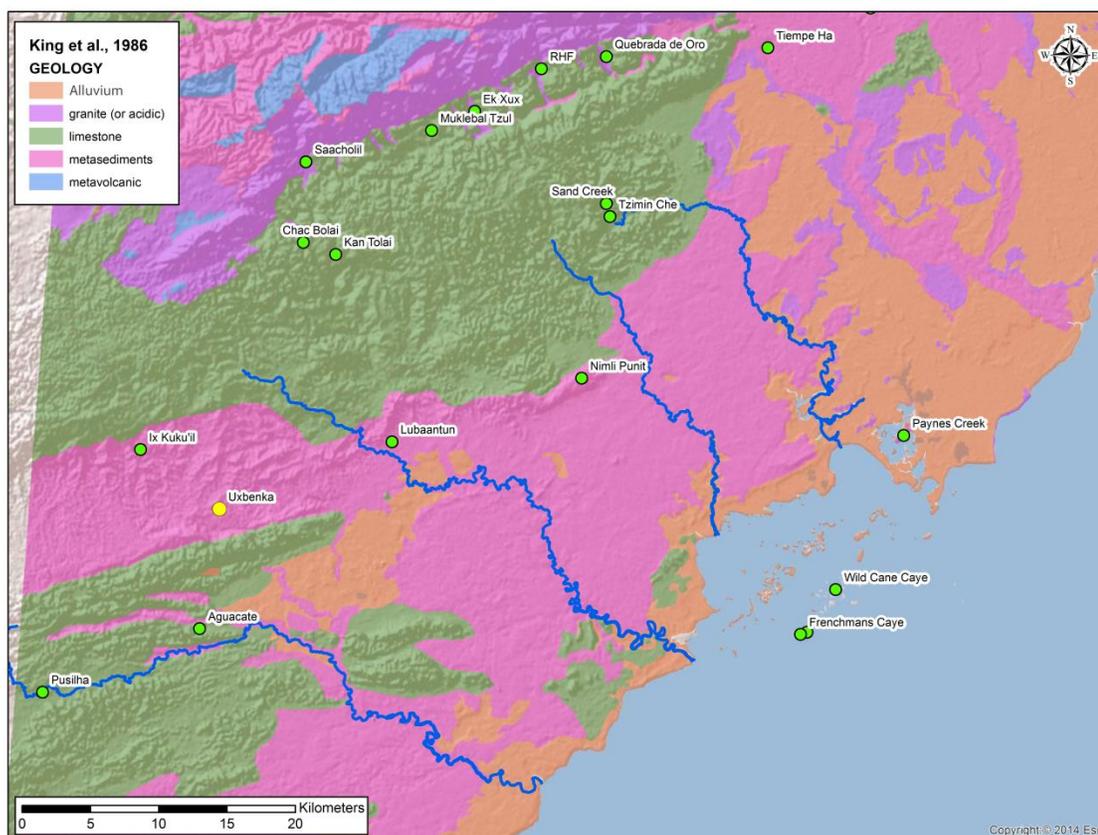


Figure 3.3. Major polities and Geologic Formations of the Southern Belize Region (Map by A. E. Thompson *after* King et al. 1986)

Uxbenká

Uxbenká, one of the earliest occupied polities in the region, was established near the end of the Late Preclassic Period (c. AD 250) and abandoned around the beginning of the Terminal Classic Period (c. AD 800) (Culleton et al. 2012; Aquino et al. 2013). Uxbenká reached its apogee during the Late Classic Period (AD 600-800) when the polity supported a minimum population of 3,427 persons based on an estimate of 5.5 persons per documented household (Prufer et al. 2017). Using a combination of pedestrian survey and remotely-sensed lidar, the Uxbenká Archaeological Project (UAP) has identified more than 100 settlement groups of varying sizes and architectural complexity (Prufer et al. 2015, 2017; Thompson et al. 2018). A settlement group (SG) is composed of one or more architectural components confined to a single, isolated landform” (Kalosky and Prufer 2012). A settlement group is roughly synonymous with household as defined elsewhere in the Maya Lowlands (e.g. Ashmore and Wilk 1984); however, structures are often not as formally arranged due to constraints imposed by the nature of the topography. These structures are dispersed over approximately 30 km² and extend as far as 3 km from the site core (Prufer et al. 2015; Prufer and Thompson 2016). To date, 44 settlement groups have been excavated out of over 100 identified. Type-variety analyses of diagnostic sherds from excavated settlement groups indicate that nearly all (n = 37) exhibit evidence of Late Classic occupation.

Geologic Setting

Southern Belize is located in the Belize Basin and, together with the Petén Basin, “form the southern edge of the Maya Block and the southernmost part of the North

American Plate” (Schafhauser et al. 2003: 625). The collision of the North American Plate and the Caribbean Plate (located to the south on the opposite side of the Motagua Fault) created a large foreland basin that subsequently infilled with clastic material deriving from the Maya Mountains, Motagua Fault System, and Cretaceous marine limestones. Uxbenká is located atop the Tertiary Toledo formation (Sepur formation in Guatemala) composed of the clastic materials that accumulated in the foreland basin. The Toledo formation is composed of interbedded mudstones, sandstones, and conglomerates (see Figure 3.3). To the south, in an area known locally as the “Rock Patch”, there is a 250 high meter karst composed of Cretaceous limestone of the La Cumbre formation “composed of shallow water subangular clastics as well as massive limestones” (Meredith 2014: 22). Cretaceous limestones also outcrop disconformably within the Toledo formation.

The soils of Belize are classified based on underlying parent material (Baillie et al. 1993; King et al. 1986, 1992; Wright et al. 1959). In general, soils in southern Belize are divided into lime-rich (soils that formed on limestone parent material) and lime-poor groups (soils that formed on non-limestone parent material) (Hammond 1975: 18; Wright et al. 1959). Uxbenká is located atop generally lime-poor soils of the Toledo suite; however, some of the clastic bedrock in the area is calcareous sandstone. The soils located atop the Toledo Beds fall into two primary subsuites (Figure 3.4). Cimin soils are grey to brown, relatively shallow, well-drained soils that grade into weathered mudstone and other clastic bedrock sediments (Baillie et al. 1993:21). Aguacate and Manfredi soils are sandy, well-developed, rubified, and have a higher clay content than Cimin soils (Baillie et al. 1993:21; Wright et al. 1959:78). The inhabitants of the modern Maya

village of Santa Cruz, where Uxbenká is located, make a broad distinction between two types of soils based on their productivity for particular types of crops. The *box lu'um* (black soil) are “well-drained black clay loams largely distributed to the north of the village and at the base of the rock patch” (Culleton 2012: 95) while *chik lu'um* (red soil) are “poorly-drained oxidized red soils primarily found in the village itself and to the south within ~500-700 m of Rio Blanco” (Culleton 2012: 95). *Box lu'um* is the more agricultural productive soil that can support nearly every crop while *chik lu'um* is used for dry rice crops (Culleton 2012: 95; Cortez 2016: 39). While pottery production is no longer practiced in Santa Cruz village, community members report that *chik lu'um* was used to produce ceramic vessels in the past.

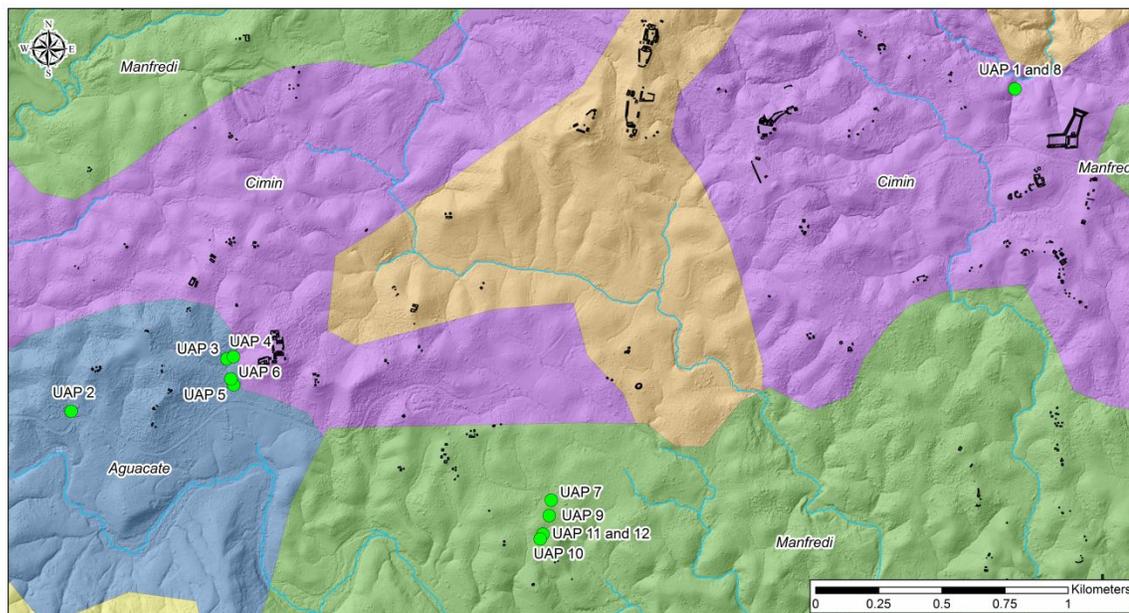


Figure 3.4. The Soils around Uxbenká Showing the Location of Geologic Samples. Each color denotes a different soil subseries. (Map by A.E. Thompson *after* Wright et al. 1959)

Spatial Identification of Neighborhoods and Districts

The identification of neighborhoods and districts at Uxbenká is based on data derived from pedestrian survey and remotely-sensed lidar. A series of methods were used to assess the geospatial relationships between Late Classic households at Uxbenká: Nearest Neighbor Analysis (NNA), Kernel Density (KD) Analysis, Directional Distributions (DD), and Ripley's K Function in ArcGIS, and hierarchical and k-means clustering in R as well as cluster validation using the Nbclust package. For details concerning geospatial and statistical analyses see Thompson et al. (2018). These analyses identified 16 geospatially discrete neighborhoods and three district seats (Figure 3.5). Neighborhoods are composed of multiple households of varying size and architectural complexity. The three districts are administrative districts that include a group(s) of monumental architecture including public spaces and elite residential locales. To date, only spatial and architectural data have been used to identify neighborhoods and districts at Uxbenká.

Recognizing Pottery Production Households

Identifying household production locales in the archaeological record in the Maya Lowlands is challenging due to poor preservation, the tendency of archaeologists to focus on architectural remains where production is unlikely to occur, dense vegetation obscuring activity areas, and the ephemeral nature of domestic pottery production. Jordan and Prufer (2017) identified three settlement groups (SG38, SG52, SG54) that participated in Late Classic pottery production based on the co-occurrence of multiple lines of evidence: the presence of ceramic and stone tools used in pottery production, abundance of finished products, and the spatial location of these settlement groups. The

same suite of evidence is present at SG60; however, this settlement group was occupied in the Early Classic Period (c. AD 250-600) and was not included in this study.

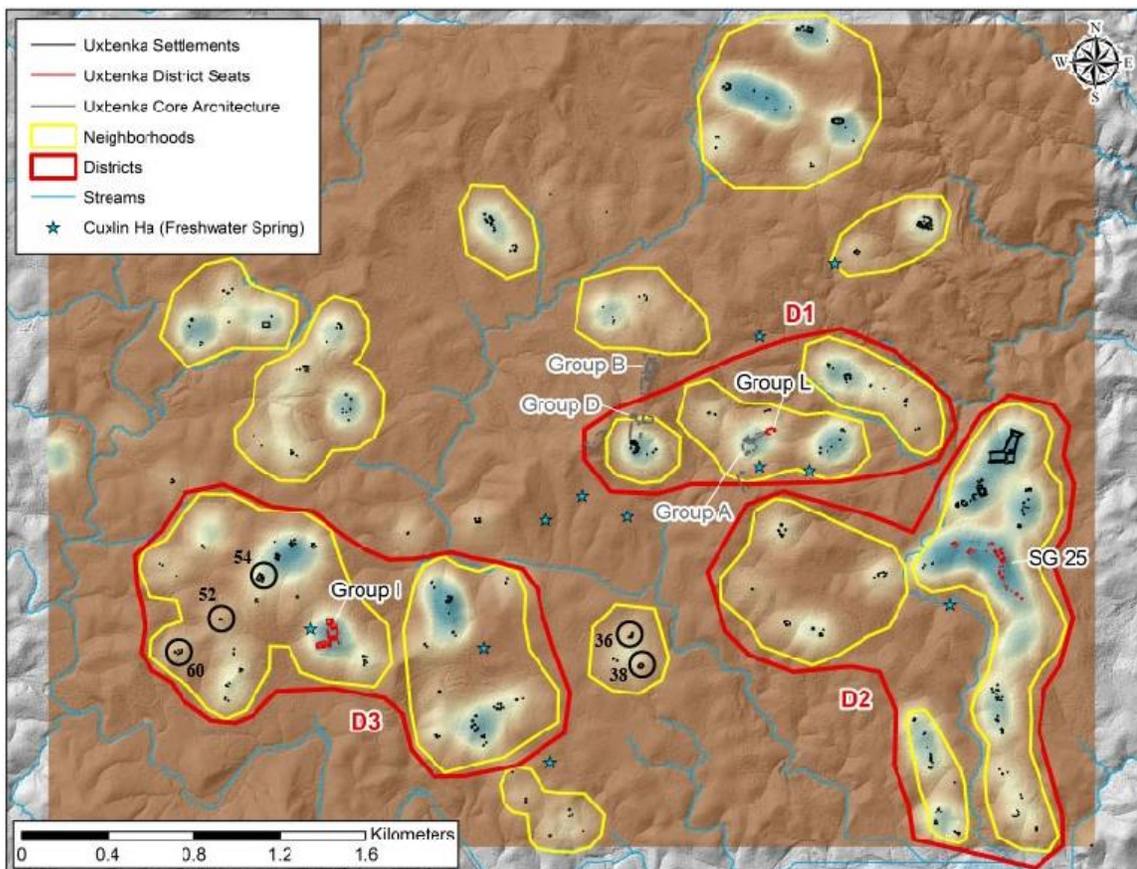


Figure 3.5. Neighborhoods and Districts Identified at Uxbenká. (Thompson et al. 2018, Figure 4). Sampled Mounds are circled in black.

All production households, in both the Early and Late Classic Periods, are located in the southwestern periphery of the Uxbenká settlement area. They are located in two spatially distinct and non-contiguous neighborhoods (see Figure 3.5). The continuity in settlement by potters throughout Uxbenká's occupational history suggests that this location provided some kind of an advantage. The proximity of these households to one another certainly suggests that interaction between potters was an important factor in

determining where to settle on the landscape. The presence of a similar suite of production tools at each household indicates shared knowledge about what constitutes a potter's toolkit. However, these tools are relatively standard (e.g. Lopez Varela et al. 2002; Thompson 1958) among ancient and modern Maya potters so additional evidence of potter interaction is required. Because settlements are located on hilltops, refuse was probably disposed of off hillsides. The hilltop placement of each settlement group increases the likelihood that artifacts recovered nearby were consumed—and even produced—at that location. The ceramic sample and tools recovered from within settlement groups are probably reflective of activities performed there.

Sample Selection and Methods

This pottery sample was selected primarily to evaluate: (1) how households in the southwest periphery produced pottery, in order to (2) determine how potters shared (or did not share) information about pottery production across spatial boundaries. A total of 97 rim sherds were analyzed using thin section petrography. The samples are from primary burial and cache contexts in the site core (n=26; 27 percent of the sample) and construction fill, caches, and ceramic deposit contexts from households (n=71; 73 percent of the sample) (Table 3.1). The household sample (n=70) was recovered from four households in the southwest periphery of the site: SG 36, SG 38, SG 52, and SG 54 (Table 3.2). A single vessel from a cache in SG 53 was also analyzed. The site core petrographic sample is composed of broken but complete vessels from primary contexts in Groups F, I, L and SG 25.

The household ceramic sample consists primarily of Turneffe Unslipped jars and serving vessels and Remate Red jars and serving vessels. These are the primary ceramic types found in household contexts at Uxbenká and macroscopic observations suggest that they were produced locally. Previous research indicated that households may have been engaged in household specialization in which they focused on a particular vessel form (e.g. red slipped jars of the Remate Red group; Jordan and Prufer 2017). This study considers resource acquisition and raw materials processing, as part of a paste recipe, because these attributes can be reliably evaluated using petrographic analysis and they provide information on how potters interacted with both their landscape and with one another. It also considers vessel form and color, which can be clearly observed on the finished product. These analyses are designed to evaluate the relationship between form and paste recipe to determine if different communities of practice existed alongside one another and produced different vessel forms within the Uxbenká polity.

The clay sampling methodology around Uxbenká was based primarily on the distinction between *box lu'um* and *chik lu'um* and then correlated with soil classification data (King et al. 1986; Wright et al. 1959). *Box lu'um* corresponds to the Cimin Subsuite while *chik lu'um* corresponds to the Aguacate and Manfredi Subsuite (Wainwright et al. 2017). Eight soil samples and four rock samples were collected to evaluate resource acquisition and raw materials processing. Geologic samples were collected from three areas on the landscape near pottery production households (Figures 3.4 and 3.6). The clay samples are represented entirely by *chik lu'um* sandy, red clays of the Aguacate and Manfredi soil subsuites. It would have been advantageous to also collect *box lu'um*

samples. However, clay sampling for this project was conducted with the help of a local guide and these locations reflect his knowledge of the project area.

Sample #	Fabric Group	Ceramic Group	Vessel Form	Context	Vessel Number	Munsell Margin	Munsell Core
1	Sandstone A1	Saxche-Palmar Polychrome	Bowl	Tomb L2	Vessel 19	2.5YR-5/8	
2	Sandstone A1	Palmar Orange Polychrome	Cylindar Jar	Tomb L2	Vessel 30	2.5YR-4/8	
3	Sandstone A	Zacatal Cream Polychrome	Tripod Plate with Hollow Feet	Tomb L2	Vessel 15	2.5YR-4/8	2.5YR-4/3
4	Quartz A	Zacatal Cream Polychrome	Cylindar Jar	Tomb L2	Vessel 6	2.5YR-5/8	
5	Quartz A	Palmar Orange Polychrome	Bowl	Tomb L2	Vessel 13	2.5YR-5/8	5YR-3/2
6	Calcite B	Saxche-Palmar Polychrome	Bowl	Tomb L2	Vessel 21	5YR-5/8	5YR-2.5/1
7	Volcanic Glass A	Saxche-Palmar Polychrome	Bowl	Tomb L2	Vessel 28	5YR-6/8	
8	Quartz A	Palmar Orange Polychrome	Dish/Plate	Tomb L2	Vessel 12	2.5YR-5/8	5YR-4/1
9	Sandstone A2	Zacatal Cream Polychrome	Tripod Plate with Hollow Feet	Tomb L2	Vessel 1	2.5YR-4/8	5YR-5/2
10	Quartz A	Remate Red	Cylindar Jar	Tomb L2	Vessel 23	2.5YR-4/8	5YR-4/2
11	Quartz A	Saxche-Palmar Polychrome	Bowl	Tomb L2	Vessel 17	2.5YR-4/8	5YR-3/1
12	Sandstone A	Santa Cruz Red	Flat Bottom Bowl	Tomb L2	Vessel 5	5YR-5/8	
13	Quartz A	Saxche-Palmar Polychrome	Bowl	Tomb L2	Vessel 8	2.5YR-5/8	
14	Sandstone A	Zacatal Cream Polychrome	Tripod Plate with Hollow Rattle Feet	Tomb L2	Vessel 2	2.5YR-5/8	5YR-5/1
15	Sandstone B	Remate Red?	Bowl	Tomb L2	Vessel 27	2.5YR-5/8	
16	Quartz A	Remate Red	Bowl	Tomb L2	Vessel 7	2.5YR-5/8	5YR-4/2
17	Quartz A	Zacatal Cream Polychrome	Bowl	Tomb L2	Vessel 9	5YR-5/8	
18	Sandstone A2	Santa Cruz Red	Bowl	Tomb L2	Vessel 26	2.5YR-4/8	
19	Mixed Sandstone and Carbonate A	Balanza Black?	Bowl	Tomb L3	Vessel 2	2.5YR-4/8	5YR-3/1
20	Mixed Sandstone and Carbonate A	Santa Cruz Red	Bowl	Tomb L3	Vessel 3	2.5YR-5/8	
21	Carbonate Sand A	Saxche-Palmar Polychrome	Bowl	Group I Tomb	Vessel 2	2.5YR-5/8	7.5 YR-2.5/1
22	Dolomite A	Zacatal Cream Polychrome	Cylindar Jar	SG 25 Crypt	Vessel 2	2.5YR-5/6	
23	Calcite A	Zacatal Cream Polychrome?	Dish/Plate	SG 53 Cache	Vessel	2.5YR-5/8	7.5 YR-2.5/1
24	Micrite A	Saxche-Palmar Polychrome	Bowl	Tomb F3	Vessel 1	5YR-7/6	
25	Quartz A	Santa Cruz Red	Bowl/Dish	Tomb F1	Vessel 4	2.5YR-5/8	
26	Mixed Sandstone and Carbonate A	Sierra Red	Bowl	Group F Plaza	Vessel 1	2.5YR-4/6	
27	Calcite B	Early Classic Orange Polychrome	Bowl/Dish	Group F Plaza	Vessel 2	5YR-6/6	

Table 3.1. Context and Descriptions of Pottery Sampled from Primary Contexts.

Sample #	Fabric Group	Ceramic Group	Fragment Type	Vessel Form	Rim Diameter	Mound	Context	Munsell Margin	Munsell Core
28	Sandstone B	Remate	Rim	Bowl/Dish	40	SG 36	Fill	7.5YR-6/8	7.5YR-4/1
29	Sandstone B3	Turneffe	Rim	Bowl	30	SG36	Fill	2.5YR-5/8	2.5YR-4/1
30	Mica A	Turneffe	Rim	Jar	25	SG 36	Fill	2.5YR-6/8	
31	Sandstone B	Remate	Rim	Bowl/Dish	30	SG 36	Fill	2.5YR-6/8	
32	Sandstone B	Remate	Rim	Jar	17	SG 36	Fill	2.5YR-6/6	
33	Sandstone B3	Turneffe	Rim	Jar	-	SG 36	Fill	2.5YR-6/8	
34	Sandstone B	Remate	Rim	Jar	20	SG 38	Fill	2.5YR-6/6	
35	Sandstone B1	Remate	Rim	Jar	25	SG38	Fill	5YR-6/6	
36	Sandstone B3	Remate	Rim	Jar	-	SG 38	Feature 1	2.5YR-6/6	
37	Sandstone B3	Remate	Rim	Bowl	23	SG 38	Feature 1	2.5YR-6/6	
38	Sandstone B1	Turneffe	Rim	Jar	25	SG 38	Feature 1	5YR-6/6	
39	Sandstone B1	Turneffe	Rim	Jar	20	SG 38	Feature 1	5YR-6/6	
40	Sandstone B	Turneffe	Rim	Jar	-	SG 38	Feature 1	7.5YR-6/6	
41	Sandstone B	Turneffe	Rim	Jar	25	SG 38	Feature 1	7.5YR-6/6	
42	Sandstone B	Turneffe	Rim	Jar	-	SG 38	Feature 1	7.5YR-6/6	
43	Sandstone B1	Turneffe	Rim	Jar	15	SG 38	Feature 1	5YR-6/6	
44	Sandstone B	Turneffe	Rim	Jar	18	SG 38	Feature 1	5YR-6/6	
45	Sandstone B3	Turneffe	Rim	Jar	20	SG 38	Feature 1	5YR-6/6	5YR-4/1
46	Sandstone B1	Turneffe	Rim	Jar	20	SG 38	Feature 1	7.5YR-5/2	
47	Sandstone B3	Turneffe	Rim	Jar	15	SG 38	Feature 1	7.5YR-6/6	
48	Sandstone B3	Unknown	Flange	Bowl/Dish	-	SG 38	Feature 1	2.5YR-6/6	
49	Sandstone B2	Turneffe	Rim	Jar	-	SG 38	Feature 1	5YR-6/6	
50	Sandstone B	Turneffe	Rim	Jar	-	SG 38	Fill	2.5YR-6/8	
51	Sandstone B3	Turneffe	Rim	Jar	25	SG 38	Fill	5YR-6/6	
52	Sandstone B1	Turneffe	Rim	Jar	-	SG 38	Fill	2.5YR-6/6;	
53	Sandstone B	Turneffe	Rim	Jar	-	SG 38	Fill	2.5YR-6/6	
54	Sandstone B3	Turneffe	Rim	Jar	-	SG 38	Fill	5YR-6/6	
55	Sandstone B	Turneffe	Rim	Jar	25	SG 38	Fill	2.5YR-6/6	2.5YR-5/4
56	Sandstone B3	Turneffe	Rim	Jar	20	SG 38	Fill	2.5YR-6/6	2.5YR-5/4
57	Sandstone B3	Turneffe	Rim	Jar	20	SG 38	Fill	2.5YR-6/6	2.5YR-5/4
58	Sandstone B1	Turneffe	Rim	Bowl/Dish	30	SG 52	Fill	5YR-6/6	
59	Sandstone B2	Remate	Rim	Jar	13	SG 52	Fill	2.5YR-6/6	
60	Sandstone B	Remate	Rim	Bowl/Dish	20	SG 52	Fill	2.5YR-6/6	
61	Sandstone B2	Remate	Rim	Bowl/Dish	30	SG 52	Fill	2.5YR-6/8	
62	Sandstone B2	Remate	Rim	Bowl/Dish	-	SG 52	Fill	2.5YR-6/6	
63	Sandstone B4	Remate	Base	Censor?	-	SG 52	Fill	2.5YR-6/8	
64	Sandstone B2	Remate	Rim	Jar	20	SG 52	Fill	2.5YR-6/6	
65	Sandstone B2	Remate	Rim	Bowl/Dish	-	SG 52	Artifact Concentration	2.5YR-6/6	2.5YR-5/4

Table 3.2. Context and Descriptions of Pottery Sampled from Household Contexts. Feature 1 is a dense ceramic deposit located outside of a structure.

Sample #	Fabric Group	Ceramic Group	Fragment Type	Vessel Form	Rim Diameter	Mound	Context	Munsell Margin	Munsell Core
66	Sandstone B	Remate	Rim	Bowl/Dish	25	SG 52	Artifact Concentration	2.5YR-6/6	
67	Sandstone B	Remate	Rim	Bowl/Dish	-	SG 52	Artifact Concentration	2.5YR-6/6	
68	Sandstone B3	Remate	Rim	Bowl/Dish	25	SG 52	Artifact Concentration	2.5YR-6/6	
69	Sandstone B3	Remate	Rim	Jar	16	SG 52	Artifact Concentration	2.5YR-6/6	
70	Sandstone B2	Remate	Rim	Bowl/Dish	30	SG 52	Artifact Concentration	2.5YR-6/8	
71	Sandstone B2	Remate	Rim	Bowl/Dish	40	SG 52	Artifact Concentration	2.5YR-6/6	
72	Sandstone B2	Remate	Rim	Bowl/Dish	25	SG 52	Fill	2.5YR-6/6	
73	Sandstone B	Remate	Rim	Bowl/Dish	25	SG 52	Fill	5YR-6/6	5YR-4/1
74	Sandstone B3	Remate	Rim	Bowl/Dish	20	SG 52	Fill	5YR-6/6	5YR-4/1
75	Sandstone B	Remate	Rim	Bowl/Dish	25	SG 52	Fill	5YR-6/6	
76	Sandstone B	Remate	Rim	Bowl/Dish	20	SG 52	Fill	2.5YR-6/6	
77	Sandstone B	Turneffe	Rim	Bowl/Dish	15	SG 52	Fill	5YR-6/6	
78	Sandstone B3	Remate	Rim	Bowl/Dish	25	SG 54	Fill	2.5YR-6/6	2.5YR-5/4
79	Sandstone B	Remate	Rim	Jar	-	SG 54	Fill	2.5YR-6/6	
80	Sandstone B	Remate	Rim	Jar	17	SG 54	Fill	2.5YR-7/4	2.5YR-4/1
81	Sandstone B	Remate	Rim	Bowl/Dish	-	SG 54	Fill	2.5YR6/6; 5YR-6/6 (I)	
82	Sandstone B	Remate	Rim	Bowl/Dish	-	SG 54	Fill	2.5YR-6/4	
83	Sandstone B	Remate	Rim	Bowl/Dish	-	SG 54	Fill	2.5YR-6/6	
84	Carbonate Sand B	Hondo	Rim	Jar	15	SG 54	Fill	5YR-7/8	
85	Quartz A	Zacatal	Rim	Dish	25	SG 54	Fill	2.5YR-6/8	
86	Quartz A	Zacatal?	Rim	Dish	-	SG 54	Fill	2.5YR-6/4; 2.5YR-6/6 (I)	
87	Sandstone B3	Remate	Rim	Bowl/Dish	-	SG 54	Fill	2.5YR-6/6	2.5YR-5/4
88	Sandstone B	Turneffe	Rim	Jar	-	SG 54	Fill	7.5YR-5/8	
89	Sandstone B1	Turneffe	Rim	Jar	15	SG 54	Fill	5YR-6/6; 7.5YR-6/2 (I)	
90	Sandstone B	Remate	Rim	Jar	25	SG 54	Fill	2.5YR-6/6	2.5YR-5/1
91	Sandstone B3	Remate	Rim	Jar	23	SG 54	Fill	2.5YR-6/6	
92	Mica A	Zacatal	Rim	Bowl/Dish	-	SG 54	Fill	2.5YR-6/6	
93	Mica A	Remate	Rim	Jar	-	SG 54	Fill	2.5YR-6/6	
94	Quartz A	Remate	Rim	Jar	-	SG 54	Fill	2.5YR-7/4	
95	Sandstone B3	Remate	Rim	Bowl/Dish	-	SG 54	Fill	2.5YR-6/6	
96	Sandstone B	Remate	Rim	Jar	20	SG 54	Fill	2.5YR-6/6	
97	Sandstone B3	Remate	Rim	Jar	25	SG 54	Fill	2.5YR-6/6	

Table 3.2 Cont. Context and Descriptions of Pottery Sampled from Household Contexts.

Thin sections were prepared by HD Analytical Solutions. All samples were impregnated with epoxy resin under vacuum conditions. The slide-mounted samples were trimmed to a 1-1.5mm thickness, lapped and polished to a uniform 30 micron end thickness, and covered with a glass coverslip. Petrographic analysis was conducted by the author using a Leica DM750P polarizing light microscope. All thin sections are described following the descriptive system (Whitbread 1989, 1995: 365-396, 2017; See Howie 2012 for applications in the Maya lowlands). The descriptive system is a qualitative method that combines aspects of sedimentary petrography and soil micromorphology, in addition to rock and mineral identification. This approach permits the examination of technological aspects of pottery production (e.g. raw materials processing, forming technique, and firing methods) in addition to provenance (Freestone 1991; Tomkins et al. 2004; Whitbread 1989, 1995, 2017). The natural clay samples were also analyzed in accordance with the descriptive system to make the two datasets comparable.

Geologic Samples Results

Four rock samples were collected (UAP3, UAP8, UAP11, UAP12; Figure 3.6) and analyzed petrographically. These samples were selected based on macroscopic observations of grain size in order to evaluate the composition of different types of rocks present in the Toledo Beds (e.g. mudstone and sandstone). The sandstone is a grain supported calcareous sandstone with inclusions of sedimentary, metamorphic, and volcanic origin owing to the depositional environment as part of turbidite sequence in

which clastic material is deposited in the ocean (UAP12; Figure 3.7:a). The inclusions are composed of monocrystalline quartz (zoned and undulose), polycrystalline quartz, polycrystalline quartz, chert, chalcedony, bioclastic limestone, plagioclase feldspar (often zoned), muscovite, biotite (often chloritized), igneous rock fragments and zircon. The igneous rock fragments (primarily basalt and glass) likely derive from the Santa Cruz Ophiolite Complex in Guatemala (Schafhauser et al. 2003:6). In this study, they are referred to generally as igneous rock fragments because most inclusions are very small and reliable rock identifications were not possible. The chert, chalcedony, and bioclastic limestone inclusions likely derive from Campur formation limestone. The very fine grained calcareous sandstone sample (UAP11; Figure 3.7:b) and graded bed sample consisting of sandstone, siltstone, and mudstone lamellae (UAP8; Figure 3.7:c) that are composed of the same inclusions but include a greater abundance of micrite and biogenic carbonate grains. Travertine (UAP3) forms in the numerous small stream in the Uxbenká polity but was not used in pottery production.

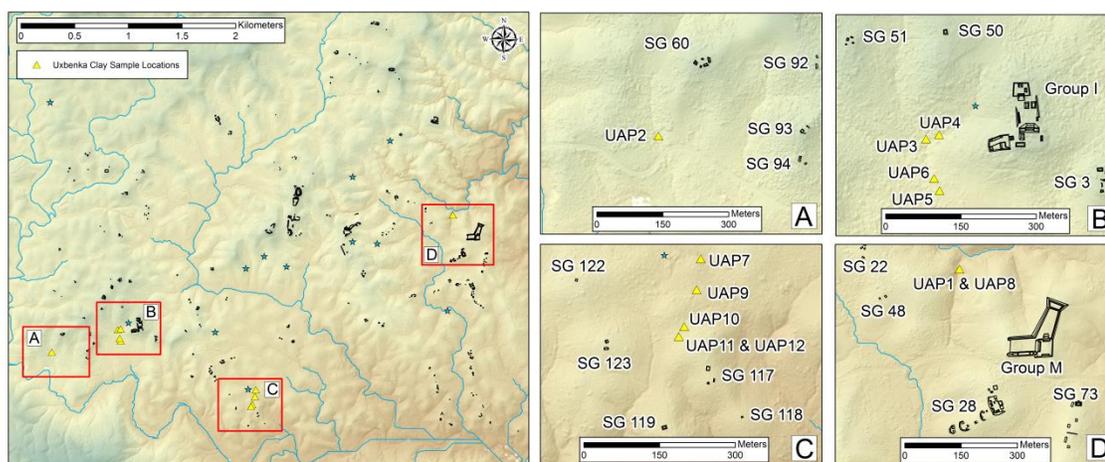


Figure 3.6. The Location of Collected Geologic Samples Included in This Study. (Map by A.E. Thompson)

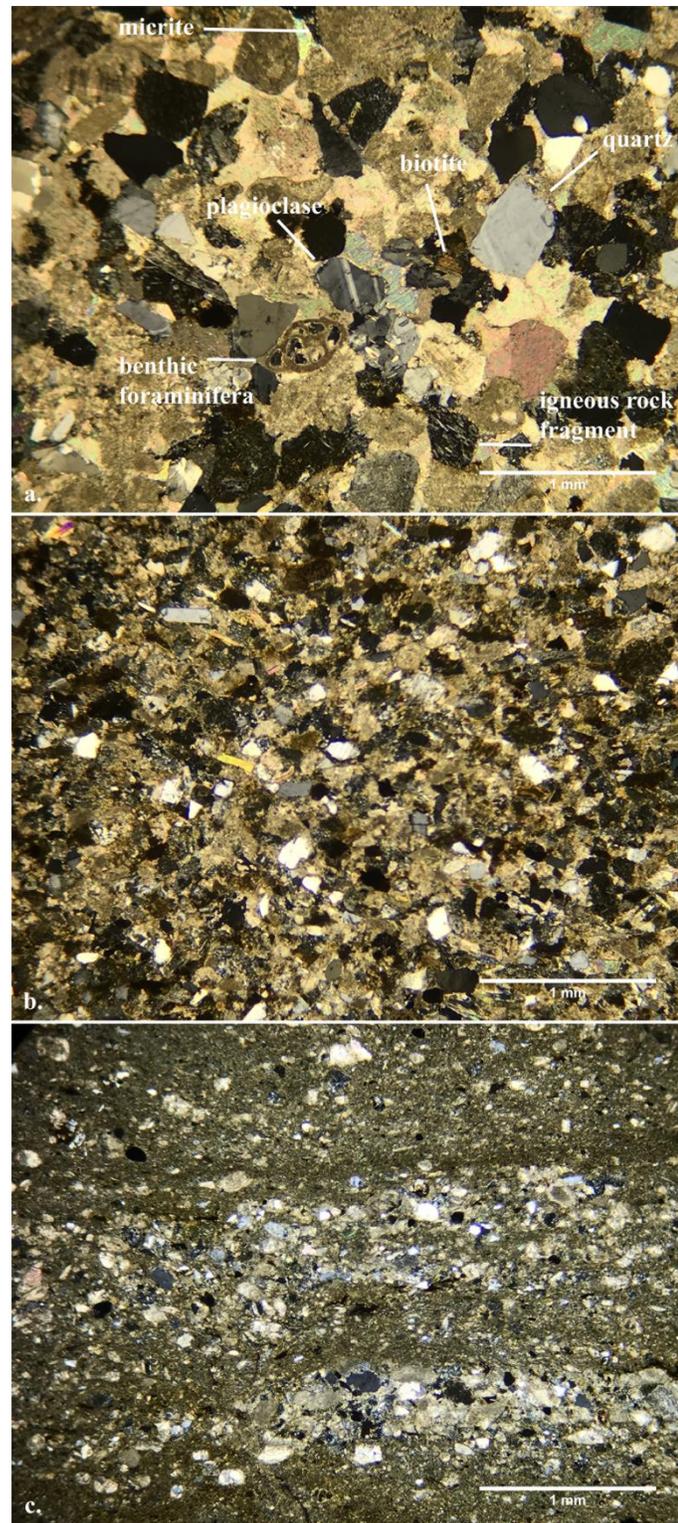


Figure 3.7. Local Rock Samples Micrographs: a. Calcareous Sandstone (UAP12, XPL); b. Fine-grained calcareous sandstone (UAP11, XPL); c. Laminated calcareous sandstone, siltstone, and mudstone (UAP8, XPL).

All of the clay samples ($n=8$) are sandy clays, but they exhibit considerable variability. Inclusions in all samples are rounded to subangular but they differ in both size and composition. The samples contain varying frequencies of the minerals and rocks discussed above and also include sandstone inclusions (Table 3.3). They also contain red, iron-rich concentration features contributing to the overall red color of most clay samples (Figure 3.8); however, the quantity and size of these features differs between samples. The size of the inclusions provides some indication of the general location on the landscape. The UAP 2 sample contains the largest mode size (.8mm, coarse sand) because it was recovered from a topographic low between two hilltops which acts as a catchment area for larger sand particles. While some clay samples contain an abundance of a particular rock or mineral relative to other samples, there is no discernable pattern concerning their location on the landscape around Uxbenká. For example, the UAP 9 contains more mica (muscovite and biotite) than any other samples (Figure 3.8: c). It is located between the UAP7 and UAP10 clay samples that are mica-poor (Figure 3.8: d). It is unlikely that additional clay sampling would produce spatial patterning because of the variability in the underlying sandstone bedrock which formed in a marine environment with varied source locations.

	UAP 1	UAP 2	UAP 4	UAP 5	UAP 6	UAP 7	UAP 9	UAP 10
Textural Characteristics								
Color (PPL)	Golden Reddish Brown	Golden Reddish Brown	Golden Reddish Brown	Brown	Brown	Golden Reddish Brown	Golden Reddish Brown	Golden Reddish Brown
Color (XPL)	Dark Golden Red	Dark Golden Red	Dark Golden Red	Golden Brown	Golden Brown	Dark Golden Red	Dark Golden Red	Dark Golden Red
Coarse (>.125mm):Fine	20:80	40:60	40:60	30:70	40:60	20:80	30:70	20:80
Inclusion Packing	Single to Open Spaced	Single to Open Spaced	Closed to Open Spaced	Single to Open Spaced	Closed Spaced to Double Spaced	Single to Open Spaced	Closed Spaced to Double Spaced	Single to Open Spaced
Inclusion Sorting	Moderately Sorted	Moderately Sorted	Moderately Well Sorted	Moderately sorted	Poorly Sorted	Moderately Well Sorted	Well Sorted	Moderately Well Sorted
Characteristics of Inclusions								
Roundness	Rounded to Subangular	Rounded to Subangular	Rounded to Subangular	Rounded to Subrounded	Rounded to Subrounded	Rounded to Subangular	Rounded to Subrounded	Rounded to Subangular
Size (mm) Largest of all/range of 98%	.75mm (IRF)/.04mm to .45mm	1.5mm (mudstone)/.04m to 1mm	.9mm (quartz)/.04mm to .5mm	.75mm (mudstone)/.04m to .5mm	2mm (quartzite)/.04mm to 1.2mm	.5mm (quartz)/.04mm to .4mm	.5mm (quartz)/.04mm to .3mm	.5mm (quartz)/.04mm to .4mm
Mode size (mm)	.2mm (fine sand)	.8mm (coarse sand)	.3mm (medium sand)	.25mm (medium sand)	.3mm (medium sand) and .8mm (coarse sand)	.3mm (medium sand)	.2mm (fine sand)	.3mm (medium sand)
Inclusions								
Quartz	Dominant	Common	Dominant	Predominant	Common	Dominant	Common	Dominant
Quartzite	Very Few	Very Few	Very Few	Very Few	Common	Very Few	Few	Very Few
Polycrystalline Quartz	Few	Few	Few	Few	Common	Few	Few	Few
Chert	Very Few	Very Rare	Few	Very Few	Few	Few	Very Few	Few
Chalcedony	Rare	Very Rare	Rare	Very Few	Very Few	Absent	Very Few	Absent
Plagioclase	Few	Few	Few	Very Few	Few	Few	Few	Few
Muscovite	Common	Common	Few	Very Few	Few	Few	Dominant	Few
Biotite	Few	Few	Absent	Absent	Few	Few	Common	Few
Sandstone	Few	Few	Few	Very Few	Common	Very Few	Few	Very Few
Mudstone	Few	Dominant	Few	Very Few	Common	Very Few	Few	Very Few
Igneous Rock	Common	Few	Few	Absent	Common	Very Few	Few	Very Few
Zircon	Absent	Very Rare	Very Rare	Absent	Very Rare	Absent	Very Rare	Absent
	Predominant (Pred.)		>70 %		Few		5-15 %	
	Dominant (Dom.)		50-70 %		Very Few (V. Few)		2-5 %	
	Frequent (Freq.)		30-50 %		Rare		0.5-2 %	
	Common		15-30 %		Very Rare (V. Rare)		< 0.5 %	

Table 3.3. Petrographic Analysis of Natural Clay Samples.

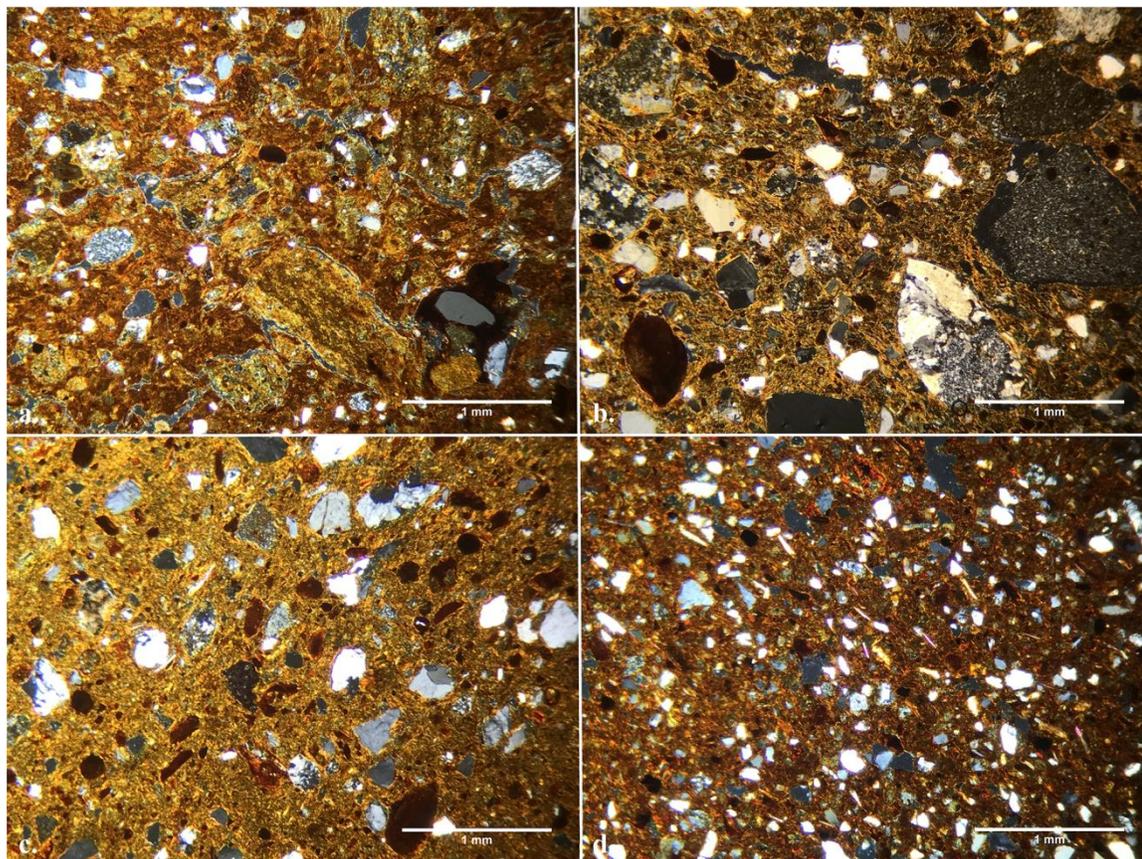


Figure 3.8. Local Clay Sample Micrographs: a. Sample UAP3, XPL; b. UAP6, XPL; c. UAP7; d. UAP9, XPL.

Ceramic Petrography Results

Petrographic analyses revealed 13 distinct fabric groups representing both non-local and local pottery produced using raw materials available in the immediate vicinity of the Uxbenká polity. Non-local pottery is composed of raw materials inconsistent with the local geology and is primarily limited to serving vessels in elite, tomb contexts. The chapter briefly addresses non-local pottery, including possible provenance, but the focus

is on locally produced pottery. A total of 7 non-local fabric groups were identified in the petrographic sample (n=8). The full petrographic descriptions for all fabric groups are presented in Appendix E.

Non-Local Fabric Groups

Seven non-local fabric groups, each represented by a single sample with the exception of Calcite B which is represented by two samples, were identified in the petrographic sample (Table 3.4). Nearly all of the non-local ceramic vessels were recovered from primary cache and burial contexts with the exception of a Hondo Red jar (Sample 84) from a household construction fill context. The paucity of detailed petrographic studies in many regions of the Maya lowlands precludes definitive provenance assessment for most of the non-local samples with the exception of the Belize River Valley (Samples 6, 23, 27; Figure 3.9: d). The provenance for these samples is based on comparison to the petrographic analyses discussed in Chapter 4. Table 3.4 summarizes the non-local fabric groups and includes possible provenance but these associations should be considered tentative at this time. The Micrite A fabric group has been tentatively assigned to the Petén region of Guatemala based on stylistic attributes (Figure 3.9: b; Figure 3.10) and geologic characteristics that are appropriate for the region. These data provide information primarily on elite interactions with other regions, possibly through gift exchange, and indicate that Uxbenká had political and/or economic ties to the north with the Belize River Valley and possibly west into Guatemala. The presence of abundant dolomite (Figure 3.9: c), consistent with the geology of the Coban Formation that outcrops near the Caribbean Coast, suggests interaction with coastal

polities perhaps in conjunction with the distribution of salt (McKillop 2008; McKillop and Aoyama 2018).

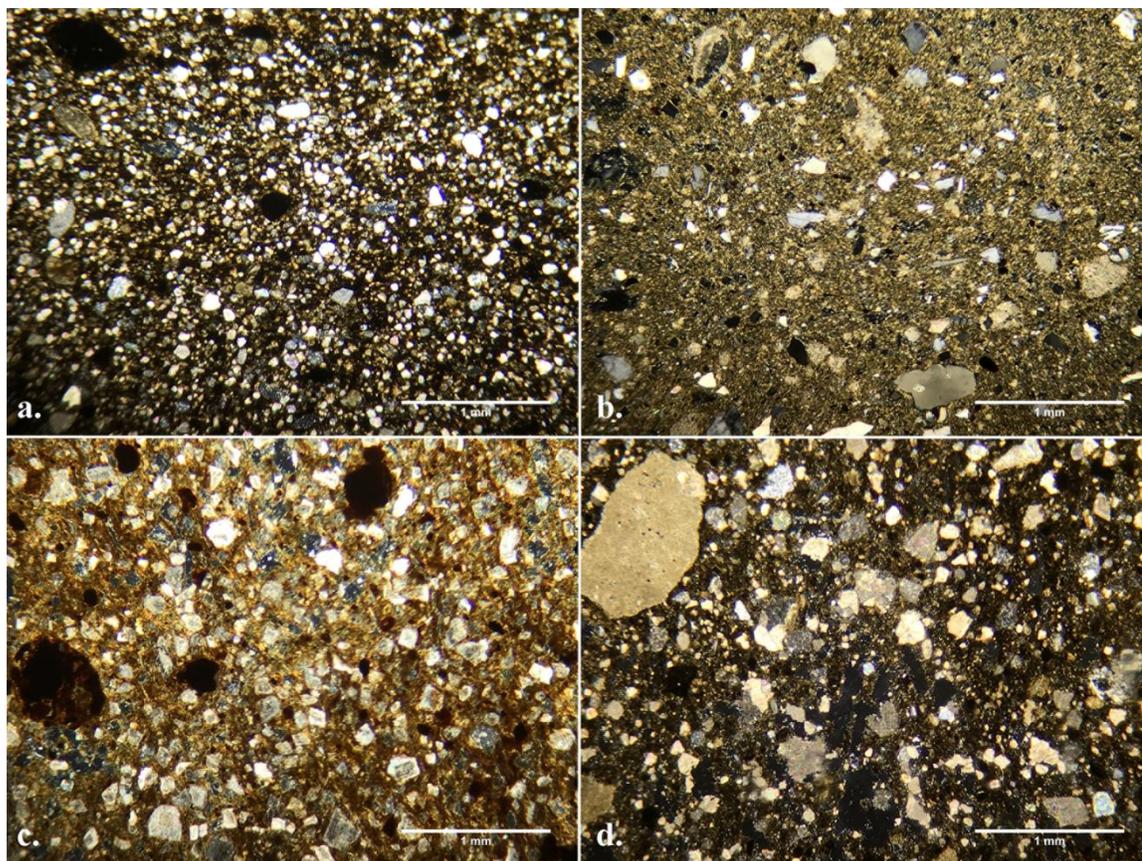


Figure 3.9. Non-Local Pottery Fabric Groups Micrographs: a. Carbonate Sand A, XPL (Sample 21); b. Micrite A, XPL (Sample 24); c. Dolomite A, XPL (Sample 22); d. Calcite B, XPL (Sample 6).

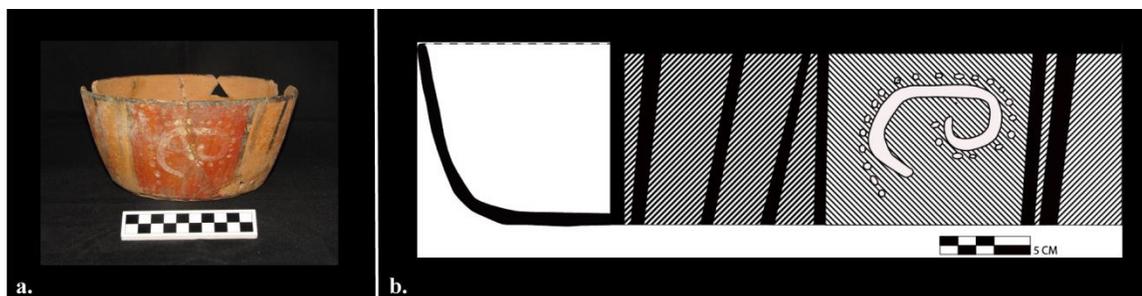


Figure 3.10. Saxche-Palmar Orange Polychrome (Sample 24, Micrite A): a. Photograph; b. Drawing

Fabric Group	Temper	Inclusions (in order of abundance)	Defining Characteristics	Possible Provenance
Carbonate Sand A	None	Carbonate sand, calcite terminal grades, micrite, monocrystalline quartz, sparry calcite	Predominant (>80%) carbonate sand (mode size: .05mm); optically inactive matrix (high fired); unimodal size distribution	Unknown
Carbonate Sand B	None	Carbonate sand, monocrystalline quartz, chert, chalcedony, muscovite	Predominant (>80%) carbonate sand (mode size: .1mm); red groundmass (PPL and XPL); unimodal size distribution	Unknown
Calcite A	Limestone	Calcite terminal grade, monocrystalline quartz, dolomite, micrite, sparry calcite, polycrystalline quartz, chert	Abundant terminal grade calcite (mode size: .3mm); tempered with sparry calcite	Belize River Valley
Calcite B	Limetone	Calcite terminal grades, carbonate sand, monocrystalline quartz, dolomite, polycrystalline quartz, micrite, sparry calcite	Carbonate rich clay (dusty appearance); abundant terminal grade calcite (mode size: .1mm); tempered with various types of limestone (sparry calcite and micrite)	Belize River Valley
Micrite A	None	Micrite, monocrytalline quartz, polycrystalline quartz, chert, muscovite, igneous rock fragments	Fine micritic clay; angular quartz inclusions; volcanic rock inclusions; unimodal size distribution	Unknown (Stylistically Peten)
Dolomite A	None	Dolomite, muscovite, monocrystalline quartz, chert, micrite, chalcedony	Predominance of dolomite (>80%); well-sorted; unimodal size distribution	Southern Belize Coast, near Punta Gorda (Coban Formation)
Volcanic Glass A	None	Tuff, volcanic glass, monocrystalline quartz, biotite, muscovite, plagioclase feldspar, micrite	Predominance of volcanic inclusions (<90%)	Unknown

Table 3.4. Summary of Non-Local Fabric Groups

Local Fabric Groups

Five primary locally produced fabric groups were identified in this sample: Sandstone A, Sandstone B, Quartz A, Mica A, and Mixed Sandstone and Carbonate A group. The *Sandstone A* ($n=7$) fabric group is a moderately sorted, sandy clay containing monocrystalline quartz, calcareous sandstone, plagioclase feldspar, calcareous mudstone, quartzite, chert, chalcedony, polycrystalline quartz, igneous (mostly extrusive) rock fragments, muscovite, and zircon (Figure 3.11: a,b; Table 3.5). The fabric is likely tempered with calcareous sandstone. It is unevenly distributed; however, it is not angular. The rounded habit would be expected if collecting soft, calcareous bedrock (*nib*) but the sandstone could be naturally occurring in clay collected from just above bedrock composed of this type of clastic rock. The size, sorting, and composition of the other mineral and rock inclusions are consistent with locally derived clays. This fabric group contains two subgroups related to resource acquisition and/or raw materials processing. The Sandstone A Fabric Group consists of vessels present only in Group L tomb contexts. Two Early Classic Santa Cruz Red bowls are also represented. The use of this fabric group in Early Classic vessels suggests at least some continuity in production practice throughout the entire occupation of Uxbenká.

The *Sandstone B* Fabric Group ($n=27$) [and its subgroups ($n=37$)] is a moderately to poorly sorted, sandy clay containing sandstone and the same inclusions described above consistent with local provenance. These sandstone inclusions are different than those identified in the Sandstone A fabric group but identical to inclusions found in the natural clay samples. This fabric is tempered with angular, rhombic carbonate (Figure 3.11: c, d). However, the presence of this temper, likely crystalline calcite but possibly dolomite, is based on the shape of the void because the carbonate is no longer present.

Sample 15 (a bowl recovered from a large tomb in the site core), however, still contains calcite providing additional evidence for carbonate temper. It is likely that carbonate was removed due to post depositional leaching and that it remained in the tomb sample because the constructed sandstone walls protected the vessel. The presence of angular, unevenly distributed temper gives this fabric a bimodal appearance. There are two possible sources for the calcite temper: limestones interbedded with clastic deposits as part of the Toledo Formation or the Cretaceous limestone “rock patch” located to the south of the Uxbenká polity. There are no descriptions of crystalline calcite in the interbedded limestone but geologic studies have been minimal. This fabric group contains jars and serving vessels (bowls and dishes) of the Turneffe Unslipped and Remate Red ceramic types in a wide variety of shapes and sizes (see Figure 3.12).

The mineralogical variability in the subgroups is the same as the main group but they differ slightly in the color of the groundmass and abundance of naturally occurring inclusions. In order to determine if the Sandstone B subgroups represented groups of potters that produced vessels in a slightly different way, each sample was categorized by fabric subgroup, ceramic type, and vessel form (Table 3.6; Figure 3.12). The data on form did not produce any clear patterns indicating that the Sandstone B fabric subgroups do not reflect groups of potters responsible for the creation of different vessel and/or rim forms. Rather, there is considerable variation in overall vessel form and rim form for each subgroup. It is likely that these subgroups represent differences in firing or slight differences in local provenance producing the color variation noted in petrographic analysis.

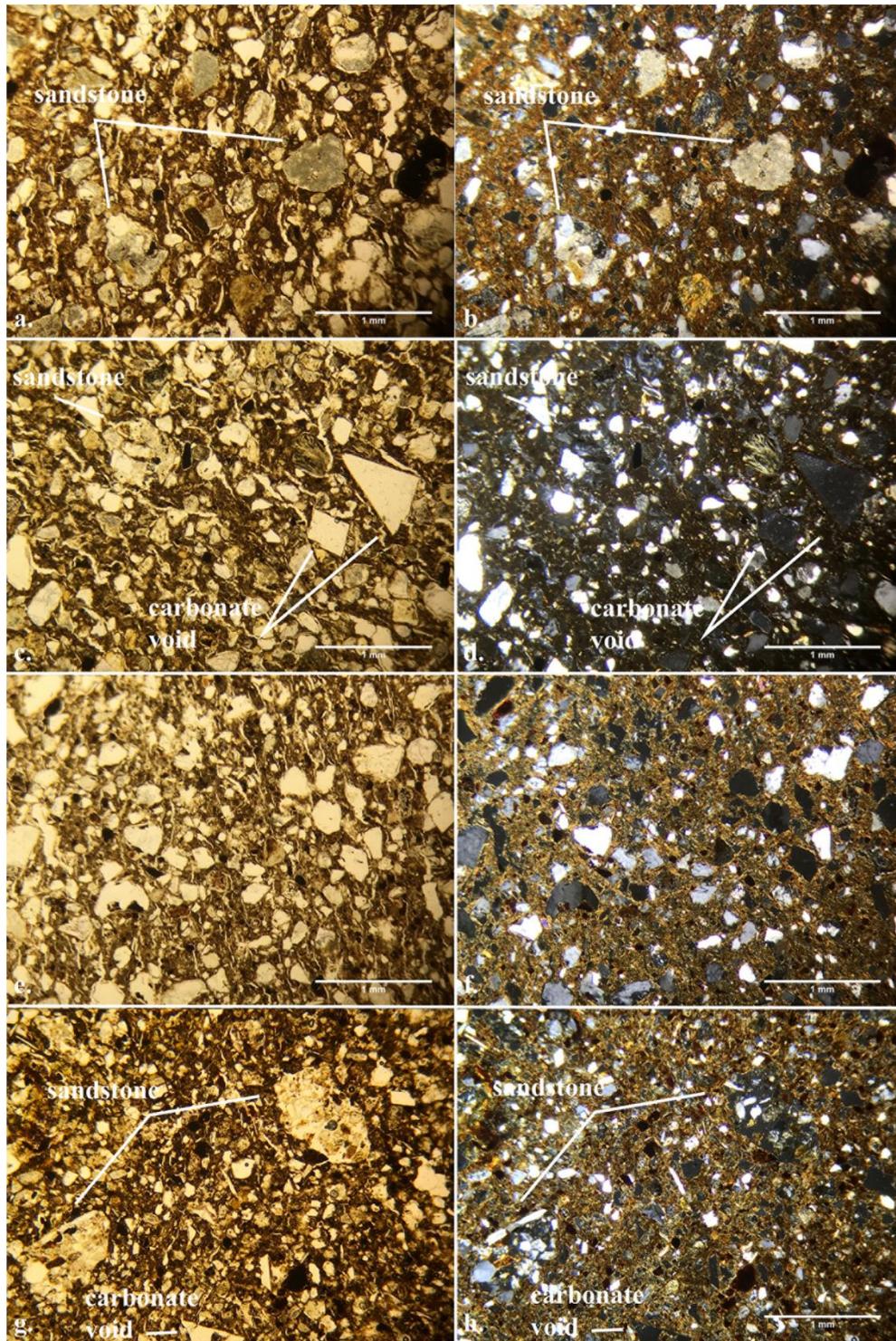


Figure 3.11. Locally Produced Ceramic Groups Micrographs: a. Sandstone A, PPL (Sample 14); b. Sandstone B, XPL (Sample 14); c. Sandstone B, PPL (Sample 75); d. Sandstone B, XPL (Sample 75); e. Quartz A, PPL (Sample 10); f. Quartz A, XPL (Sample 10); g. Mica A, PPL (Sample 94); h. Mica A, XPL (Sample 94).

Fabric Group	Temper	Inclusions (in order of abundance)	Mode Size of Inclusions	Defining Characteristics
Sandstone A	Calcareous sandstone	Monocrystalline quartz, muscovite, calcareous sandstone, plagioclase feldspar, calcareous mudstone, biotite, quartzite, chert, chalcedony, polycrystalline quartz, igneous rock fragments, zircon	.3mm (medium sand)	Highly birefringent calcareous sandstone temper; various naturally occurring rock and mineral inclusions
A1	Calcareous sandstone		.25mm (medium sand)	Same as Sandstone A but with smaller sized temper and naturally occurring inclusions.
A2	Calcareous sandstone and rhombic carbonate		.3mm (medium sand)	Same as Sandstone A but with rhombic, carbonate inclusions as temper
Sandstone B	Rhombic Carbonate (likely calcite but possibly dolomite)	Monocrystalline quartz, muscovite, rhombic carbonate, sandstone, chert, mudstone, quartzite, plagioclase feldspar, biotite, igneous rock fragments, zircon	.35mm (medium sand)	Naturally occurring sandstone (not birefringent); angular carbonate temper; various naturally occurring rock and mineral inclusions; more abundant chert than in Sandstone A; golden brown micromass (XPL)
B1				Same as Sandstone B but with a very dark golden brown (XPL) micromass
B2				Same as Sandstone B but with a golden reddish brown (XPL) micromass
B3				Same as Sandstone B but with sparse naturally occurring inclusions
Quartz A	None	Monocrystalline quartz, polycrystalline quartz, quartzite, chert, chalcedony, plagioclase feldspar, muscovite, biotite, igneous rock fragments, sandstone, zircon	.2mm (fine sand)	No carbonate (either as temper or naturally occurring); unimodal size distribution; generally smaller inclusions; absence of large rock and mineral inclusions
Mica A	Rhombic Carbonate (likely calcite but possibly dolomite)	Monocrystalline quartz, muscovite, biotite, rhombic carbonate, sandstone, plagioclase feldspar, quartzite, polycrystalline quartz, igneous rock fragments, zircon	.1mm (very fine sand)	Micaceous clay; very fine sand inclusions
Mixed Carbonate and Sandstone A	Rhombic crystalline calcite	Monocrystalline quartz, muscovite, calcite, sandstone, chert, mudstone, quartzite, plagioclase feldspar, biotite, igneous rock fragments, zircon	.35mm (medium sand)	Abundant rhombic crystalline calcite inclusions; very similar to Sandstone B except for the use of more carbonate temper

Table 3.5. Summary of Locally Produced Fabric Groups.

	Sandstone B	Sandstone B1	Sandstone B2	Sandstone B3
Ceramic Group				
Turneffe	9	7	1	8
Remate	18	1	8	10
Unknown				1
Vessel Form				
Jars	14	7	3	11
Bowls/Dishes	13	1	6	8
Group and Form				
Turneffe Bowls	1	1	0	7
Turneffe Jars	8	6	1	1
Remate Bowls	12	0	6	6
Remate Jars	6	1	2	4
Settlement Group				
SG 36	4	1	0	2
SG 38	7	5	1	7
SG 52	7	1	8	6
SG 54	8	1	0	2

Table 3.6. Sandstone B Fabric Subgroups categorized by ceramic group, vessel form, ceramic group and form, and location (settlement group).

The *Quartz A* Fabric Group (n=12) is nearly identical to the Sandstone B Fabric Group except for an almost complete lack of rock content and limestone temper (Figure 3.11: e, f). The unimodal size distribution indicates that no temper of any kind was added. The mineralogy, sorting, and size of the sand inclusions is consistent with geology descriptions of the Toledo formation and comparable to natural clay samples indicative of a local provenance. However, all of the clay samples also include rock (mudstone, sandstone, igneous rock fragments) inclusions. This suggests that potters either removed the rock content as part of raw materials processing or purposefully selected clays devoid of rock content (i.e. clay not located just above bedrock). This fabric group is present primarily in thinner-walled, Saxche-Palmar Orange bowls and Zacatel Cream polychrome serving vessels including bowl/dishes and cylinder jars (Figure 3.12). It is used with less frequently in the production of monochrome Late Classic Remate Red jars and an Early Classic Santa Cruz Red bowl. The lack of rock content, either by removal or

purposeful clay selection, is a technological choice. The fact that these vessels also completely lack carbonate content, unlike both Sandstone Fabric Groups, is also a deliberate choice by potters. This fabric group again provides evidence for continuity in production practice from the Early to Late Classic at Uxbenká.

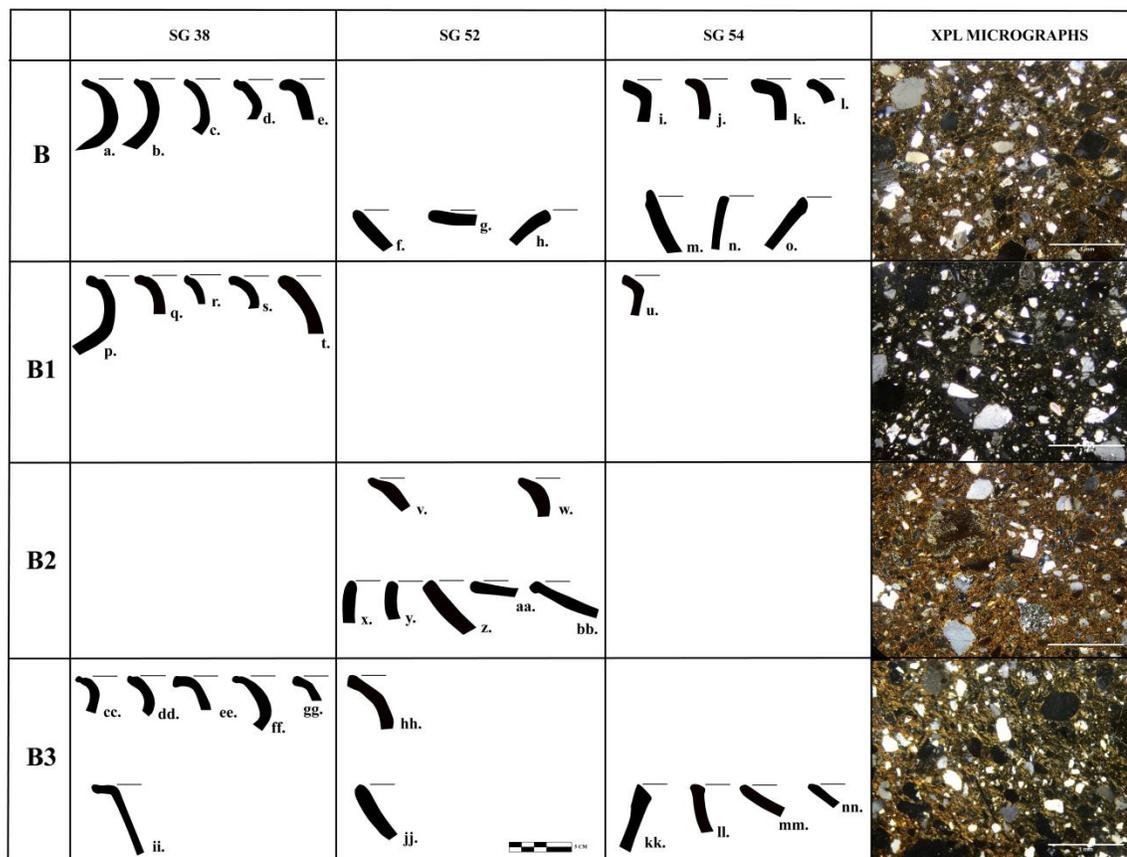


Figure 3.12. The Sandstone B Fabric Group and Subgroups categorized by Ceramic Group and Rim Form. Sandstone B: Turneffe Unslipped (a. 42, b.44, d. 41, e. 50, k. 88) and Remate Red (c. 34, f. 60, g. 67, h. 66, i. 90, j. 79, l. 80, m. 83, n. 81, o. 82); Sandstone B1: Turneffe Unslipped (q. 43, r. 39, s. 46, t. 38, u. 89) and Remate Red (p. 35); Sandstone B2: Remate Red (v. 59, w. 64, x. 65, y.61, z. 71, aa. 70, bb. 62); Sandstone B3: Turneffe Unslipped (cc. 45, dd. 47, ee. 51, gg. 54) and Remate Red (ff. 36, ii. 37, hh. 69, jj. 68, kk. 95, ll. 78, mm. 87, nn. 90).

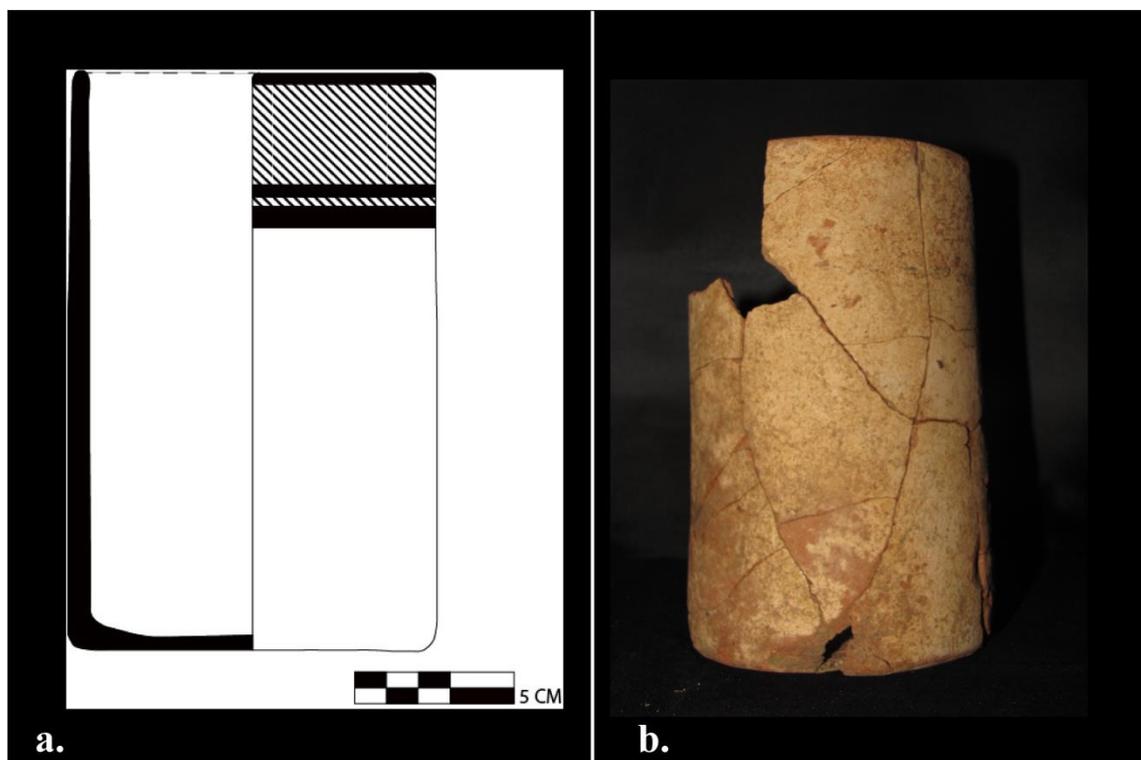


Figure 3.13. Zacatel Cream Cylinder Jar (Sample 6, Quartz A): a. Drawing; b. Photograph

The *Mica A* Fabric Group is similar to the Sandstone B Fabric Group except that the clay is very micaceous (primarily muscovite) and the rock and mineral inclusions are much smaller (mode size: .15mm; very fine sand-sized). The *Mica A* group is also tempered with rhombic crystalline calcite or dolomite (Figure 3.11: g,h). Only three samples, all dating to the Early Classic Period, were characterized as the *Mixed Carbonate and Sandstone A* fabric group. This group is nearly identical to Sandstone B but with a more crystalline calcite temper. The abundance of this type of temper is consistent with macroscopic characterizations of the majority of pottery from the Early Classic Period. The vessel form for the *Mica A* Fabric Group is consistent with Sandstone B.

The remaining sections consider the petrographic data collected on locally produced pottery and geologic samples to evaluate resource acquisition and raw materials processing as part of a potters' paste recipe. These data are used to identify communities of practice among household pottery producers in order to address intrapolity information exchange, and the relationship between information exchange networks and spatial boundaries, at Late Classic Uxbenká.

Communities of Practice at Uxbenká

In the Maya Lowlands, household potters living in the hinterlands surrounding the core of monumental architecture produced the unslipped and monochrome storage and serving vessels used by elite and non-elite alike in their everyday lives (Jordan and Prufer 2017). Painted, polychrome serving vessels were also likely produced by household potters although some, particularly the more elaborately decorated vessels with courtly scenes and hieroglyphic texts, may have been decorated by elite artisans (Rice 2009). Pottery production is a complex process involving numerous steps including the gathering and processing of raw materials, combining the materials into a workable mixture, forming, drying, firing and decoration including the application of slips and paint (Crown 2014; Rice 2015; Rye 1981; Shepard 1985). Potters are not born with the knowledge and skill necessary to manufacture a ceramic vessel. Rather, they must learn the process through interactions with more experienced potters (Crown 2014). Although learning frameworks vary (Hayden and Cannon 1984; Schiffer and Skibo 1987), most learning within traditional societies, including the ancient Maya, occurs through imitation

and observation (Crown 2002, 2014). The most salient aspect of this type of learning framework to this study is that it occurs through repeated, face-to-face interaction between experienced potters and learners. While each step of the pottery production process requires specialized knowledge, this study is primarily concerned with where potters acquire raw materials and how they combine clay and temper into a distinctive paste recipe.

Most of the Late Classic pottery produced at Uxbenká is remarkably similar. However, there are important differences in both paste recipe and context indicative of more than one community of practice. Potters procured clay and temper in the immediate vicinity of the polity (<1km), likely from the red, clay-rich sandy soils located in the southern portion of the settlement area. The sandy clay, with a wide variety of rock and mineral inclusions, was used by potters in five primary paste recipes. These recipes differ in how the clays were processed, both in terms of removing large inclusions to refine the natural clay and by adding (or not adding) temper.

The Sandstone A Fabric Group is characterized by a unique paste recipe used to create ceramic vessels found in ritually charged spaces. The use of highly calcareous sandstone as temper is a practice not identified in any other locally produced paste recipes. All of the vessels produced in this manner were recovered from an elite tomb located in the site core, a courtyard likely used for elite habitation. Potters who used this paste recipe produced Late Classic orange-slipped Saxche-Palmar Orange bowls and Palmar Orange cylinder jars as well as cream-slipped Zacatel Cream polychrome tripod plates. It was also used in the production of two monochrome red bowls that were stylistically dated to the Early Classic Period. The choice by potters to use a paste recipe

with calcareous sandstone inclusions is likely not a functional one dictated by the physical properties of the clay to produce a particular vessel form. Rather, it appears to have been used for the production of special purpose items and this practice extends back to the earliest period of occupation at Uxbenká. A larger sample set is necessary to determine if the vessels composed of this paste recipe are exclusively found in funerary contexts. In terms of practice, this fabric group could represent a distinct community of practice in which potters created vessels for a specific purpose. However, it is more likely that this fabric groups represents a different temper choice by potters in the same community of practice discussed below.

The majority of the pottery produced at Uxbenká is composed of the Sandstone B and Quartz A fabric groups. Nearly all pottery (n=64; 90 percent of the household sample) recovered from domestic contexts was characterized as the Sandstone B Fabric Group. Potters used this paste recipe to produce Turneffe Unslipped and Remate Red jars in a wide variety of forms including restricted orifice and unrestricted orifice jars, incurving wall bowls, and flared wall bowls and dishes. The Quartz A fabric group was used in the production of Zacatel Cream and Saxche-Palmar and Palmar Orange polychrome vessels recovered from both site core and household contexts. Potters produced multiple vessel forms, including cylinder jars and flared wall dishes, but they exhibit much less variation in form than vessels produced using the Sandstone B paste recipe. The difference in these two fabric groups is related to raw materials processing. The clay used to produce thin-walled polychrome vessels was either processed to remove large rock and mineral fragments or preferentially selected because it contained smaller inclusions. In addition, no carbonate was added to the Quartz A fabric.

These two paste recipes are likely the result of potters within the same community of practice using different recipes for different vessel forms due to functional requirements. The raw materials selection and/or processing reflect the potter's intimate knowledge of their landscape and performance characteristics of the raw materials. A potter cannot produce a thin-walled vessel with large inclusions. The clay may have been procured from locations where the natural clay contained smaller inclusions (e.g. near the tops of hillslopes). Given that all large rock fragments, including chert and igneous rock fragments, are absent in this fabric group it is probable that the natural clay was processed by potters, perhaps through levigation, sieving, or simply removing large rocks by hand. The absence of carbonate in the Quartz A fabric may be due to the fact that calcium carbonate rehydrates when heated, causing expansion of the vessel walls and creating stress. This rehydration can cause low strength, spalling, cracking, and crumbling (Rice 2015:377), which are more likely to affect a thin-walled vessel. The petrographic data indicate that nearly all pottery at Uxbenká, be it unslipped or red-slipped utilitarian vessels or polychrome serving wares, was produced by potters within a single community of practice.

Petrographic studies of Lowland Maya pottery are minimal; however, information on paste recipes from other polities indicates the variation in practice across the region and highlights how smaller polities like Uxbenká differ in terms of social organization. Ceramics from the large polity of Palenque, located in Chiapas, Mexico, were produced using four primary paste groups that could be distinguished on the basis of mineralogical differences owing to the unique geology of the region. The distribution of these paste groups suggests that pottery at Palenque was produced via community specialization

(Rands and Bishop 1980:42). Detailed analysis of technological and stylistic attributes on pottery from Tikal, another large lowland Maya polity located in Petén, Guatemala, suggests a similar type of production in which communities produced pottery using a unique paste recipe that can be distinguished from other communities based on technological attributes (Fry 1979). Howie's (2012) large petrographic study of Terminal to Postclassic pottery at Lamanai in northern Belize revealed five distinct petrographic traditions that could be tied to the local landscape. The paste recipes differed in the type of raw materials used as well as different processing techniques including the addition of different types of temper suggestive of multiple, distinct communities of practice operating simultaneously. Pottery production from at Preclassic K'axob in northern Belize is most similar to the data from Late Classic Uxbenká. Potters used different paste recipes for vessels with different functions. Unslipped vessels were produced using calcite tempers while slipped serving wares exhibited a variety of inclusions (Bartlett 2004). The homogeneity in production practice at Uxbenká, including at least some continuity from the Early to Late Classic Periods, is likely due to the fact that Uxbenká is a small polity that supported a limited group of potters and reveals long-term stability in potting practice.

Neighborhoods, Districts, and Intracommunity Interaction

The Uxbenká settlement area, like other low-density, agrarian based urban environments in tropical regions, consists of dispersed households organized in a similar and repetitive pattern (Fletcher 2009). Although the distribution of households in the

region is affected by the uneven, hilly topography, households group into spatially discernable neighborhoods and districts. This study seeks to understand non-elite, bottom-up social organization through the investigation of local pottery production. Three Late Classic households (SG 38, SG54, SG56) and one Early Classic household (SG 60) participated in household ceramic production (Figure 3.5). Three of these households are located in the same neighborhood in District 3. SG 38 is located in a separate and isolated neighborhood located between District 1 and District 2. Although these households are located within distinct, spatially defined neighborhoods and districts, they are all situated in the southwest portion of the Uxbenká settlement. The proximity of households participating in similar economic activities has been noted elsewhere in Mesoamerica (e.g. Feinman and Nicholas 2012). In the case of Uxbenká, the location of these households near one another in the southern portion of the site is likely related to proximity to raw materials required for pottery production. All four households are located atop the clays used in pottery production and are closest to the Rio Blanco, which would have provided a reliable perennial source of water, and to the “rock patch” where limestone temper was likely procured.

Household potters participated in a single community of practice in which they shared information on resource acquisition, raw materials processing, and used the same repertoire of ceramic and stone tools for pottery production (Jordan and Prufer 2017). While potters living in a particular neighborhood undoubtedly interacted with one another regularly, interaction networks among potters extended beyond the boundaries of spatially defined neighborhoods. SG 52 and SG38 are located over 2km from one another in different neighborhoods. These two settlement groups are low-status households

comprised of only two modest structures and share a similar suite of household artifacts. By considering the paste recipe of locally produced pottery, and how this reflects learning networks and practice, it was possible to determine that the inhabitants of these households were part of the same community of practice. This approach revealed a link between two households that would have otherwise gone unnoticed due to their distance from one another, location in two distinct, non-contiguous neighborhoods, and comparable artifact assemblages. Identical economic activities, in this case pottery production, occurred in multiple neighborhoods and not all households in a neighborhood participated in pottery production. There is not a one to one relationship between spatial unit and economic activity at Uxbenká. The lack of a direct correlation highlights the importance of considering both practice and place in neighborhood studies.

Some inferences concerning the social organization of districts are possible with this study. The presence of Group I, with its monumental architecture, public spaces including large plazas and a ballcourt, and elite residential complex, certainly suggests that District 3 functioned as an administrative district. Administrative districts, and the location of households near monumental architecture, are often evaluated in terms of top-down processes and urban planning as dictated by elites or at least related to the services they can offer (e.g. Chase 2016). While this may have played a role in the formation of districts at Uxbenká, the data presented in this paper suggests that the location of some of the households (SG 52 and SG 54) in District 3, and adjacent to the district as is the case of SG 38, was the result of bottom-up decision making based on the location of raw materials suitable for pottery production and/or the desire to live near other people who participated in pottery production. These households may have functioned as a social

district in which the inhabitants shared similar social characteristics and interacted regularly as part of their involvement in the same community of practice. They are located far enough apart that they cannot be considered part of the same neighborhood although they likely interacted with one another face-to-face on a regular basis. The social aspects of districts, at least in the case of Uxbenká, cannot be defined as a single spatial unit.

Conclusion

The goal of this study was to consider both practice and place when evaluating intrapolity social organization among non-elite populations in low-density, agrarian-based urban environments. Evaluating locally produced pottery within the communities of practice framework, combined with technological analyses focused on reconstructing paste recipes, provides a method for evaluating interaction among crafts producers living within the same urban environment. The ceramic data from Uxbenká, in conjunction with geospatially identified neighborhoods and districts, indicate that potters lived in different neighborhoods clustered in the southwest periphery of the settlement area. They shared information about the pottery production process, indicative of face-to-face interaction, across neighborhood boundaries and not all households in a neighborhood participated in craft production. Although the conclusions regarding the composition and organization of districts are preliminary, this study suggests that administrative districts may also function as social districts but that these boundaries are not easily defined in spatial terms. This paper focused on the Uxbenká case study to demonstrate a theoretical and

methodological approach that is broadly applicable and well-suited for evaluating interaction and social boundaries in dispersed low-density urban environments. The approach complements spatial analyses and provides an opportunity to examine intrapolity interaction that is flexible enough to consider historical development, reducing homogenization in cross-cultural studies.

CHAPTER 4

**POTTERY, PRACTICE, AND PLACE: A COMMUNITIES OF PRACTICE
APPROACH TO NON-ELITE INTERACTION IN THE BELIZE RIVER
VALLEY**

Daily activities play an important role in defining social groups, yet certain aspects of practice and place that define contemporary social groups, including who we interact with and where, are obscured in the archaeological record. Researchers are tasked with defining social boundaries and interaction networks based solely on material culture. In many cases, the focus is on long distance trade and/or interaction networks based on the distribution of exotic goods. In some regions, such as the Maya lowlands, interaction networks among elites are evaluated based on information contained in hieroglyphic texts on monuments and portable artifacts (Martin and Grube 2008). This approach yields important information but it inordinately favors our understanding of elite interaction networks.

Most approaches to understanding non-elite social organization and interaction in the Maya lowlands rely heavily on spatial data. This often involves delineating polity boundaries based on the dispersion of households around a centrally located core of monumental architecture and detailed settlement pattern studies (Ashmore 1981; Bullard 1960; Ebert et al. 2016a; Willey et al. 1965). Most recently, the identification and analysis of neighborhoods, defined as discrete spatial groups composed of multiple households where face-to-face interaction occurs regularly, has provided additional insight (Arnauld et al. 2012; Bevan et al. 2013; Hoggarth 2012; Smith 2010; Thompson

et al. 2018). While people living within the same polity and neighborhood certainly interacted with one another regularly, spatial analyses alone cannot capture the broad and often complex relationships that exist within and among individuals in communities. Evaluating interaction networks that extend beyond, or crosscut, these spatial groups is even more challenging. The vast majority of the material culture recovered from non-elite households consists of locally produced items, such as utilitarian pottery and stone tools, which tend to be stylistically and technologically similar, rendering it difficult to assess interaction based on resource acquisition and trade.

This study approaches social boundaries within a community of practice theoretical framework and explores potter interaction as a proxy for community interaction in the Late to Terminal Classic (600-900 CE) Upper Belize River Valley (Figure 4.1; hereafter abbreviated BRV). Pottery production in the Maya lowlands was the domain of non-elite potters and is characterized as a decentralized, part-time, seasonal activity conducted in rural areas (Howie 2012; Rice 2009). A potter learns to create a ceramic vessel within a community of practice and “what is transmitted is rarely imputable to a single person but corresponds to shared norms of a particular group, be it a family, a local socioprofessional grouping, the potters of a whole district, or some other grouping” (Gosselain 2008: 160). Potter interaction networks act as a proxy for non-elite relationships at a more general level because information exchange among pottery producers occurs within existing social networks.

The BRV is one of the most studied regions in the Maya lowlands due to early and sustained archaeological research, particularly in the realm of settlement pattern analysis and household archaeology (Ashmore 1981; Bullard 1960; Ebert et al. 2016b;

Garber 2004; Hoggarth 2012; Robin 2003, 2004; Willey et al. 1965). This study builds upon this large body of data and provides an additional dataset with which to evaluate non-elite social networks.

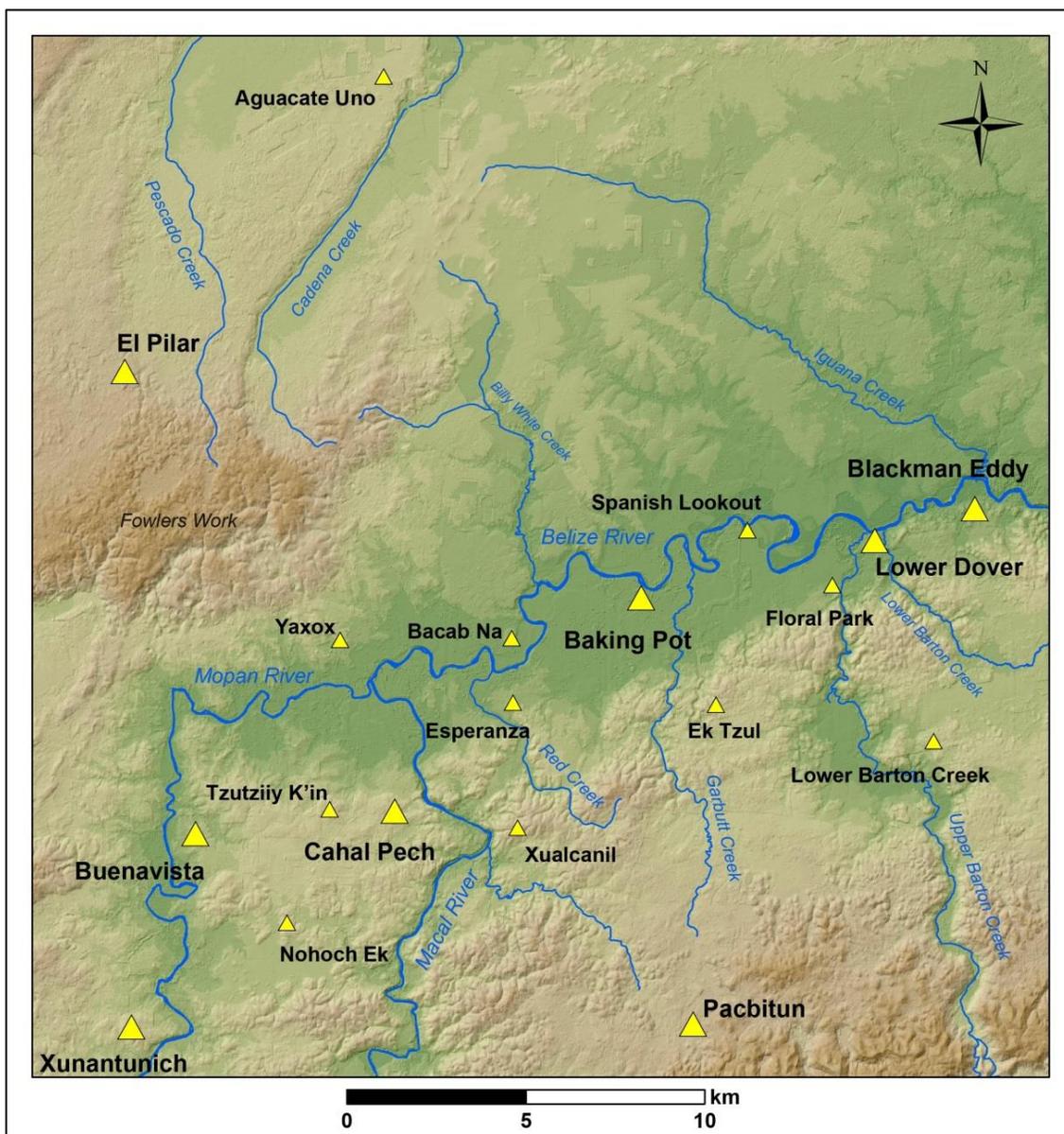


Figure 4.1. Map of the Belize River Valley. (Map by C.E. Ebert)

We employ thin section petrography and macroscopic observations to identify communities of practice by evaluating low and high visibility attributes on unslipped jars and monochrome bowls and dishes (n=144) recovered from five households in a single neighborhood at Baking Pot. Our analysis focuses primarily on low visibility attributes, which cannot be seen by observing a finished ceramic vessel, because information on these attributes must be learned via face-to-face interaction (Carr 1995). We consider resource acquisition and raw materials processing, as part of a paste recipe, because these attributes can be reliably evaluated using petrographic analysis and they provide information on how potters interacted with both their landscape and with one another. We also consider vessel form and color, which can be clearly observed on the finished product, and are thus high visibility attributes, which can be copied. We evaluate these attributes with reference to paste recipe in order to determine if communities of practice manifest in a highly visible manner. By evaluating the extent and nature of shared ceramic traits, it is possible to identify interaction networks among non-elite potters living in the Late to Terminal Classic BRV. The provenance information gleaned from petrographic analysis is also used to consider the BRV as a taskscape in which potters collected raw materials in association with other activities including habitation and farming (Arnold 2018; Gosselain 1998; Ingold 2000; Michelaki et al. 2012, 2015). We argue that potters living across the BRV were part of a regional constellation of practice (Wenger 1998) in which potters participated in a shared technological tradition and conducted daily activities as part of a shared taskscape.

Communities and Constellations of Practice

A ceramic vessel is not only a durable container for transporting, storing, cooking, and serving food and water. It is the physical manifestation of a potter's social relationships. Pottery production is a multi-step process that requires considerable knowledge about the local landscape and the properties of raw materials. Information about each step of the production process, from clay selection to firing, is imparted by an experienced potter to a learner (Crown 2014). Among the modern Maya, and in many traditional communities, learning occurs through imitation and observation with no formal instruction (Arnold 2008; Crown 2007a; Deal 1998; Hayden and Cannon 1984; Minar and Crown 2001). Ethnographic studies on Maya potters demonstrate considerable variability in social networks in which learning occurs, a pattern that likely extends back in time to the ancient Maya. Most potters learn within the household from an immediate family member but some learn from extended kin and non-family members beyond the household, at the neighborhood level or from potters in another village (Deal 1998:27-37; Hayden and Cannon 1984:351). The household is certainly an important locus of interaction among the Maya (Freter 2004; LeCount and Yaeger 2010; McAnany 1995; Robin 2003, 2004; Webster and Gonlin 1988; Wilk and Ashmore 1988; Wilk and Netting 1984; Yaeger and Canuto 2000), but social relationship extended beyond the household, neighborhood, and even the polity. While the exact learning framework cannot be determined for the ancient Maya (Schiffer and Skibo 1987), the most important element is that learning and knowledge transmission occurred through face-to-face interaction.

Potters make choices regarding the materials they use and how they use them; these choices are learned and passed on via social relationships. They reflect a potter's involvement in a community of practice which, which is a group of people who engage in a similar learning environment and shared experience (Lave and Wenger 1991; Wenger 1998). This framework, originally developed to explore shared practice in contemporary society, examines the relationship between community and practice through the integration of mutual engagement, joint enterprise, and shared ways of doing (Lave 2008; Lave and Wenger 1991; Roddick and Stahl 2016; Wenger 1998). Different communities of practice can form a constellation of practice, which is a group of people too broad, diverse, or diffuse to be considered one community. Participants in a constellation of practice are connected by shared historical roots, related enterprises, or geographic relations, to name a few (Wenger 1998:126-133). In this study, both decorative style and technological style are viewed as an intentional choice by potters (Gosselain 1998, 2008; Hegmon 1998; Lechtman 1977; Lemonnier 1986, 1992) and these choices are indicative of different aspects of a potter's interaction sphere.

Identifying Interaction Networks in the Belize River Valley

Archaeological studies have traditionally focused on decorative style to evaluate interaction and social boundaries (Hegman 1992; Neimann 1995; Sackett 1977; Weissner 1989; Wobst 1977). This study incorporates aspects of decorative style, but focuses primarily on technological style. Technological style provides an alternative avenue for evaluating social boundaries (Lechtman 1977). Technology is not simply the rules that

govern the behavior of raw materials and the artisans' knowledge of these physical properties. According to Lechtman (1977:6), "it is the format or 'package' defined by these relationships that is stylistic in nature, and it is the style of such behavior, not only the rules by which any of its constituent activities is governed, that is learned and transmitted through time."

Attributes of material culture that are directly related to human behavior learned within a community of practice are evaluated by investigating multiple steps of the pottery manufacturing process from resource acquisition to final product appearance following a *chaîne opératoire* methodology (Lemonnier 1986, 1992). Specifically, this study focuses on paste recipe, vessel form, and color (Table 4.1).

Attribute	Research Questions	Visibility Level	Learning Mode	Geographic Distribution
Paste Recipe				
Resource Acquisition	Where did potters procure raw materials (clay, temper, fuel, water)? How did potters share (or not share) information on resource acquisition?	Low	Process-Oriented	Restricted
Raw Materials Processing	Did potters process natural clay (e.g. levigation, sieving, rock removal, add temper)? How did potters share (or not share) information on processing?	Low	Process-Oriented	Restricted
Styles of Form				
Vessel Form	Does paste recipe correspond with overall vessel form (restricted orifice jar, unrestricted orifice jar, monochrome bowl/dish)?	High	Process-Oriented or Final Product	Restricted or Broad
Rim Form	Does paste recipe correspond with rim form?	High	Process-Oriented or Final Product	Restricted or Broad
Color	Does paste recipe correspond with vessel color on monochrome serving wares (black versus red)?	High	Process-Oriented or Final Product	Restricted or Broad

Table 4.1. Ceramic Attributes and Research Questions.

Carr's (1995) theory of artifact design provides the methodological framework for understanding interaction through an examination of ceramic attributes. Carr organizes attributes hierarchically according to visibility, manufacturing decisions, and production sequence. According to Carr (1995: 173), "the hierarchy of processes and constraints

that determine an artifact's attributes and design somewhat parallels and can be linked to the hierarchy of attributes that is defined independently by their relative visibility, decision order, and production order." *Low visibility* attributes are characteristics that are not visible to the naked eye and generally exhibit a restricted geographic distribution. These attributes are a proxy measure for interpersonal relationships because they cannot be copied and thus must be learned through direct contact with another potter within a community of practice. This type of information transmission is part of process-oriented learning in which a learner directly observes the pottery production process in order to gain the necessary skills to create their own ceramic vessel (Van Hoose 2008: 25). The low visibility attributes considered in this study are the acquisition and processing of raw materials. *High visibility attributes* are clearly visible on the final product and can have a broad geographic distribution. Decorative styles and styles of form are highly visible attributes that can be copied by other artisans via final product learning (Van Hoose 2008: 24), that is, these attributes are not necessarily indicative of interpersonal interactions (though they can also be transmitted by direct interaction). High visibility attributes considered in this study are vessel form and slip color. In order to use the theory of artifact design, there must be a uniformity of raw materials and a lack of significant artifact exchange to reduce other factors that could affect variability in the material culture (Carr 1995:179). These conditions are met in this study. The Belize Valley has a relatively homogeneous intraregional geology providing potters with similar raw materials. Further, though unslipped jars are exchanged long distances the majority are exchanged at the local level (Rice 2009).

The Belize River Valley

The Upper BRV encompasses an area approximately 125 km² and extends from Xunantunich in the west to Blackman Eddy in the east (Ebert et al. 2016b; Figure 4.1). Numerous medium-sized polities and households occupy both the alluvial bottomlands adjacent to the Belize River and the foothills to the north and the south of the river valley (Fedick 1988; Ford and Fedick 1992; Ebert et al. 2016b; Willey et al. 1965). Radiocarbon and ceramic evidence indicate that sedentary communities in the BRV were established by around 1200 BCE (Awe 1992; Ebert 2017; Sullivan and Awe 2013). By the height of Classic Maya civilization in the Late Classic Period (AD 600-800), population density reached its peak and households filled the landscape. Settlement patterns in the BRV can be described as low-density agrarian based urbanism with a central center surrounded by dispersed households (Awe et al. 2014; Fletcher 2009, 2012; McAnany 1993; Robin 2003, 2012). The major polities in the region are located within 10km of one another; the area between these centers is densely occupied and consisted of both minor centers and households (Driver and Garber 2004).

Baking Pot is located on the southern bank of the Belize River. It was established by the Middle Preclassic Period (700-400 BC; Hoggarth et al. 2014) and is comprised of two monumental groups surrounded by eight distinct residential clusters in the settlement area (Hoggarth 2012). At its apogee in the Late to Terminal Classic Period (AD 600-900), Baking Pot supported a maximum population of approximately 3,000 people in its immediate hinterland area (Hoggarth 2012:54). Current evidence suggests that political activities and large-scale occupation ceased at the end of the Classic Period (AD 800-

1000), with reoccupation in the settlement area in the Late Postclassic Period after AD 1250 (Hoggarth et al. 2014).

Locally Available Rock and Clay Resources

The BRV is underlain by marine limestones of varying age, composition, and textural characteristics providing potters with different types of mineralogically similar rock to use as tempering material (Figure 4.2; Table 4.2). The relative homogeneity of the bedrock geology of the Belize Valley means that potters living across the region had access to similar resources for pottery production. Multiple types of limestone [e.g. microcrystalline marl (often referred to as *sascab*) and cryptocrystalline sparry calcite] can occur near one another due to changing sea level from the Cretaceous to the Miocene. However, the ancient Maya were certainly aware of the location of specific types of limestone as attested to by their selection of raw materials for the construction of monumental architecture. For example, the construction pens atop Structure B1 at Baking Pot were filled almost exclusively with crushed marl (Helmke and Villaseñor 2007). People had an intimate knowledge of the geologic landscape that allowed them to specifically procure this type of soft limestone for construction purposes. Limestone is not located in the valley bottom and must be procured from the foothills (see Figure 4.3).

Clay is abundant in the region and soils vary from 30-40 percent clay in the alluvial bottomlands to 60-90 percent clay content in the foothills located to the north and south of the Belize River (Jenkin et al. 1976:85-90). Jordan and Hoggarth collected seventeen clay samples from across the BRV from riverine, drainage, and alluvial terrace locations (Figure 4.3). The sampling strategy focused on riverine locations to document the mineralogical variation in the region as a result of diverse source locations for each

waterway [e.g. quartzite and shale of the Santa Rosa Formation (Bateson 1972; Bateson and Hall 1977) or granite from the Pine Ridge Batholith (Kesler et al. 1974)].

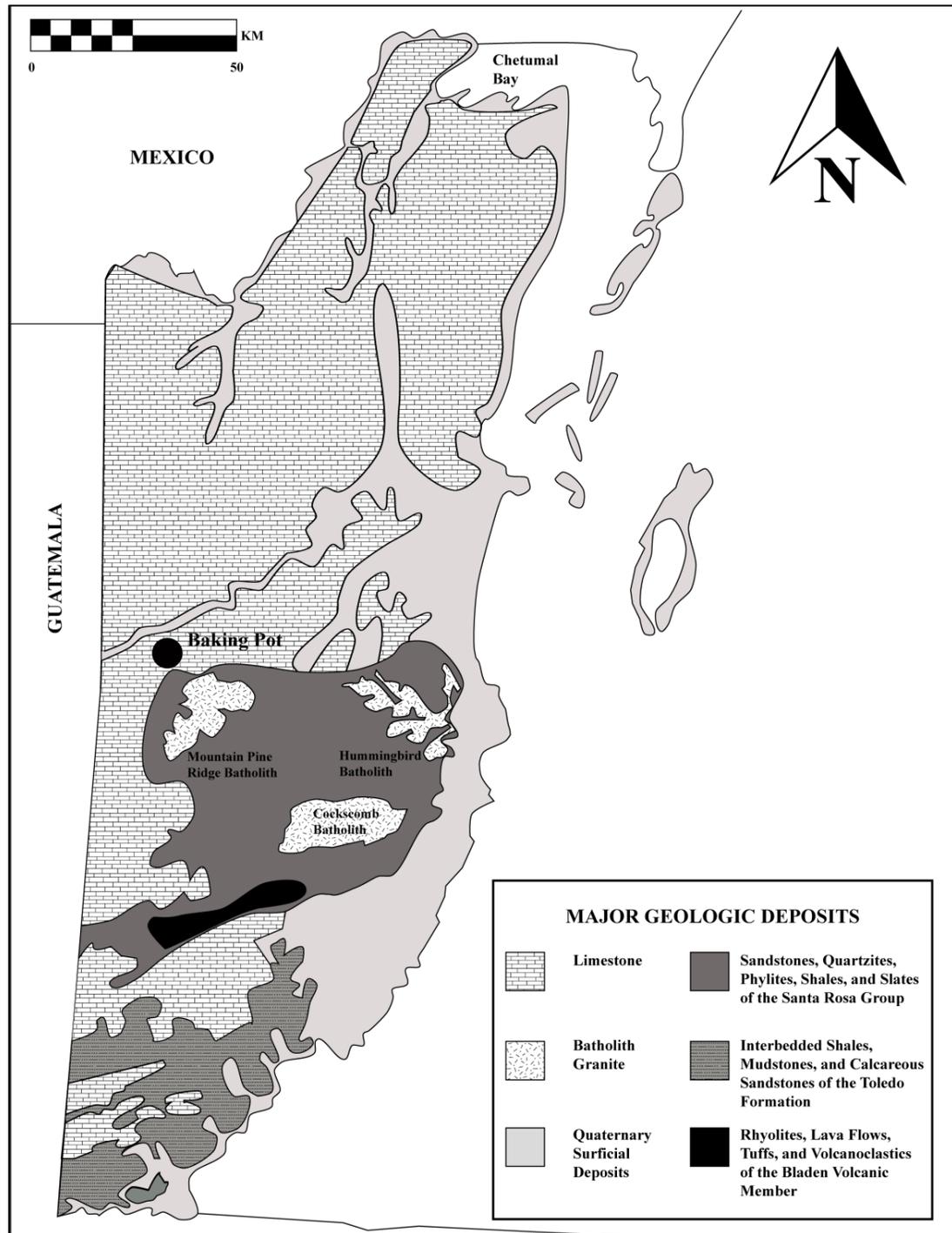


Figure 4.2. Major Geologic Deposits in Belize (after Cornec 2010).

Formation	Group	Description	Depositional Environment
Orange Walk		Miocene- Pleistocene	
	San Lorenzo	Yellow brown, hard, sandy limestone (up to 30% quartz) and calcareous sandstone	Sandy Beach
	Louisville	White, soft, marly limestone	Shallow lagoon, brackish to normal marine
	Orange Walk	White to cream, sandy limestone; coquinal limestone	Shallow beach to lagoon
Red Bank		Oligocene- Miocene	
	Iguana Creek	Sand, gypsum, chert, chalcedony	
	Iguana Creek	Oligocene	Limestone conglomerate (rounded chert and limestone)
Doubloon Bank		Middle Eocene	Dense, tan fossiliferous limestone with some marl; large chert nodules (up to ft) and lenses
			Warm normal marine (50-200m)
El Cayo		Paleocene- Lower Eocene	Dense to crystalline, buff to pink to cream limestone. Dolomite, gypsum, bedded chert
			Shallow water, warm lagoonal backreef; possible reef and evaporite
Barton Creek		Upper Cretaceous	Dense tan, hard to crystalline limestone and dolomite.
			Shallow water, warm lagoonal backreef; occasional reef and questionable evaporite

Table 4.2. Limestone Formations in the Belize River Valley (based on Cornec 2010; King et al. 2004; Flores 1952).

Petrographic analyses of the clay samples documented considerable variation in mineralogical content (Table 4.3), size, sorting, and angularity of mineral and rock inclusions (Appendix C contains full petrographic descriptions and micrographs for all clay samples). Notably, there is a lack of carbonate inclusions from these depositional environments. Clay samples were not collected from the foothills. However, data from soil profiles in the foothills indicate that limestone inclusions are present throughout the soil profile (Jenkin et al. 1976:322). These clays are primarily smectites (montmorillonites) (Baillie et al. 1993:65; Jenkin et al. 1976:89). Smectites are often considered less than ideal for pottery production because “their fine particles and tendency to absorb water between the layers means that they usually have high shrinkage, often cracking as they dry” (Rice 2015:55; see also Arnold 1971:30-31; 1985:21,

2018:80-89). Illites are likely also present given that foothill clays are located atop non-siliceous carbonate marine rock formations (Rice 2015:55-56).

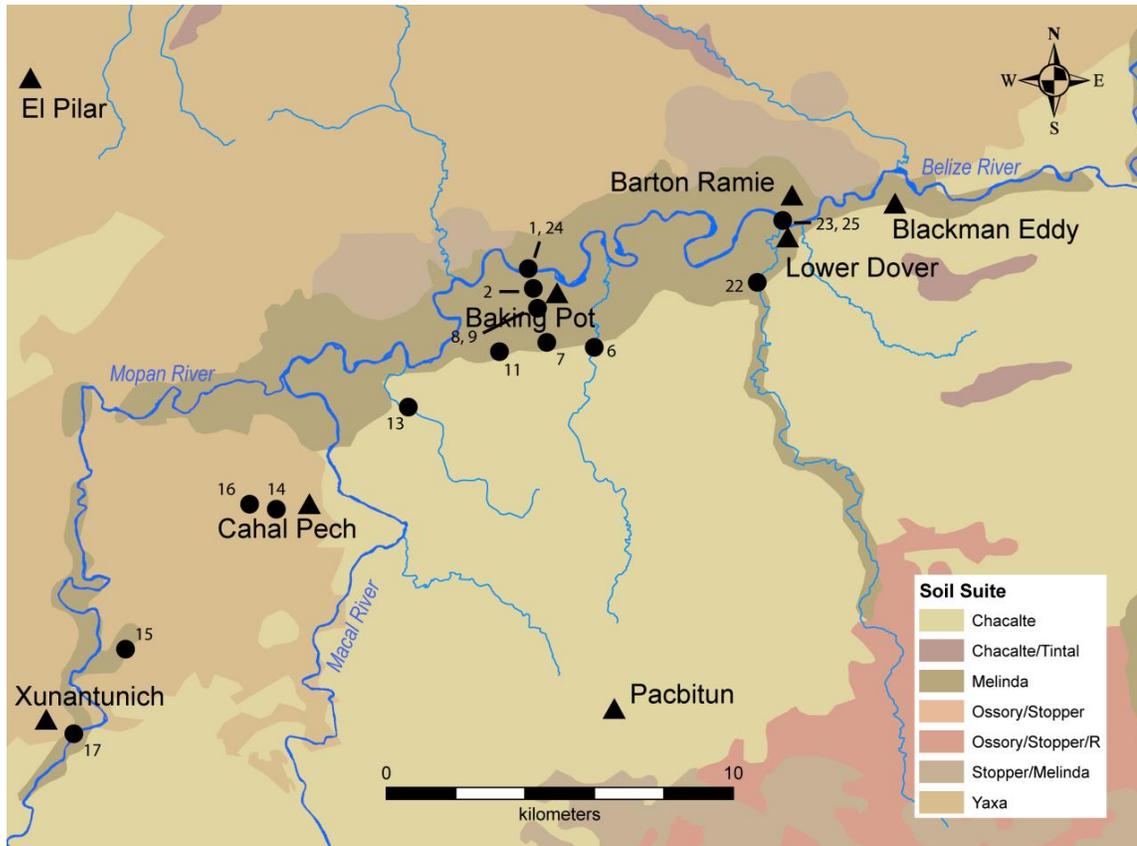


Figure 4.3. Soil Suite Map of the Belize Valley (after Wright et al. 1959) with the Location of Clay Samples. Melinda Suite soils form on alluvial parent material Chacalte/Yaxa Suite soils form on limestone parent material. (Map by C. E. Ebert)

Sample	Location	Crystalline			Quartz	Chert	Chalcedony	Muscovite	Biotite	Poly.				
		Calcite	Sparite	Micrite						Quartz	Quartzite	Perthite	Feldspar	Zircon
1	Belize River Floodplain	Rare	V. Rare	Freq.	Dom.	Freq.	Rare	Common	Rare	Rare	Rare	V. Rare	V. Rare	V. Rare
2	Belize River Floodplain				Dom.	Freq.	Few	Common	Rare	Rare	Rare	Rare	Few	V. Rare
6	Garbutt Creek	Few		Dom.	Few	Few	V. Few	V. Rare	V. Rare	V. Few	V. Few	V. Rare	V. Rare	V. Rare
7	Drainage at Baking Pot				Dom.	Rare	Rare	Few		V. Rare	Rare	V. Rare	V. Rare	
8	Drainage at Baking Pot				Dom.	V. Few	V. Few	Few		V. Few	V. Few		Rare	V. Rare
9	Aguada at Baking Pot				Dom.	Rare	Rare	Few		Rare	Rare	V. Few	V. Rare	V. Rare
10	Macal River	V. Rare		Few	Dom.	Few	V. Few	Common	Few	Rare	Common	Few	Few	V. Rare
11	Belize River Floodplain			V. Few	Dom.	V. Few	Rare	Common			Few	V. Rare	V. Rare	V. Rare
13	Red Creek	V. Rare		V. Few	Pred.	V. Rare	V. Rare	V. Few	V. Rare	Few	V. Rare	V. Few	V. Rare	Rare
14	Drainage at Cahal Pech	Rare	Rare	Dom.	V. Few	Rare	Rare	V. Rare		Rare		V. Rare	V. Rare	
15	Belize River Floodplain	Rare		Few	Freq.	Few	Few	Dom.	V. Few	V. Rare	Few	V. Rare	V. Rare	V. Rare
16	Drainage at Cahal Pech	Rare	V. Rare	Common	Rare	V. Rare	V. Rare	V. Rare				V. Rare		V. Rare
17	Mopan River	V. Rare		V. Rare	Few	Rare	V. Rare	Rare	V. Few				V. Rare	V. Rare
22	Barton Creek	V. Rare			Pred.	V. Rare		Few	Rare	Few	Few	Few	Few	V. Rare
23	Belize River Floodplain				Dom.	Rare	Rare	Common	V. Rare	V. Rare		V. Rare	V. Rare	V. Rare
24	Belize River Floodplain	V. Rare	V. Rare	Common	Dom.	V. Few	V. Few	Common	Rare	V. Few		V. Rare	Rare	V. Rare
25	Belize River Floodplain				Freq.	Rare	Rare	Common	V. Few					
	Predominant (Pred.)	>70 %			Few		5-15 %							
	Dominant (Dom.)	50-70 %			Very Few (V. Few)		2-5 %							
	Frequent (Freq.)	30-50 %			Rare		0.5-2 %							
	Common	15-30 %			Very Rare (V. Rare)		< 0.5 %							

Table 4.3. Mineralogical Content of Natural Clays in the Belize River Valley.

The Ceramic Sample and Methodology

Ceramics analyzed for this study were recovered from nine structures (M90 and M91; M109, M110, and M111; M100 and M101; M181; M184) in five household groups in a single settlement cluster in the Baking Pot periphery (Hoggarth 2012; Figure 4.4). The ceramic sample was recovered from construction fill contexts, which are “loose material, generally placed by dumping, with little or no capacity to maintain its own stability above the natural angle of repose” (Loten and Pendergast 1984:9). Artifacts from fill were likely retrieved by the Maya from existing middens to use in building construction. Ethnographic studies among Tzeltal communities in the Chiapas Highlands of Mexico indicate that people discard pottery in a variety of ways including “within the household complex, at neighborhood dump sites, or in the streets of the community” (Deal 1985:261; also Hayden and Cannon 1983). No middens have been identified in the Baking Pot periphery so it is unclear if individual households used only their refuse for building purposes or if material was recovered from larger community middens containing the refuse from multiple households. Thus, it is impossible to determine if artifacts from the construction fill of a particular household actually belonged to those inhabitants alone. We can be reasonably sure, however, that the pottery considered in this study was consumed by people living at Baking Pot during the Late to Terminal Classic Period and the fill in buildings was likely recovered from nearby.

The ceramic sample was selected to address local communities of practice. The petrographic assemblage (N=144) consists primarily of unslipped jars because these vessels were likely produced by non-elites at the household level (e.g. Fry 1979, 1980;

Jordan and Prufer 2017; Rands and Bishop 1980; Rice 2009), are less likely to move long distances, and were essential containers for the storage of solid and liquid materials for all households. Only vessels that could be chronologically placed within the Late to Terminal Classic Spanish Lookout ceramic complex were included in this study (AD 700-900; Gifford 1976:225-288).

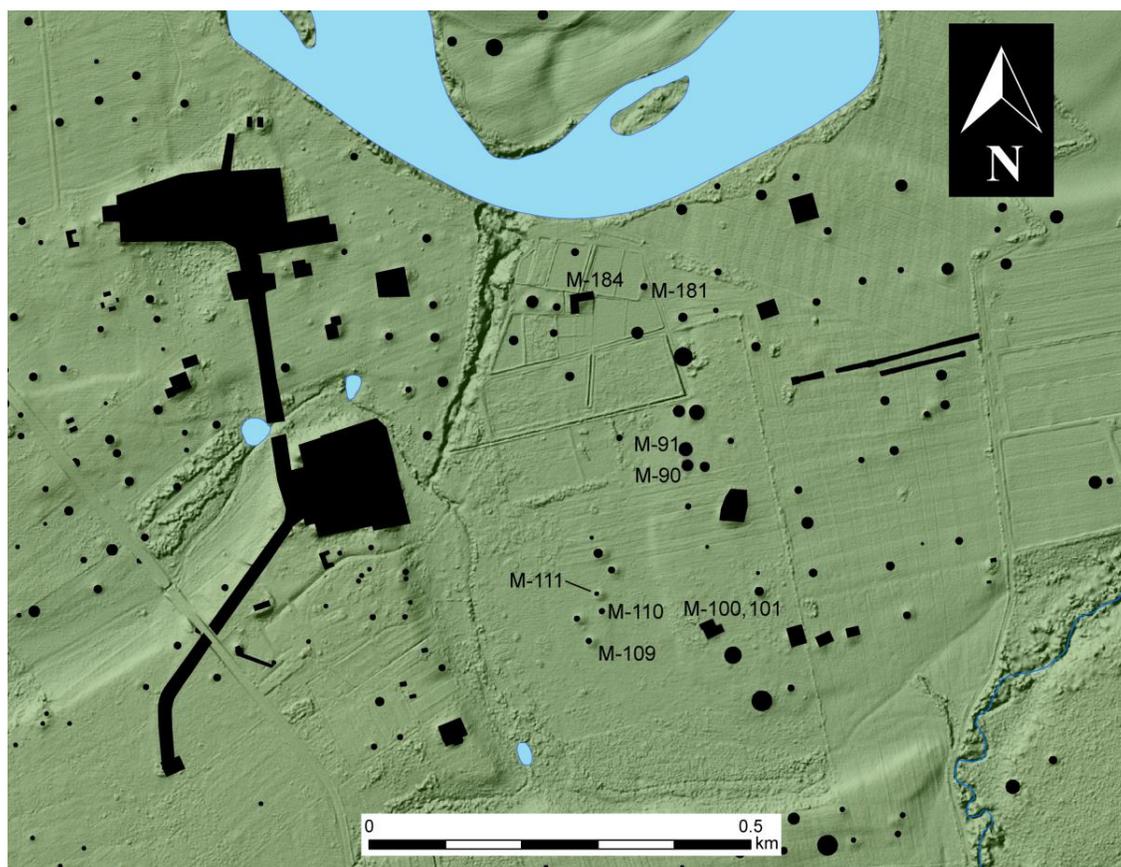


Figure 4.4. Sampled Mounds in the Baking Pot Periphery. (Map by C.E. Ebert)

The petrographic assemblage in this study represents two percent of the entire ceramic assemblage from Late to Terminal Classic contexts including both diagnostic and non-diagnostic sherds. The diagnostic ceramic count, including ceramic types and forms, was unfortunately lost. However, the senior author analyzed 502 diagnostic rim

samples (representing seven percent of the total ceramic assemblage) and collected detailed macroscopic descriptions on 305 jar and serving vessels. Each of these was assigned to a macroscopic paste group defined by color, texture (coarse: fine), and inclusions (sorting, size, shape, composition). Of these, 144 sherds were subsampled and analyzed using thin section petrography. All sherds were assigned to a ceramic group and type according to the type: variety classification scheme designed by Gifford (1976) for Barton Ramie and used widely for archaeological sites in the BRV. All of the sampled jars (n=124; 86 percent of the petrographic sample) are categorized as either Cayo Unslipped or Alexanders Unslipped of the Cayo Ceramic Group (Gifford 1976:276-286). No attempt was made to categorize the samples to the variety level given the goal of assessing practice with reference to basic formal functional categories. Cayo Unslipped jars are “unslipped brown or dark red-brown medium-sized jars with rough and grainy or lightly smoothed surfaces” (Gifford 1976:278) while Alexanders Unslipped jars are “thick-walled, large unslipped brown jars” (Gifford 1976:283). A small number of monochrome-slipped bowls and dishes were also analyzed (n= 20; 14 percent of the petrographic sample) to begin to address questions about how pottery production may have varied (or not) between different vessel categories. Sampled slipped serving wares include Mount Maloney Black, Garbutt Creek Red, and Dolphin Head Red (Gifford 1976:227-235, 243-245).

Petrographic analysis was conducted using a Leica DM750P polarizing light microscope and follows the descriptive system developed by Whitbread (1989, 1995: 365-396; 2017) specifically for the examination and characterization of ceramic fabrics (see Howie 2012 and Sánchez Fortoul 2018 for applications in the Maya region). The

descriptive system is a qualitative method that combines aspects of sedimentary petrography and soil micromorphology, in addition to rock and mineral identification. An advantage is that it permits examination and comparison of a broad range of geological characteristics of raw material ingredients and multiple aspects of technology, including the treatment of raw materials, paste recipes, forming techniques and firing temperature (Freestone 1991; Tomkins et al. 2004; Whitbread 1989, 1995, 2017). Thin section petrography is not a commonly used analytical technique in the Maya lowlands (for some exceptions see Angelini 1998; Bartlett et al. 2002; Howie 2012; Howie et al. 2014; Iceland and Goldberg 1999; Jones 1986; Sánchez Fortoul 2018; Sunahara 2003; Ting et al. 2014). Previous research in the on Late to Terminal Classic pottery in the BRV suggests that all polities likely engaged in pottery production and locally produced vessels were exchanged via a market economy (Sunahara 2003). LeCount (2010) has argued convincingly that Mount Maloney Black jars and bowls were produced in the vicinity of Xunantunich based on the concentration and abundance of these vessels in household and ritual contexts in western portion of the BRV (see Figure 4.1). Consumption of Garbutt Creek Red incurving bowls, and possibly their production, is more common at sites located in the eastern Upper BRV including Baking Pot (Aimers 2002: 280-281).

Petrographic Fabric Groups

All 144 thin sections were assigned to a petrographic fabric group. A total of 34 fabric groups were identified in the petrographic sample. Six fabric groups were locally

produced (n=108; 75 percent of the total sample), twenty-two fabric groups were possibly locally produced (n=30; 20.8 percent of the total sample), and six fabric groups were produced outside of the Belize River Valley (n=6; 4.2 percent of the total sample).

Provenance for the locally-produced fabric groups was determined based on comparison to the geologic literature of the region, comparison to rock and clay samples, and the Criterion of Abundance (Bishop et al. 1982). Non-local and possibly local fabric groups are discussed briefly below but the majority of the paper focuses on the fabric groups than can be firmly tied to the BRV (all fabric groups are summarized in Table 4.4). For full petrographic descriptions see Appendix D.

Fabric Group	Provenance	Added as Temper	Naturally Occurring (In Order of Abundance)	Count
Calcite A	Local	Limestone	Cal, Qz, PolyQz, Ch, Chal, Feld, Z	21
Calcite B	Local	Limestone	Cal, Qz, PolyQz, Chal, Ch, Z	50
Calcite C	Local	Limestone	Cal, Qz, PolyQz, Ch, Chal, Z	24
Calcite D	Local	Limestone	Cal, Qz, Ch, Chal,	10
Calcite E	Possibly Local	Limestone	Cal, Qz, Ch, Chal, PolyQz	7
Calcite F	Possibly Local	Limestone	Cal, Qz, Feld (?)	1
Calcite G	Possibly Local	Limestone	Cal, Qz, PolyQz, Ch	1
Calcite H	Possibly Local	Limestone	Cal, Qz, Ch	1
Calcite I	Possibly Local	Limestone	Cal, Qz	1
Calcite J	Possibly Local	Limestone	Cal, Qz	1
Calcite K	Possibly Local	Limestone	Qz, PolyQz, Per, Micro, Plag, Z	1
Calcite L	Possibly Local	Limestone	Cal, Qz, Ch, Chal, Z	1
Calcite M	Possibly Local	Limestone	Cal, Qz, PolyQz, Ch, Perth, Feld, Z	1
Calcite N	Possibly Local	Limestone and Quartz Sand	Cal, Qz, PolyQz	1
Calcite O	Non-Local	Crystalline Calcite	Cal, Qz, Ch	1
Carbonate Sand A	Possibly Local	Limestone	CarSand, Qz	1
Carbonate Sand B	Possibly Local	Limestone	CarSand, Qz, Musc, Z	1
Carbonate Sand C	Possibly Local	Limestone	Qz, PolyQz, Mudstone	1
Carbonate Sand D	Possibly Local	Limestone	CarSand, Qz, Mic, Poly Qz, Sph, Ch, Chal, Z	3
Carbonate Sand E	Possibly Local	Limestone	CarSand, Qz, Poly Qz, Ch, Z	1
Carbonate Sand F	Possibly Local	Limestone	CarSand, Qz, Poly Qz, Sph, Z	1
Carbonate Sand G	Possibly Local	Limestone	CarSand, Qz, Ch	1
Carbonate Sand H	Possibly Local	Limestone	CarSand, Qz	1
Carbonate Sand I	Possibly Local	Limestone	Qz, Poly Qz, Per, Z	1
Carbonate Sand J	Possibly Local	Limestone	CarSand, Qz, PolyQz	1
Quartz A	Local	Limestone	Qz, Musc, Poly Qz, Plag, Biot, Ch, Chal	2
Quartz B	Local	Limestone	Qz, Poly Qz Qzt, Plag, Per, Mud, Musc, Biot, Ch, Chal	1
Quartz C	Possibly Local	Limestone	Csand, Qz, Poly Qz, Qzt, Plag, Per, Ch, Biot, Sandst	1
Quartz D	Non-Local	Sandstone Sand	Qz, Feld, Sandstone, Biot, Z	1
Quartz E	Non-Local	Crushed Granite	Musc, Per, Qz, Qzite, Plag, Micro, Biot, Z	1
Quartz F	Non-Local	Granitic Sand	Qz, PolyQz, Plag, Micro, Qzite, Ch, Musc	1
Quartz G	Non-Local	Crushed rock and Sand (Granite)	Qz, Biot, Seriticized Feldspar, Epidote	1
Quartz H	Non-Local	Crushed rock and Sand (Granite)	Qz, PolyQz, Ch, Chal, Perth, Plag, Musc, Biot, Z	1
ASH	Possibly Local	Ash	Calcite	1
TOTAL				144
Cal	Calcite		Per	Perthite
Qz	Quartz		Micro	Microcline
PolyQz	Polycrystalline Quartz		Plag	Plagioclase
Ch	Chert		CarSand	Carbonate Sand
Chal	Chalcedony		Sph	Glass Spherule
Feld	Feldspar		Musc	Muscovite
Z	Zircon		Biot	Biotite

Table 4.4. Summary of Petrographic Fabric Groups.

Non-Local Fabric Groups

Non-local fabric groups contain rocks and minerals inconsistent with the local geology and are only represented by a single sample. The Calcite O fabric group (BKP60) contains carbonate but it is tempered solely with rhombic, crystalline calcite, which is not a practice observed in the Belize Valley. It is, however, consistent with crystalline calcite tempered fabric groups described by Howie (2012) for Lamanai. The Quartz E fabric group contains abundant biotite, chloritized biotite, and granite (Figure 4.5: d). These minerals are consistent with the Cockscomb Batholith located in the Stann Creek District of southern Belize (Kesler et al. 1974; see Figure 4.2). The sample is comparable to pottery analyzed petrographically from the Alabama site located in the same area (Peuramaki-Brown et al. 2017). The remainder of the fabric groups cannot be tied to specific locations due to the lack of petrographic studies for comparison. However, the rock and mineral inclusions provide broad geographic areas where the pottery was likely produced. The Quartz F fabric groups is tempered with sand composed of slightly metamorphosed sandstone (Figure 4.5: c) and is consistent with the geology of the Baldy Beacon formation in the Maya Mountains (Martens et al. 2010). The Quartz E, Quartz F, and Quartz H groups contain granite consistent with the Mountain Pine Ridge including abundant perthite and microcline feldspar (Shiple 1978). Imported jars represent 4.2 percent of the household ceramic assemblage indicative of interaction with areas located far from the Belize Valley and/or a market system of exchange. The movement of unslipped jars, and the social and economic relationships between these different regions of the Maya lowlands, deserves further study.

Possibly Local Fabric Groups

Fabric groups characterized as possibly local are consistent with the local geology, but cannot be conclusively tied to the BRV due to small sample sizes and a lack of comparative geologic data. They likely represent a combination of locally produced and non-locally produced pottery. For example, ten fabric groups (n=12; 8.3 percent of the total sample) contain carbonate sand as their primary component (Figure 4.5b). The carbonate sand fabrics do not contain marine shell indicating that they were not produced using sands from a coastal environment.

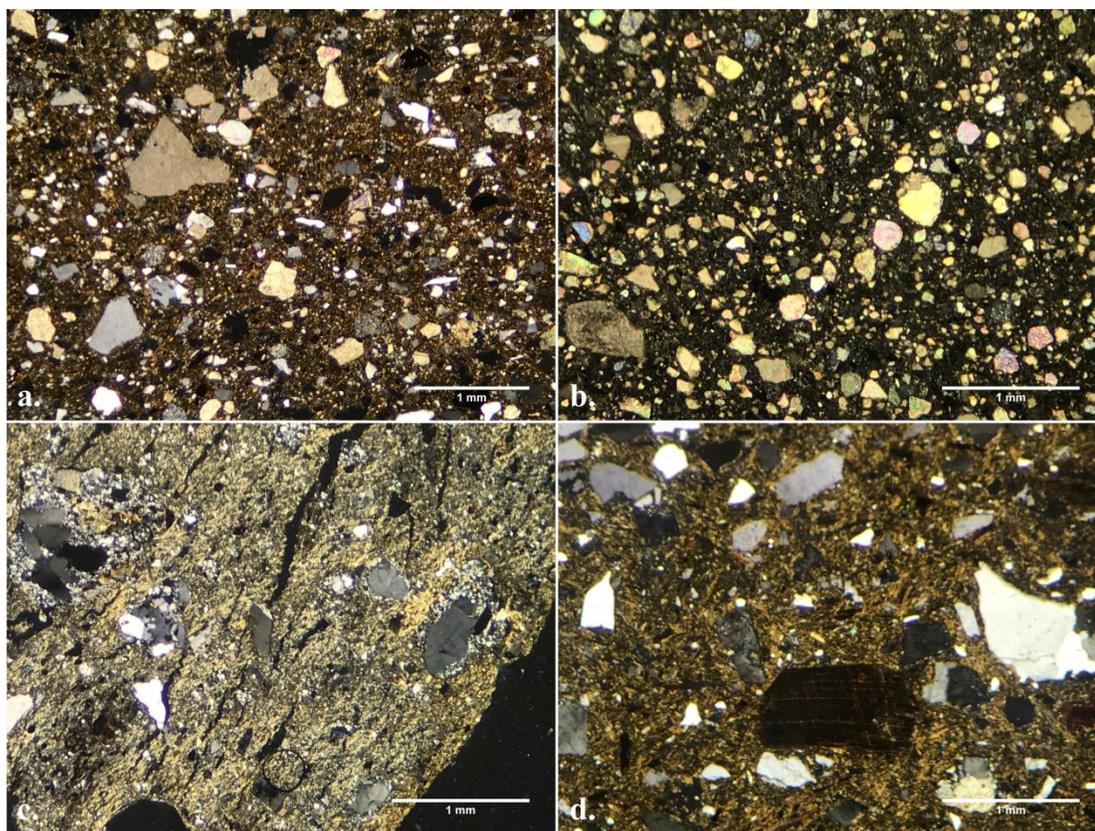


Figure 4.5. Mixed Fabric Groups Micrographs. a. Quartz A, Local River Clay (BKP55, XPL); b. Carbonate Sand D, Possibly Local (BKP67, XPL); c. Sandstone Sand Tempered, Possibly Baldy Beacon (BKP2, XPL); d. Crushed Rock Tempered, Possibly Cockscomb Batholith (BKP57, XPL).

Sunahara (2003:114) reported the use of carbonate sand by local potter David Mangaña in the village of San Jose Succotz located just across the Mopan River from Xunantunich. However, carbonate sand is not reported in the geologic literature of the region and was not sampled for this study. Another source of carbonate sand is Lake Petén Itza in northern Guatemala (Mueller et al. 2010:1228). Carbonate sand fabrics likely represent both locally produced and imported vessels, though this assertion should be considered tentative pending additional geologic sourcing.

Locally Produced Pottery in the Belize River Valley

Four primary locally-produced fabric groups were identified in the petrographic sample: Calcite A, Calcite B, Calcite C, and Calcite D. The fabric groups are remarkably similar in terms of their rock and mineral inclusions. The differences in the four main locally produced fabric groups (and their subgroups) are not as self-evident as those made based on diverse geological characteristics. Rather, distinctions are based on characteristics of the groundmass indicative of different provenance and/or differences in inclusion size, sorting, and composition due to the processing of raw materials. Most pottery produced in the BRV consists almost exclusively of carbonate inclusions both as naturally occurring in the clay and added as crushed limestone temper. The bimodal and uneven distribution of the large limestone inclusions, in conjunction with their angularity, indicates that it was added as tempering material which is “the coarse components in a paste, usually assumed to have been added by potters to modify the properties of the clay” (Rice 1987:406). The Quartz A and Quartz B fabric groups are also locally produced but are present in far fewer quantities.

Calcite A Fabric Group. Calcite A and its subgroups have a dense, dark brown micromass with abundant and varied carbonate inclusions (Figure 4.6: a). Calcite A is characterized by a bimodal distribution with the upper size class (>0.1mm) dominated by terminal grade calcite (Figure 4.7: c) and sparry calcite limestone (Figure 4.7: a). Other minerals present in lesser amounts in the upper size class include monocrystalline quartz, rhombic crystalline calcite (Figure 4.7: d), micrite (Figure 4.7: b), dolomite, polycrystalline quartz, chert, and chalcedony. Other types of limestone are rare and include calcite+monocrystalline quartz (Figure 4.7: b), calcite+chalcedony (Figure 4.7: b), and sparry calcite in a micrite matrix (Figure 4.7: c). Dolomitic limestone was used to temper some of the vessels. Most quartz, polycrystalline quartz, chert, chalcedony, and feldspar were part of the natural clay (Figure 4.7: d). The dominant terminal grade calcite in the coarse fraction and common crystalline calcite in the fine fraction contribute to the very packed appearance of this fabric group.

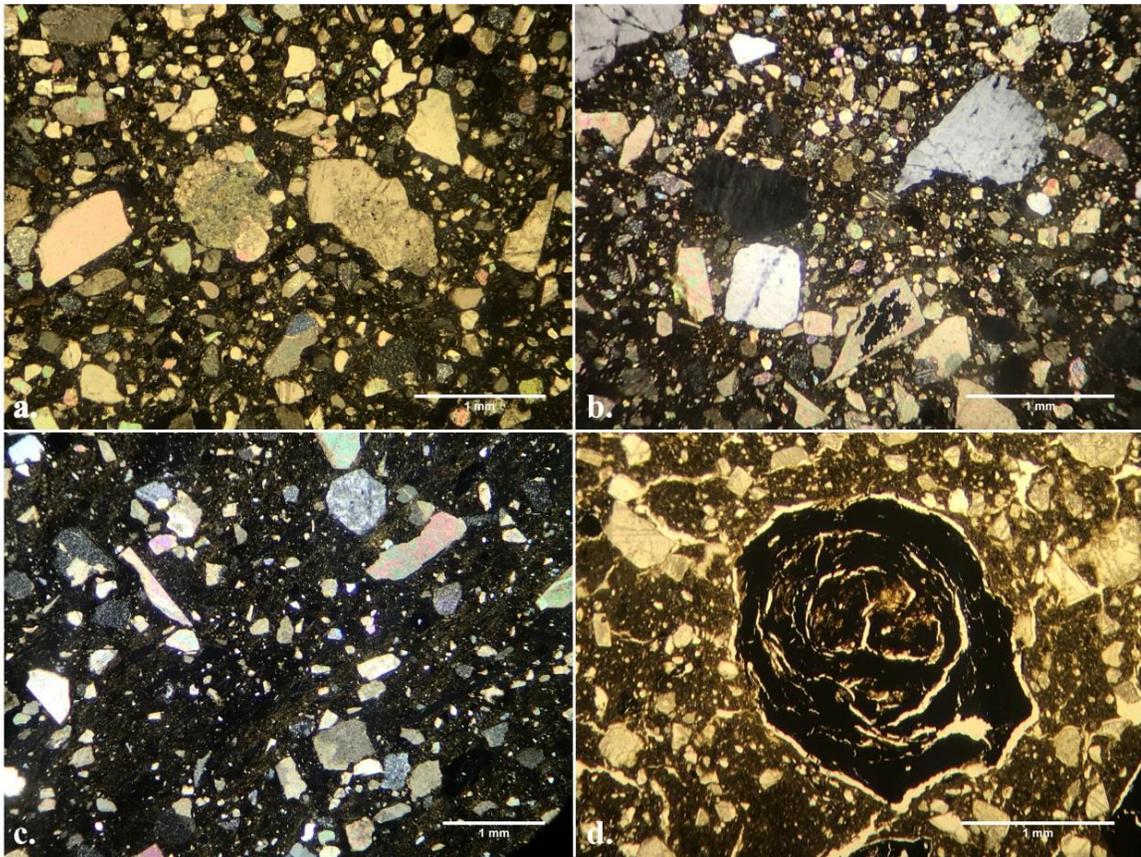


Figure 4.6. Calcite A Fabric Group Micrographs. a. Calcite A (BKP14, XPL); b. Calcite A, Subgroup 1 (BKP184, XPL); c. Calcite A, Subgroup 2 (BKP8, XPL); Concentric circle soil feature (BKP8, PPL).

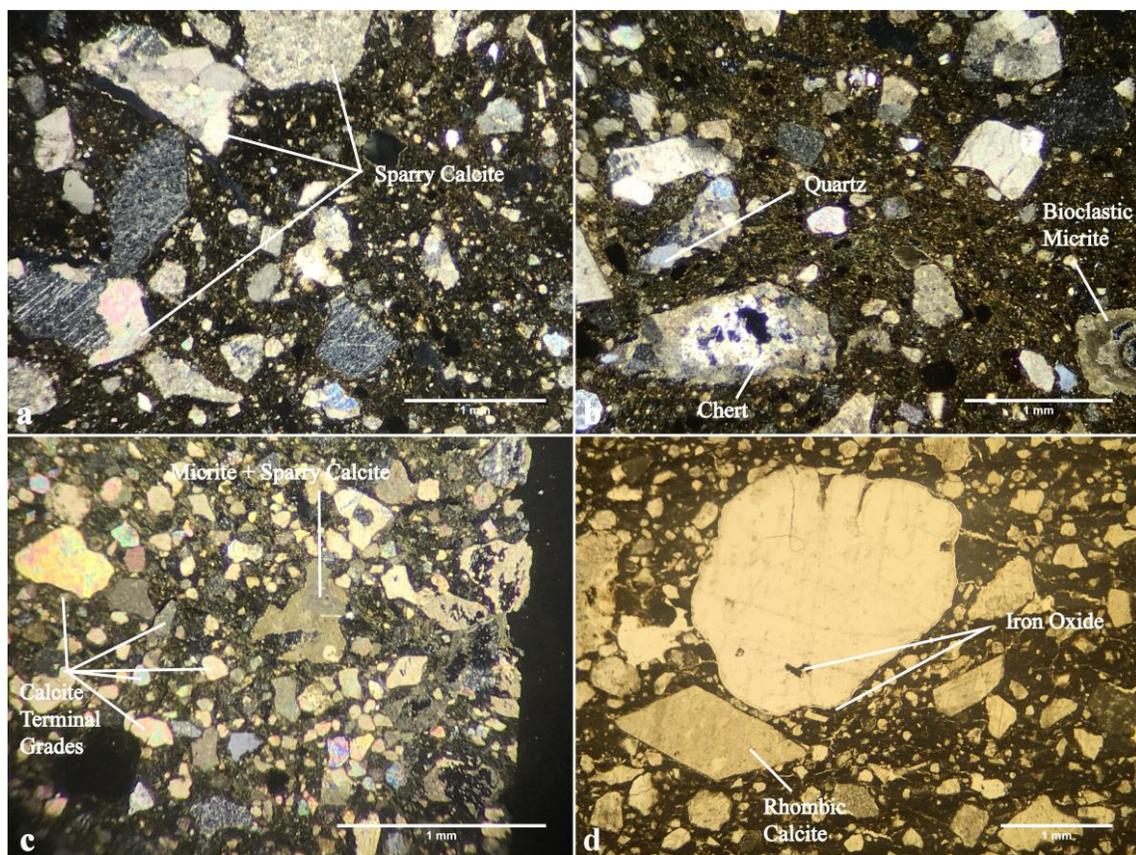


Figure 4.7. Limestone and Soil Features Micrographs: a. Sparry calcite, upper: finely crystalline, middle: medium crystalline, lower: coarsely crystalline), (BKP175, XPL); b. Sparry calcite+quartz limestone, sparry calcite+chert limestone, and bioclastic micrite (BKP 19, XPL); c. Terminal grade calcite and sparry calcite in a micrite matrix limestone (BKP209, XPL); d. Rhombic crystalline calcite and quartz with an iron oxide coating (BKP171, PPL).

The abundance of crystalline calcite in the fine fraction indicates that this clay formed atop limestone bedrock. The Calcite A fabric group contains numerous concentric circle soil features (Figure 4.6: d). These nodules form in soils that experience seasonal water inundation and repeated wet/dry cycles and are characteristic of Vertisols. Vertisols contain an abundance of expanding lattice clay (e.g. smectite) common in the foothills of the BRV (Baillie et al. 1993:12; Kovda and Mermut 2010:117). These concentric circle

features suggest that this clay formed in depressions in the foothills where water was retained periodically (Figure 4.8; Baillie et al. 1993:25). Calcite A, Subgroup 1 (Figure 4.6: b) has few, large (coarse to very coarse sand-sized) monocrystalline and polycrystalline quartz inclusions and a sandstone fragment. Given their size, angularity, and uneven distribution, these inclusions were likely added as temper along with the limestone discussed part of Calcite A. Calcite A, Subgroup 2 (Figure 4.6: c) is sparsely tempered and includes a carbonate sand component. Both of these subgroups are indicative of different raw materials acquisition and processing.

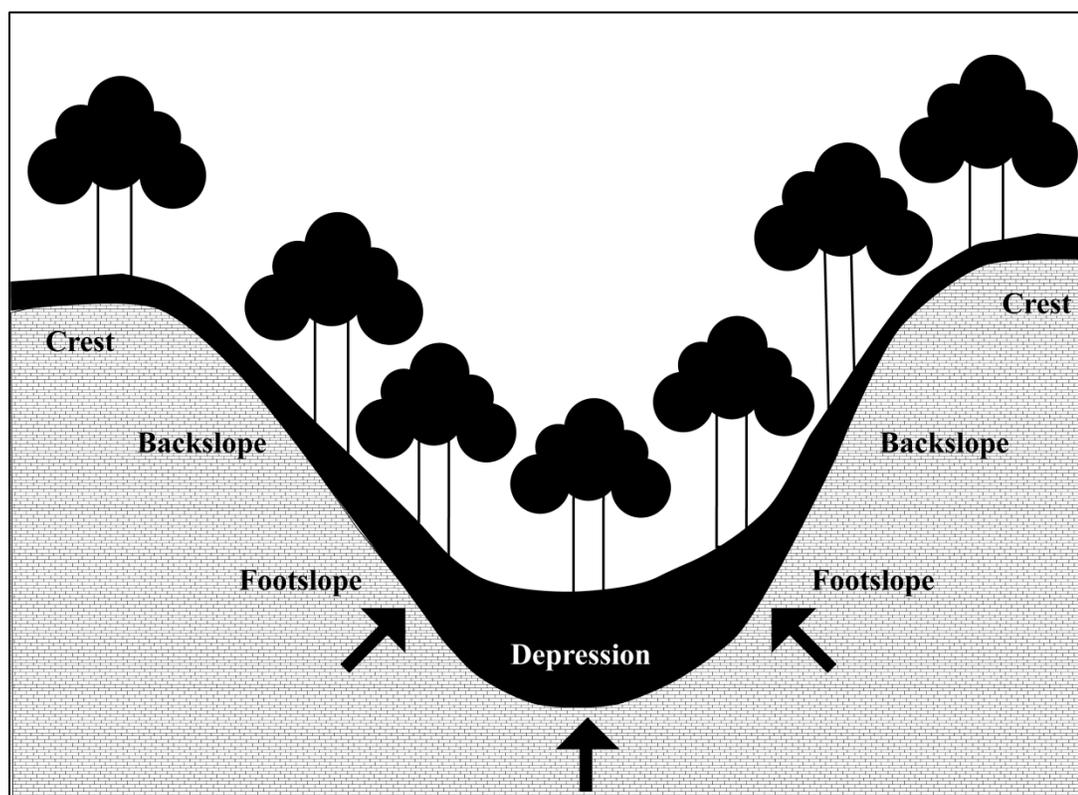


Figure 4.8. Foothill (Catena) Schematic. The Arrows point to footslope and depression where clay-rich soil accumulates in the foothills of the Belize River Valley. These locations are where potters likely retrieved clay for pottery production. The depression between hillslopes is likely where the Calcite A clay in particular was located.

Calcite B Fabric Group. Calcite B is similar to Calcite A in many respects except the micromass is a golden brown and there are no concentric circle concentration features, indicative of a slightly different provenance in the BRV foothills. It has fewer large limestone inclusions than Calcite A and a generally less packed appearance (Figure 4.9: a). The temper was processed differently (e.g. crushed more thoroughly to remove larger rock fragments). The clay used in this fabric group was procured from a different depositional environment, possibly from the footslope, rather than depression, where clay would have been abundant but that did not seasonally retain water (see Figure 4.8).

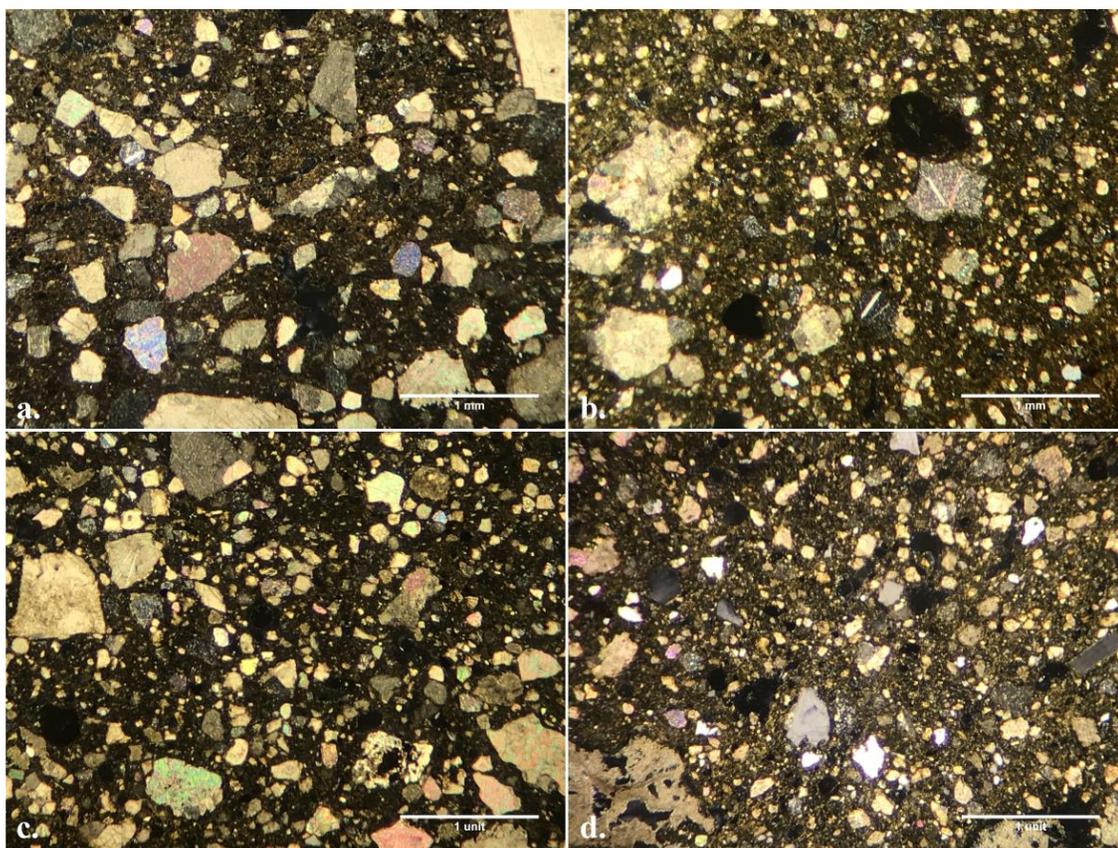


Figure 4.9. Calcite B Fabric Group Micrographs: Calcite B (BKP25, XPL); b. Calcite B, Subgroup 1 (BKP17, XPL); c. Calcite B, Subgroup 2 (BKP83, XPL); d. Calcite B, Subgroup 4 (BKP24, XPL).

The Calcite B fabric group is the most variable with four subgroups. Calcite B, Subgroup 1 (Figure 4.9: b) is dominated by calcite terminal grades of finely crystalline sparry calcite (Folk 1959). All of these vessels are thin-walled (Figure 4.13). This subgroup is indicative of the purposeful selection of finely crystalline limestone that was then crushed more thoroughly to eliminate large fragments of limestone within the ceramic body. Calcite B, Subgroup 2 (Figure 4.9: c) is dominated by calcite terminal grades of medium crystalline sparry calcite. This subgroup also represents the specific raw material acquisition and processing though it is unclear if the purpose was functional or just the preference of the potter(s). Calcite B, Subgroup 3 is characterized by a predominance of very fine sand to silt sized calcite in the groundmass giving the fabric a “dusty” appearance. Calcite B, Subgroup 4 (Figure 4.9: d) is dominated by finely crystalline calcite terminal grades (like Subgroup 2) but with the additional of monocrystalline and polycrystalline quartz. Given their size, angularity, and uneven distribution, these inclusions were likely added as temper along with the crushed limestone.

Calcite C Fabric Group. The Calcite C (Figure 4.10a) fabric group is identical to Calcite B in terms of rock and mineral inclusions and soil features. The primary distinguishing characteristics of this fabric group are the use of less temper giving the fabric a more sparse appearance and incompletely mixed clay in which the limestone temper is randomly distributed and there are large swaths of clay that contain no limestone inclusions. These characteristics suggest that these vessels were constructed in a more expedient manner or at least that the clay and temper mixture was not mixed as thoroughly.

Calcite D Fabric Group. Calcite D (Figure 4.10b) is sparsely tempered, has a distinctive yellow brown fabric in XPL, and an abundance of coarsely crystalline sparry calcite limestone. There is much less monocrystalline quartz in Calcite D and much of the quartz is angular and does not have an oxide coating suggesting it was part of the crushed limestone temper. The clay in this fabric group is very refined and contains few non-carbonate inclusions indicative of a foothill location. The abundance of coarsely crystalline sparry calcite and dolomite indicates a different provenance for the temper, as well. Calcite D, Subgroup 1 is the same as Calcite D in all respects except the fabric is a reddish brown in both PPL and XPL. Calcite D, Subgroup 2 contains abundant small calcite terminal grades and the limestone temper is predominantly finely crystalline calcite.

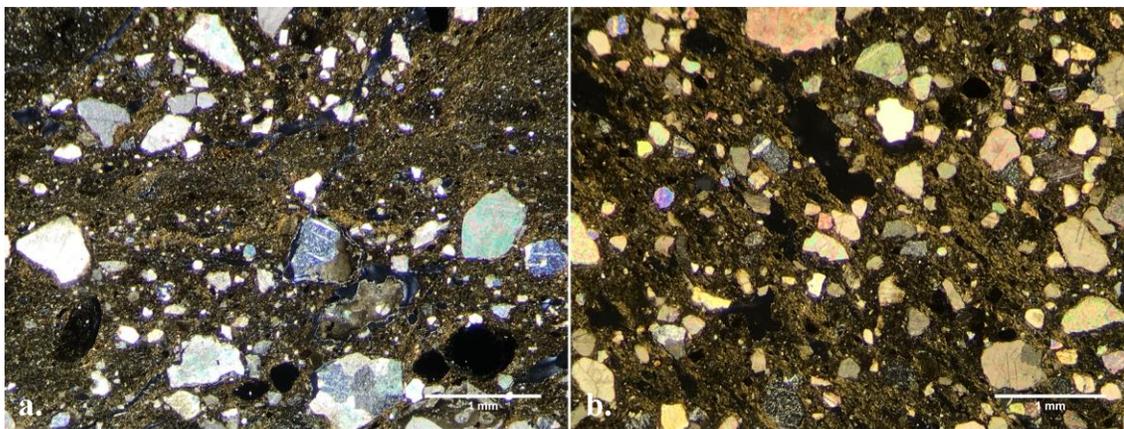


Figure 4.10. Calcite C and D Fabric Groups Micrographs: a. Calcite C (BKP55, XPL); b. Calcite D (BKP92, XPL).

The Quartz Fabric Groups. Quartz A and Quartz B are locally produced ceramics that contain inclusions consistent with the riverine clays collected for this study. They are tempered with medium to coarsely crystalline sparry calcite but the terminal grades are

more abundant than the rock fragments indicating that the limestone was crushed thoroughly before adding it to the clay. The Quartz A clay is very micaceous and consists primarily of muscovite (Figure 4.5: a). The mineralogy of Quartz A and Quartz B suggests that the clay was procured from a drainage that originates in the Mountain Pine Ridge (Figure 4.2). The temper is consistent with limestone used in the locally produced carbonate fabrics.

In summary, the majority (75 percent) of the petrographic sample is consistent with the local geology of the BRV. The non-local vessels indicate interaction with people as far south as the Stann Creek District (See Figure 4.2; location of the Cockscomb Batholith) and likely west into the Petén of Guatemala. Of the local sherds, most (98 percent) were produced using clay procured from above limestone bedrock in the foothills (Figure 4.3: Yaxa and Chacalte Soils) and tempered predominantly with sparry calcite limestone. The following sections address the research questions (Table 4.1) regarding paste recipe and styles of form in order to reconstruct interaction networks among potters and between potters and their environment in the Late to Terminal Classic BRV.

Resource Acquisition

The acquisition and use of specific raw materials are low visibility attributes that cannot be copied by a potter from observing the final product alone. Resources necessary for making pottery include water, fuel for firing, and clay (Arnold 1985:20). Temper is not necessarily essential because some potters do not add temper to their clay and many clays have suitable aplastic inclusions naturally (Arnold 1985:20); however, potters

living in the BRV did add temper to their clay and it is considered a necessary resource in this study. Water is abundant in the area and polities are located near major perennial waterways such as the Macal, Mopan, and Belize Rivers as well as smaller waterways that would have provided reliable and nearby locales for water acquisition (see Figure 4.1). Potters generally extract resources close to home in order to limit energy expenditure associated with transporting heavy materials such as clay, rock, and wood used as fuel. Arnold's (1985:38-50) compilation of ethnographic literature indicates that potters travel between 1km to 50km to acquire clay resources though the preferred distance is 1km; 84 percent of potters in his study acquired clays within a 7km range. Most resource acquisition occurs within a 5km range. The major polities in the BRV are located close to one another so potters likely shared information about the location of suitable raw materials, or the raw materials themselves, for pottery production (see Figure 4.11 for a 1km and 5km buffer around major centers).

Baking Pot is located on alluvial bottomlands so potters had to go into the foothills, a distance of over 2km, to retrieve clay and temper for pottery production. The variability across the locally produced fabric groups indicates that there was flexibility in the actual location. That is, potters did not procure clay from a single, specific place on the landscape. The limestone temper was also procured from the foothills. The prevalence of sparry calcite limestone indicates that this was the preferred type of limestone but the temper shows variation similar to that of the clay. The compositional variation of both the clay and limestone suggests that this ceramic sample represents production that occurred at multiple places across the BRV supporting Sunahara's (2003) conclusion that most, if not all, polities participated in pottery production. Although there is variation suggestive

of multiple communities of practice, these data indicate that potters widely shared information on where to procure suitable raw materials in terms of a general depositional environment.

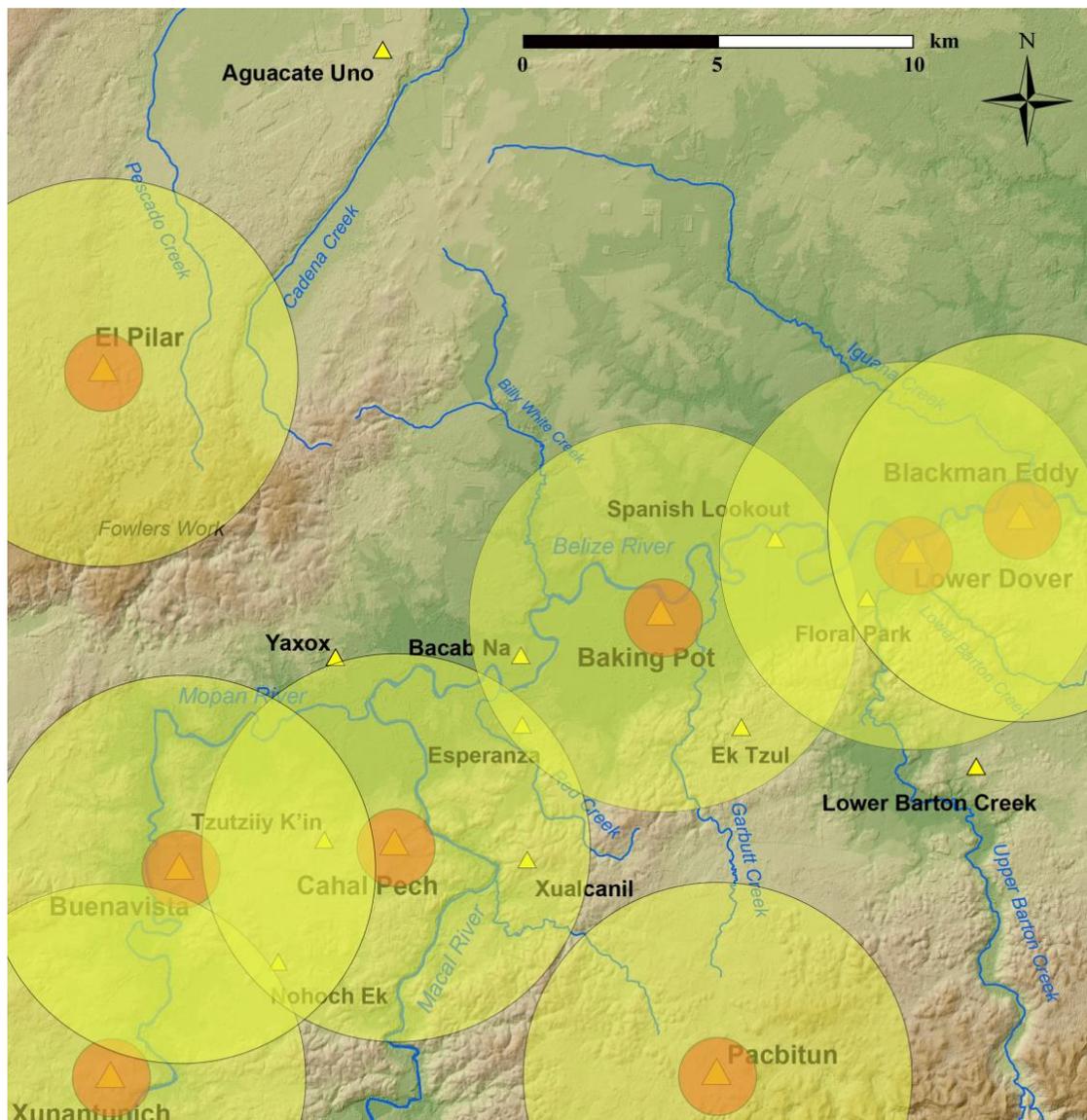


Figure 4.11. Major Polities of the Belize Valley with a 1km (red circle) and 5km (yellow circle) buffer showing possible overlap in raw materials sources.

Raw Materials Processing

How potters process raw materials is also a low visibility attribute. Potters process natural clays, by removal and/or addition, to improve the quality of their raw materials (Arnold 1985:29). Ways in which potters process raw materials include cleaning the clays by removing organic matter and large rocks and/or minerals, crushing, grinding, winnowing, water levigation, and adding tempering material (Rice 2015:133; Rye 1981:17-19, 36-37; Shepard 1985:51-53). Potters remove larger particles from clay because they can cause the vessel to crack during drying (Shepard 1985:51). Rock and mineral fragments can be removed by winnowing or sieving clay when it is dry. Water levigation, in which the clay is soaked in water and the coarse particles sink to the bottom out of suspension, is an alternative method (Rice 2015:133-135; Shepard 1985:51-52; Rye 1981:17-18). An alternative to the removal of particles is the selection of naturally refined clays. There are virtually no large (>0.25mm, medium sand sized) non-carbonate inclusions in the locally produced carbonate fabric groups. Unfortunately, because we did not sample foothill clays we cannot determine if the clay was processed to remove large inclusions or was preferred because they are naturally “clean” clays. Either way, all local calcite fabric groups exhibit this characteristic indicative of either shared practice or the sharing of information with regard to where to procure naturally clean clays.

Tempering materials (which is most commonly mineral and rock but can also include other clay, shell, and organic material; [Rice 2015:79-82]) “are intended to modify workability and porosity; reduce time, shrinkage, and deformation during drying; and improve firing behavior” (Rice 2015:79) and improve vessel performance

characteristics. All locally produced pottery, including both calcite and quartz fabric groups, are tempered with crushed limestone. There appears to be little concern for the creation of a uniform size class for the temper with a few notable exceptions. The Calcite A group consists primarily of very large unslipped jars (see Figure 4.12). This fabric groups contains abundant, large rock inclusions that may have been necessary to provide a skeletal structure for supporting the weight of such a large vessel. The Calcite B, Subgroup 1 fabric group consists of very well-processed and thoroughly crushed finely crystalline limestone. These vessels are all thin-walled and most are serving vessels (see Figure 4.13). Thus, even though potters were largely using the same raw materials to produce all vessel forms considered in this study they were surely aware of locations where finely crystalline limestone could be found and made decisions about processing based on the functional requirements of vessel production. All potters, even those that used riverine derived clays, tempered their clay with limestone, indicating a widely shared practice.

Vessel Form and Color

Vessel form and color are highly visible attributes that can be learned through direct interaction but can also be copied by potters by observing the final product.

Vessel form is often considered in tandem with function (e.g. cooking and food preparation, storage, and serving). Clay selection and processing can vary based on desired performance characteristics for a given form (Schiffer and Skibo 1987).

Ethnographic data suggest that potters (and consumers) often identify the products of a

particular potter based on form. For example, in Tlaxcala, Mexico, Kempton (1981) found that when asked, people classify vessels based on their function, stress presence/absence of appendages, and focus on overall shape (the ratio of height to width) and neck position. These classifications varied based on the informants' age, sex, occupation, and socioeconomic status (Rice 1991). Males tend to classify vessels based on overall shape while women focused on handles. Reina and Hill (1978) found that both potters and consumers could identify regional production locales based on the form of a *tinaja*, or water jar. Vessel form and rim form were the most useful attributes in determining patterns of intracommunity style in Chanal (Hayden and Cannon 1984). A unique rim form also helps potters identify their vessel in group firing (Arnold 2018:149). Vessel form is not just important among Mesoamerican potters. Among the Luo, a low-density agricultural community in western Kenya, different potting communities exhibit different microstyles based on form. A similar relationship between potter and rim form is present in the Titicaca Basin (Roddick 2016). While folk classifications are an attempt to get at an emic classification of ceramic vessels, which archaeologists may never be able to understand, variation in form is an important consideration.

Vessel Form

All sherds in the locally produced calcite fabric groups were categorized as restricted orifice jars, unrestricted orifice jars, and serving vessels (bowl/dish) to determine if there is a relationship between fabric group and both overall vessel form and rim form (Table 4.5). Restricted orifice jars were most likely used for transport of solid and liquid material while unrestricted orifice jars were more likely to be used for storage. In this study, jars categorized as restricted have a rim diameter of 20 centimeters or less.

Most of the jars with restricted orifices have outflared or everted rims making them easier to transport across the landscape (Arnold 2018:144-146).

The Calcite A fabric group is almost completely limited to very large, unrestricted orifice jars of the Alexanders Unslipped ceramic type. However, potters also used the same raw materials to create smaller jars and serving wares (Figure 4.12). These large, outflaring rim jars with thickened exterior rims were likely used for storage perhaps with a perishable cover affixed to the top. Given their size (rim diameters range from 20 to 50 with a mean of 42) it is unlikely that these vessels were carried any distance across the landscape. This fabric group may represent ceramic production very localized to the Baking Pot polity given its dominance among large vessels that would have been difficult to transport.

Ceramic Group	Cayo Unslipped		Alexanders Unslipped	Silver Creek Impressed	Garbutt Creek Red	Mount Maloney Black	Dolphin Head Red	Total
	Restricted Orifice Jars	Unrestricted Orifice Jars	Bowls/ Dishes	Unrestricted Orifice Jars	Bowls/ Dishes	Bowls/ Dishes	Bowls/ Dishes	
Calcite A	1	3	1	14				19
A1					1			1
A2				1				1
Calcite B	10	8	1	4		1		24
B1	1					2	2	6
B2	4	2	1	1			1	9
B3		1		6	2			9
B4	1						1	2
Calcite C	6	12	1	3				22
C1	1	1						2
Calcite D	3	5						8
D1							1	1
D2	1							1
								105

Table 4.5. Locally Produced Fabric Groups Categorized by Ceramic Group and Form.

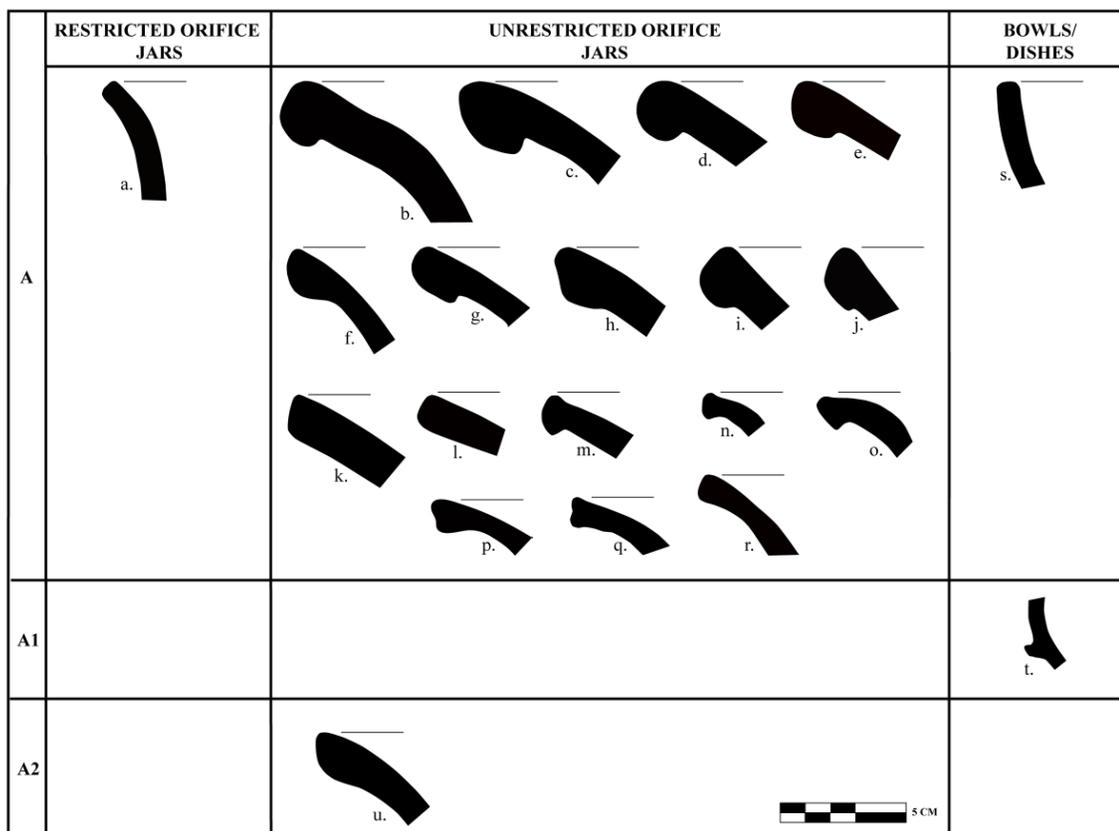


Figure 4.12. Calcite A Fabric Group Rim Forms: Cayo Unslipped (a.16, o.209, p. 86, q. 84, s. 176); Alexanders Unslipped (b. 21, c. 205, d. 27, e.32, f. 38, g. 51, h. 22, i. 18, j. 14, k. 210, l. 167, m. 7, n. 88, u.8); Silver Creek Impressed (t.184).

The Calcite B fabric group is highly variable in both composition and its use in different vessel forms (Figure 4.13). This fabric group is present in restricted and unrestricted orifice jars of both the Cayo Unslipped and Alexanders Unslipped jar types. It is also present in Mount Maloney Black, Garbutt Creek Red, and Dolphin Head Red bowls. Perhaps unsurprisingly, Subgroup 1 composed of highly processed finely crystalline calcite mosaics is preferred for thin walled jars and serving vessels. The vessel forms for Calcite C and Calcite D exhibit much less variation (Figure 4.14). They are predominantly relatively thin-walled jars of the Cayo Unslipped group though some

thinner-walled Alexander's Unslipped and a Mount Maloney Black are also present. This could suggest a correlation between fabric group and form but these contain fewer numbers than Calcite B so our sample may not represent the full range of variation. There is certainly a correlation between function and fabric group (i.e. finely crushed crystalline calcite for thin walled vessels) but the data do not show a strong relationship between fabric group (or subgroup) and vessel form that would suggest that a distinct community of practice can be linked to a specific vessel form.

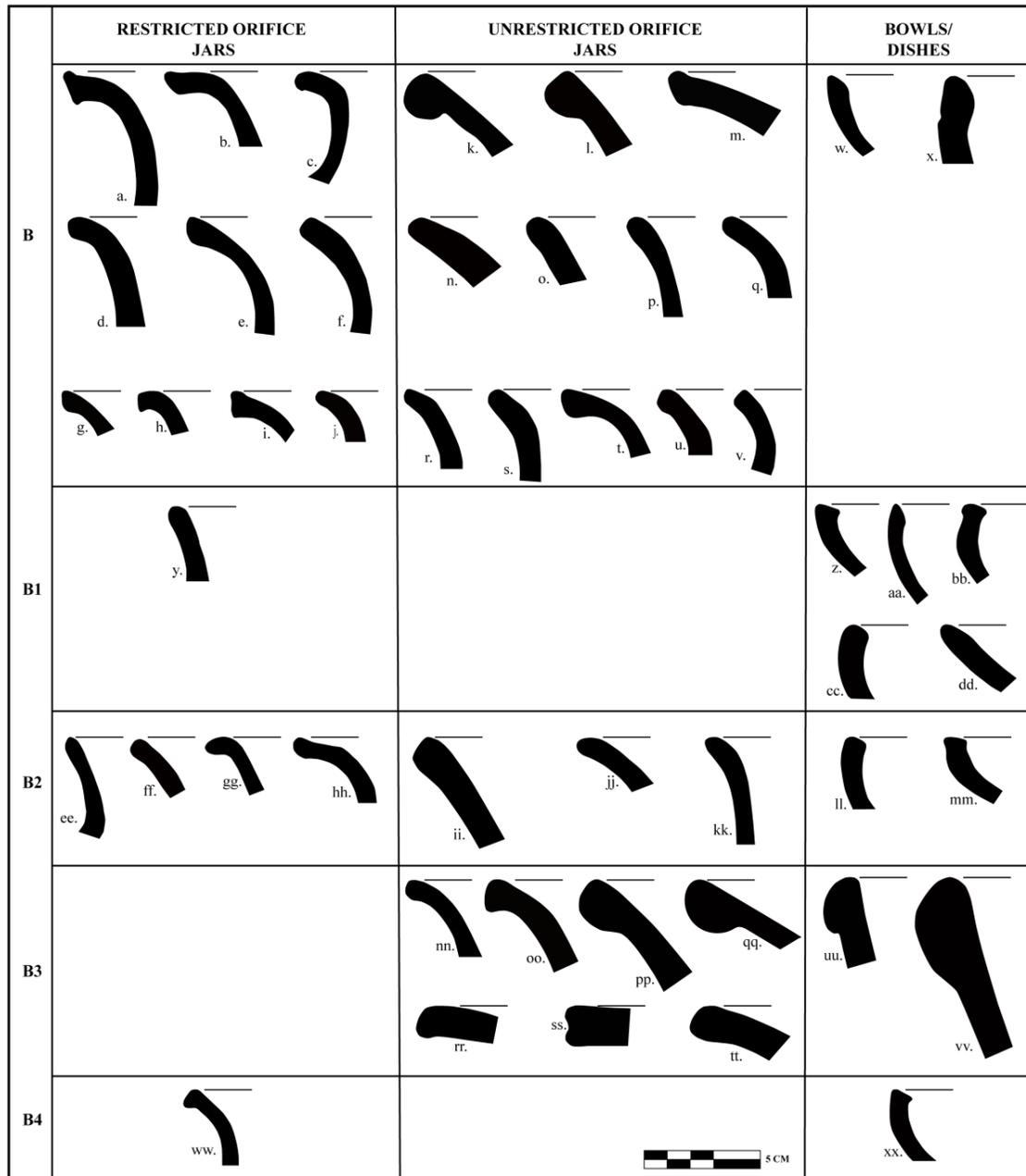


Figure 4.13. Calcite B Fabric Group Rim Forms: Cayo Unslipped (a. 69; b. 87; c. 194; d. 6; e. 181; f. 199; g. 34; h. 41; i. 93; j. 193; o. 186; p. 82; q. 50; r. 212; s. 189; t. 78; u. 165; v. 197; x. 204; y. 168; ee. 163; ff. 172; gg. 208; hh. 83; jj. 48; kk. 12; ll. 42; nn. 10; ww. 28); Alexanders Unslipped (k. 26; l. 25; m. 66; n. 171; ii. 215; oo. 65; pp. 64; qq. 73; rr. 30; ss. 175; tt. 74; uu. 35; vv. 190); Mount Maloney Black (z. 94; bb. 72; mm. 5; xx. 24); Garbutt Creek Red (w. 59; aa. 17; cc. 90); Dolphin Head Red (dd. 62).

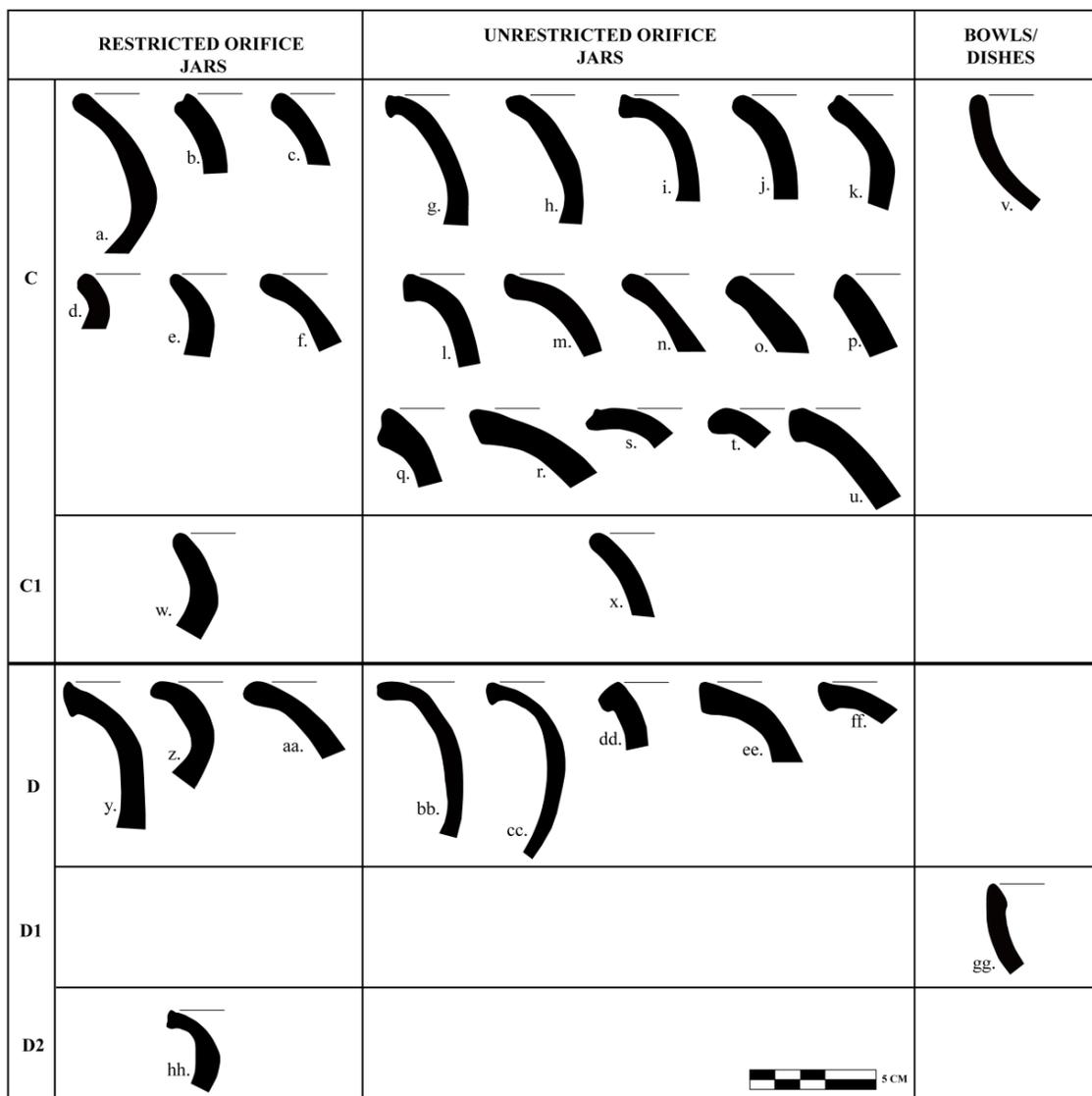


Figure 4.14. Calcite C and D Fabric Groups Rim Forms: Cayo Unslipped (a. 23; b. 201; c. 46; d. 191; e. 202; f. 4; g. 206; h. 213; i. 52; j. 211; i. 207; k. 207; l. 105; m. 81; n.19; p. 187; q. 177; s. 162; t. 47; v. 36; w. 80; x. 43; y. 169; z. 53; aa. 54; bb. 77; cc. 76; dd. 178; ee. 11; ff. 75; hh. 9); Alexanders Unslipped (o. 39, r.31, u. 92); Mount Maloney Black (gg. 20)

Rim Form

There is no obvious relationship between rim form and fabric group that would indicate that this attribute is a unique identifier of a potter or a community of potters. This was surprising given the extremely variable and highly distinctive rim forms on Cayo

Group jars and the importance of rim form as an identifier in the ethnographic literature worldwide. It is possible that rim form does indeed signal the work of a particular potter, or group of potters, but because they all use similar raw materials it was not possible to detect the relationship in this sample. A different sampling strategy, perhaps one based primarily on rim form, might produce results that this study did not. Alternatively, rim form could be an indicator of vessel contents or signal something other than potting community. This highly visible and very distinctive feature of unslipped jars in the BRV is unlikely to be a random stylistic choice.

Vessel Color

Monochrome bowls and dishes were consumed by both elites and non-elites; they would have been the primary vessel used to serve food in non-elite households. Our sample of slipped serving wares is small but the results are interesting given the observations made by other researchers that black-slipped Mount Maloney Black bowls and jars were likely produced around the site of Xunantunich while red slipped serving wares including Dolphin Head and Garbutt Creek are more prevalent down valley around Baking Pot (Aimers 2002; LeCount 1996, 2010). Our data indicate that the same paste recipes were used to produce black-slipped serving wares, red-slipped serving wares and unslipped jars [Garcia (2008) also noted a similar pattern]. Thus, paste recipe does not correspond to vessel color. Potters may have achieved a desired color by using different firing regimes (i.e. reducing atmosphere to achieve a black slip and oxidizing atmosphere to achieve a red slip) rather than through the use of different raw materials. This highly visible attribute likely signaled polity identity (LeCount 2010) during the Late to Terminal Classic Period. However, the potters responsible for their production, who lived

in the far western reaches of the Upper Belize River Valley, used the same paste recipe as potters on the other side of the valley. This further suggests that information about the location of raw materials and how to process them was shared much more broadly in the region.

Discussion

Late to Terminal Classic pottery production in the BRV is characterized simultaneously by technological and stylistic variability and shared technological traditions. Some of the variability in the locally-produced fabric groups may be due to changing practice over time. The Spanish Lookout Phase (AD 700-900) spans a two hundred year period and combines the Late Classic II and the Terminal Classic Periods. It is difficult to assign pottery to a more specific chronological period due to continuity of production, particularly for utilitarian vessels (LeCount 1996). LeCount (1996) documented changes in rim form from the Late Classic to Terminal Classic on both Cayo Group jars and Mount Maloney incurving bowls and jars. However, petrographic analyses revealed that the paste recipe remains constant (Garcia 2008:132; LeCount 2010:217-218). The petrographic sample in this study does not include enough rim forms that can be classified as Terminal Classic chronological markers so variation due to changing practice cannot be ruled out. However, given the strong technological traditions present in the sample and the continuity noted by LeCount and colleagues it is unlikely that chronological variation would significantly alter our interpretations regarding shared practice.

The ceramics discussed in this paper were excavated from consumption contexts and the variability in the assemblage as a whole is likely partially due to distribution. A total of 34 fabric groups in a sample of 144 sherds, all recovered from coeval deposits in households in a single neighborhood, certainly suggests that ceramic vessels were distributed as part of a market exchange system. Other researchers have argued for Late Classic market exchange in the BRV based on plaza excavations where the market may have been located at Buena Vista del Cayo (Cap 2015) and Xunantunich (Keller 2006). Sunahara (2003) argued that vessels were exchanged via a regional market system based on petrographic analysis of Spanish Lookout Phase pottery from eight polities in the BRV. The distribution and consumption of both local and non-local pottery is beyond the scope of this paper but will be the focus of future research.

Pottery production in the BRV, as elsewhere in the Maya lowlands, was the domain of household potters. Our data are consistent with the only other large petrographic study of Late to Terminal Classic pottery in the region (Sunahara 2003). Vessels with thin walls considered subgroups in this study (e.g. Calcite B, Subgroup 1) correspond to the Calcite 1 petrofabric while the thick bodied, large jars correspond to Calcite 2 petrofabric [see Sunahara (2003:100-110) for the complete description of carbonate petrofabrics]. Our dataset supports the idea that most polities participated in pottery production. The variability suggests that there were many potters on the landscape, which is expected given that there would have been a high demand for utilitarian vessels.

The BRV petrographic data show a range of almost continuous variation in which potters were guided by general principles about which types of clay and rock resources

were appropriate for making ceramic vessels. The lack of distinct, clearly defined petrographic groups stands in stark contrast to Lamanai during the Late to Terminal Classic Period and suggests a different scale of interaction for potters in the BRV. Howie's (2012) consideration of both geologic sourcing and ceramic petrographic analysis indicates that Lamanai potters used a variety of locally available clays and tempers to produce both utilitarian and fine wares during the Terminal Classic to Postclassic transition. She identified five distinct petrographic traditions that could be tied directly to the landscape around Lamanai. These different technological traditions, characterized by the use of different clays, tempers, and processing (i.e. the crystalline calcite group versus the grog tempered group), were practiced simultaneously and much more clearly indicate the presence of distinct communities of practice. Our data, on the other hand, suggest that there were numerous communities of practice present in the Late to Terminal Classic BRV. These communities of practice were linked to one another by a shared taskscape, combining practice and place, to form a constellation of practice operating at a regional level.

The Belize River Valley as a Taskscape

Pottery production does not occur in isolation. Resources are collected in conjunction with other activities and are located in a potter's place of experience or "the territory within which potters and/or members of their communities live, carry out activities, and develop social interactions" (Gosselain 1998:70). This concept has been developed more recently by scholars in terms of a potter's taskscape (Arnold 2018; Ingold 2000; Michelaki et al. 2012, 2015). We cannot pinpoint the exact location where potters procured clay and temper, but the fact that nearly all locally produced vessels

were composed of resources from foothill locations provides important information. According to Michelaki and colleagues (2015:787), “the performance of habitual tasks in a specific landscape, then, over time orients the movements of potters in that landscape and generates perceptions of where the “appropriate” clays are.” We use the provenance information gleaned from petrographic analysis, in combination with settlement pattern and soils data, to suggest that potters procured raw materials as part of a taskscape that included habitation, farming, and possibly quarrying for building materials.

Many of the larger polities, including Baking Pot, are located on alluvial bottomlands but the foothills were also densely occupied. The BRASS project (Fedick and Ford 1990; Fedick 1988; Ford and Fedick 1992) documented significant occupation outside of the alluvial bottomlands to the north of the Belize River. Fedick’s (1998:183) research indicates that settlement occurred predominantly in areas with high quality soil and “settlement distribution within the limestone platform is best described as a mosaic, patterned by differential agricultural development potential.” Although the southern foothills area has not been as extensively surveyed, research by the BVAR project around Cahal Pech documented a similarly densely occupied landscape (Awe 1992; Ebert 2017; Ebert et al. 2016b; Iannone 1996; Powis 1996).

Settlement was not continuous and the foothills area was used for other activities, namely farming. While the alluvial bottom has the most productive soils for farming, there was not enough space in this narrow corridor to provide food for the entire population of the BRV. The soils of the foothills vary in suitability for farming. Well-drained Mollisols (soils with a thick, organic epipedon) are ideal for farming while Vertisols (clay rich soils with expanding lattice clays) are not. Fedick’s (1988:178-200)

detailed study of the relationship between household location and soil quality indicates that households in the foothills were located atop the best soils for agriculture leaving other areas open for other activities. The Maya refer to clay rich soils as “‘Yaxhom’ meaning that it is slow to dry up after a rain” (Wright et al. 1959:69). Areas of water retention on the landscape would have alerted potters to the presence of dense clay deposits below the surface, specifically in the depressions where we hypothesize potters procured their clays. The felling of trees for farming would have provided fuel for firing pottery (Arnold 2018:171). The foothills are also where the limestone is located and a significant amount was quarried for the construction of monumental and household architecture. While limestone is a relatively soft stone, it is still a massive undertaking to quarry the materials and transport it over 2km in the case of Baking Pot (see Figure 4.11). It is possible that potters procured temper, and clay that formed atop limestone, in conjunction with quarrying activities. By considering how and where potters engage with the landscape in activities other than pottery production, we have a better understanding of a daily practice, and by extension interaction, in the BRV.

Communities and Constellations of Practice

Ceramic vessels produced locally within the Late to Terminal Classic BRV exhibit evidence of a shared technological tradition. These traditions are the result of over a millennium of practice in which the inhabitants of the region were intimately aware of and engaged with the landscape and the physical properties of locally available raw materials. As the landscape infilled over time with the establishment of new polities and the growth of others, knowledge about how to make ceramic vessels would have been passed on intergenerationally within a community of practice. Our data indicate that most

potters conceived of and engaged with the landscape in a similar fashion and created technologically and morphologically similar ceramic vessels. However, while shared technological traditions certainly suggests some form of information exchange among potters, there is enough variability in the paste recipes to argue against a single community of practice.

We suggest, then, that potters were part of a constellation of practice. The shared historical roots, related enterprise, and geographical proximity are certainly enough to link communities of practice to form a constellation of practice in the BRV (Wenger 1998:127). What links potters in different communities of practice on a more tangible level is their shared taskscape which was a place of habitation, farming, and resource acquisition for pottery production. Participants are not necessarily aware that they are in a constellation of practice (Wenger 1998:128); however, it is likely that Belize Valley potters were cognizant of the fact that they produced pottery in much the same way as potters at other polities. This is not to say that a more robust petrographic sample from multiple polities across the region would not produce evidence of more polity-specific practice that would allow us to define what each community of practice looks like in the BRV. Future analysis will focus on understanding the composition and spatial boundaries of the potting communities that comprise the much larger constellation of practice. However, the strong patterns identified in the Baking Pot sample argue more for the integration of non-elites across all spatial boundaries- the household, neighborhood, and polity-during the Late to Terminal Classic than for their division at least as it relates to pottery practice.

CHAPTER 5

DISCUSSION AND CONCLUSION

Anthropologists have long been interested in understanding the nature and scale of social groups, be it kin-based residential units or regions composed of multiple settlements. Evaluating the formation, maintenance, and transformation of social boundaries is essential to anthropological questions of cultural stability and change in human societies (Peeples 2018; Stark et al. 2008). Archaeological research provides a deep historical perspective on these fundamental issues. However, the research must employ a theoretical and methodological approach capable of *both* documenting social boundaries and evaluating how they change over time. The communities of practice framework, paired with technological analyses of ceramic artifacts and locally available raw materials, provides an approach that can do both; however, it has not been previously used to evaluate communities in the Maya lowlands (see Munson 2012 for an exception). This study documents social boundaries and interaction networks among non-elite potters at two polities in the Maya lowlands: Uxbenká and Baking Pot, Belize. The broadly applicable theoretical and methodological framework provides a way to compare pottery production and interaction in two different locations that do not share the same types of pottery or underlying geology. Future work, discussed at the end of this chapter, will build upon the data presented here to examine how social boundaries were transformed in the wake of societal collapse, regional depopulation, and migration in the Belize River Valley.

This chapter begins by situating this study within the broader literature on communities and social boundaries and discusses how it builds on, and is different from, prevailing approaches to community in the Maya lowlands. The data and interpretations presented in this dissertation provide a wholly bottom-up perspective that incorporates household archaeology, spatial evaluations, ethnographic correlates, and consideration of both technological style and styles of form on ceramic assemblages from household contexts to evaluate social organization among non-elites in the Maya lowlands. One of the central objectives is to compare information exchange networks in two regions of the Maya lowlands. To do this, the previous chapters presented data from Uxbenká (Chapter 2 and Chapter 3) and Baking Pot (Chapter 4) as three discrete manuscripts. Each chapter pursues three research goals: (1) to understand pottery production practice among non-elite potters, (2) to identify communities of practice and (3) to evaluate community interaction through sharing of knowledge and practice across spatial and social boundaries. This chapter summarizes and synthesizes the data collected with reference to the research and the primary research question: *Do communities of practice correspond to spatial zones (neighborhood, district, and/or polity) commonly identified using spatial analyses?* These data are used to compare pottery production and distribution in southern Belize and the Belize River Valley to address the second research question: *Does location affect patterns of information sharing?* The results inform on social organization in two discrete areas of the Maya lowlands and provide an avenue for considering the impact of historical trajectory and social milieu on the interaction networks of non-elite communities.

Approaches to Community and Social Boundaries in Archaeology

Archaeological studies often focus on the community as a unit of analysis but there are many ways of defining and documenting community in the archaeological record. Approaches to community emphasize interaction among its members but they generally fall into two categories: those that emphasize practice over place and those that emphasize place over practice. Yeager and Canuto (2000) consider community to be at the intersection of people and practice. They acknowledge that physical proximity plays a role in how communities are defined and emphasize co-presence over co-residence. According to Yeager and Canuto (2000:6), “we do not neglect the spatial aspect of the community because there must exist physical venues for the repeated, meaningful interaction needed to create a community, but we reject notions of the community as a solely socio-spatial unit.” Their interactionist approach also recognizes the historically situated, dynamic, and multiscalar aspect of community.

In the same volume, Isbell (2000) discusses natural communities versus imagined communities. He argues that natural communities, or spatial entities defined on the basis of face-to-face interaction between their members, are largely the creation of anthropologists and urges archaeologists to instead focus on the imagined community. Isbell’s (2000:249) imagined community approach “recognizes that correspondence between a socially interacting group, a bounded territory, economy, politics, reproductive pool, intergenerational education, desires and sentiments can only exist in an ideal model, not in the real world. Local groups are never so secluded that their members are isolated from outsiders, and there are always cross-cutting allegiances.” Varien and Potter (2008:

3-4), in their edited volume on practice approaches to communities in the American Southwest, discuss the difficulty defining and addressing the imagined community in the archaeological record. They also emphasize agency and practice approaches to community in archaeology.

By and large, most approaches to community conceive of them as inherently spatial. Kolb and Snead (1997:611) define a community as “a minimal, spatially defined locus of human activity that incorporates social reproduction, subsistence production, and self-identification.” Over two decades later, archaeological research into what constitutes a community remains largely focused on the spatial attributes and some are critical of the approaches discussed above. For example, Smith (2010:6-7) states that “the Canuto-Yaeger concept of community is a prime example of an archaeological concept out of step with the social sciences today. Adherence to this kind of relativist and interpretivist approach only serves to isolate archaeological research from the concerns of the contemporary world.” Smith and colleagues emphasize cross-cultural comparative studies that focus on spatial and architectural data as the jumping off point for comparing disparate datasets (e.g. Fletcher 2009; Smith 2010). Spatial data are used to infer interaction based on proximity using examples from modern communities. However, a strictly spatial approach does not provide a method for evaluating diachronic change in social relationships (e.g. Harris 2014:78).

The analysis and interpretation of spatial data have a long history in the Maya lowlands (Ashmore 1981; Willey et al. 1965) and researchers have again focused their attention on the analysis of spatial data to identify neighborhoods and districts to evaluate intrapolity social organization (Arnauld et al. 2012; Chase 2016; Hutson 2016; Prufer et

al. 2017; Smith 2010; Smith and Novic 2012; Thompson et al. 2018). Early settlement pattern and household archaeology studies and the more recent analyses focused on intracommunity spatial and social boundaries are fundamental to the research presented in this dissertation. While this study focuses on a single time period in two regions, it is meant to be a starting point to evaluate change over time in the Maya lowlands. Spatial data are vital to this study because potters learn pottery production via face-to-face interaction with an experienced potter. However, the boundaries of these learning and/or craft production communities are not necessarily synonymous with clearly defined spatial boundaries such as the neighborhood, district, or polity. A mechanism behind this, to be addressed in future work, is that potters may be moving and intermarrying (e.g. Mills 2018) which would affect interaction networks and learning communities. My research builds on the seminal research in the region and more recent studies and incorporates practice to evaluate the relationship between spatial boundaries and practice in the Maya lowlands.

This work is part of a larger trend in archaeological research focused on understanding social boundaries, ethnicity, and identity among prehistoric populations through practice-based research (Peeples 2018:21). Stone (2003 in Peeples 2018) argues that approaches to these issues can be generally categorized as interactionist or enculturationist. The interactionist approach views social boundaries as the result of interaction between distinct groups while the enculturationist approach seeks to understand how shared practice within a single group results in the formation of identity (Peeples 2018:21-22). These approaches play out in studies that employ ceramic analyses largely in terms of what aspects of a ceramic vessel are elevated to evaluate interaction.

Studies taking an interactionist approach often focus on highly visible attributes of decorative style or form while those with an enculturationist approach focus on low visibility attributes of technological style. According to Peebles (2018:23), “the enculturationist approach has most frequently been used to identify groups characterized by divergent learning frameworks or communities of practice, suggesting distinct enculturative or historical backgrounds, especially in contexts characterized by immigration and the coresidence of multiple social groups.” This study falls into what Stone (2003) would refer to as an enculturationist approach. However, it differs from other studies because it focuses on shared knowledge among artisans that share an enculturative and historical background by evaluating practice at different scales and uses the data to reevaluate commonly cited intrapolity and intraregional social boundaries that are based primarily on spatial data.

Pottery Production and Distribution in southern Belize and the Belize River Valley in the Late to Terminal Classic Period

The previous chapters focused on pottery production and the scale of information exchange between potters in two, coeval regions of the Maya lowlands: southern Belize and the Belize River Valley. Uxbenká and Baking Pot were both medium-sized Maya polities that supported a similar number of people. The households in the dispersed settlement area were clustered into larger social units called neighborhoods (Hoggarth 2012) and, in the case of Uxbenká, neighborhoods and districts (Thompson et al. 2018). They differ in location and degree of participation in larger regional dynamics, which

provides a unique opportunity to evaluate and compare information exchange among crafts producers in the two regions.

Potters at Uxbenká and Baking Pot used raw materials derived from completely different geologic formations. Uxbenká is located atop Tertiary clastic rocks composed of interbedded sandstones and mudstones. Baking Pot is located atop floodplain deposits near marine limestones of varying ages and compositions. Petrographic analysis of both ceramic assemblages focused on answering the same research questions using the descriptive system to document the ceramic fabrics (Whitbread 1989, 1995: 365-396, 2017). By asking questions about resource acquisition and processing, and using an analytical approach capable of evaluating the pottery production process, the data collected on pottery produced in two different geologic regions can be compared in a meaningful way. Furthermore, while each sample was assigned to a ceramic group and type according to the type: variety classification system [Hammond (1975) and Jordan and Prufer (2014) for Uxbenká; Gifford (1976) for Baking Pot] the research questions focused on general styles of form categories to make the data from Uxbenká and Baking Pot comparable. The typological information is essential for making the petrographic data relevant to other ceramic studies in southern Belize and the Belize River Valley.

Pottery Production in Southern Belize

Analyses of household artifact assemblages at Uxbenká presented in Chapter 2 focused on macroscopic and microscopic observations of ceramics and stone tools in order to identify pottery production households based on a suite of co-occurring artifacts and the abundance of ceramic artifacts compared to households that did not participate in pottery production. I evaluated the ceramic and lithic artifacts from every context

excavated by the Uxbenká Archaeological Project. It was only through the analyses of non-diagnostic ceramic sherds, usually just counted, weighed, and set aside, that the presence of shaped ceramic tools was identified and used as an indication of practice. These tools were made from locally produced pottery for various tasks including scraping, incising and boring. Ceramic production tools co-occur with chert tools used for smoothing and polishing ceramic vessels. The three households discussed in detail in Chapter 2 (SG 36, SG 52, and SG 54) were modest households of low status yet they contained more ceramics by volume than most other households in the Uxbenká polity. The data indicate that potters lived near one another in the southwest periphery of the settlement area.

The fact that all three households were located near one another and shared a common toolkit is suggestive of a community of practice in which non-elites who participated in pottery production engaged in personal interaction with one another on a regular basis. It is not clear why these households are located where they are but a few scenarios are possible. First, they were located on the periphery of the polity where Fry (2013) suggested Mayanists would find evidence of pottery production possibly due to proximity to resources or the abundant smoke associated with open firing, or both. Second, they are located near the Rio Blanco which would have provided a reliable source of water. Third, conversations with people who live in the modern village of Santa Cruz revealed that when women used to make pottery in the village they retrieved clay from this area because it produced a better finished product. The southwest periphery of the settlement area was an important location to the potters of Uxbenká. SG 60, a household dating primarily to the Early Classic Period (c. 300-600 CE), produced the

same suite of ceramic tools, stone tools, and an abundance of finished products. The artifacts were not included in this dissertation because they predate the Late Classic Period. However, they are indicative of strong patterns of intergenerational transmission of knowledge regarding both place and practice.

Chapter 3 builds directly on Chapter 2 to identify communities of practice at Uxbenká and evaluate how information was shared across spatial boundaries. The ceramic sample from Uxbenká ($n = 97$) was recovered from both elite, site core contexts ($n = 26$) and non-elite, household contexts ($n = 71$). Petrographic analysis revealed 13 distinct fabric groups representing imported and locally produced pottery. Nearly all of the imported pottery was recovered from primary contexts (i.e. burials and caches). The petrographic sample in this study likely underrepresents the abundance of non-local pottery in household contexts due to its explicit focus on evaluating local pottery production. However, macroscopic paste analysis indicates that the overwhelming majority of pottery excavated from Uxbenká households was produced locally. The types of non-local pottery, and their provenance, provide important information on extraregional interactions between Uxbenká and other regions of the Maya lowlands. The Calcite A and Calcite B fabric groups indicate that Uxbenká elites had a relationship with the Belize River Valley as early as the Early Classic Period. Other imports suggest interactions with the coast of southern Belize and the Petén region of Guatemala.

Potters at Uxbenká acquired clay from the clay rich, sandy soils located to the south of the polity in the vicinity of their households, a distance of less than 1km (Table 5.1). The use of crystalline calcite as a temper in many of locally produced fabric group (Sandstone B) does not appear to be a functional choice. In many cases, there are very

few crystalline calcite inclusions (occasionally only 1 or 2) and potters were able to make vessels without the addition of this type of temper (as is the case with the Quartz A fabric group). This type of limestone was likely procured from the karstic ridge composed of Cretaceous limestone, known locally as the “rock patch”, located immediately to the south of the polity.

Locally-produced polychromes include both cream-slipped (Zacatel) and orange-slipped (Saxche-Palmar and Palmar) and are painted with black and red paint.

Polychrome vessels are produced in much the same way as unslipped Turneffe and monochrome red slipped Remate vessels with two notable exceptions. The Sandstone A fabric group, which contains abundant calcareous sandstone that may be naturally occurring in the clay or added as temper, comprises *only* locally produced polychromes. Although the sample is small, these data suggest that either these vessels were produced by potters within a different community of practice or that the same potters purposefully used this type of clay and/or temper for pottery that would ultimately be placed in a burial context. In this case, they were all excavated from the Group L2 tomb. Both the Sandstone B and Quartz A fabric groups, the two most abundant local groups, are present in Early Classic Santa Cruz Red (AD 250/300 to 600) pottery indicative of continuity in pottery production technology even though the style changed over time. There is also evidence of change in production from the Mixed Carbonate and Sandstone A group to the Sandstone B group in which potters used less crystalline calcite in the production of ceramic vessels over time. The petrographic data indicate that most, if not all, potters at Uxbenká were involved in a community of practice operating at the level of the polity (Table 5.1). Potters shared information on where to procure raw materials and how to

process them to make ceramic vessels. The same basic paste recipe was used to create thin-walled and thick-walled jars that were mostly unslipped but some were monochrome red slipped. This recipe was also used to create monochrome red serving vessels of all shapes and sizes. A different, but related, paste recipe was used to produce fine paste, thin-walled polychrome serving vessels. These two paste recipes were used by potters in the same community of practice and the differences are related to functional requirements of vessel construction.

	Research Questions	Uxbenka	Baking Pot
Paste Recipe			
Resource Acquisition	Where did potters procure clay ?	Red, clay rich Aguacate and Manfredi soils to the south of the polity (< 1km)	Yaxa and/or Chacalte Soils that form above limestone bedrock in the foothills to the north and/or south of the Belize River (> 2km); some riverine sources
	Where did potters procure temper ?	Crystalline calcite/dolomite, possibly from the rock patch ; calcarous sandstone bedrock (<1 km)	Limestone (primarily sparry calcite) in the foothills to the north and/or south of the Belize River (> 2km)
Raw Materials Processing	Did potters process natural clay?	Yes. Removed large rocks, added limestone and calcareous sandstone temper	Likely removed large rocks and added limestone temper
	How did potters share (or not share) information on resource acquisition and raw materials processing?	Intrapolity	Regional
Styles of Form			
Vessel Form	Does paste recipe correspond with overall vessel form (restricted orifice jar, unrestricted orifice jar, monochrome serving wares)?	No	No
Rim Form	Does paste recipe correspond with rim form?	No	No
Color	Does paste recipe correspond with vessel color(s)?	Yes, Quartz A fabric group used to produce polychrome vessels.	No
		Intrapolity, A community of practice at the level of the polity	Regional, A constellation of practice at the level of the region

Table 5.1. Comparative Data on Pottery Production at Uxbenká and Baking Pot with Reference to the Primary Research Questions.

Pottery Production in the Belize River Valley

Potters at Baking Pot procured both clay and limestone from the foothills located to the north and/or south of the Belize River, a distance of over 2km from Baking Pot. The data generated from the petrographic study of 144 samples from Baking Pot were unexpected. While I anticipated variation due to the population density of the Belize River Valley, I expected that communities of practice would be recognizable based on a set of discrete technological and formal characteristics unique to different potting communities, likely centered on learning networks that existed at the polity level. None of these expectations were born out in the data. The petrographic data indicate that potters in the region shared information on resource acquisition and raw materials processing at a much larger scale than anticipated. The four locally produced petrographic groups, comprising seventy four percent of the sample, are not distinguishable based on an exclusive suite of characteristics. Rather, they exhibit almost continuous variation related to both resource acquisition and processing. There is no relationship between fabric group and form in the Baking Pot sample. However, the range of variation in form, as well as in fabric groups, suggests that additional work is necessary to identify communities of practice in the region. Baking Pot potters were part of a constellation of practice in which potters living across the Belize Valley engaged in resource acquisition as part of a taskscape that also included habitation and farming.

The high degree of variation in the ceramic sample from Baking Pot suggests to me that there were many potters on the landscape that were guided by general principles about where to procure clays for pottery production and which types of limestone were preferred for temper. I do not mean to suggest, however, that future research will not

identify discrete groups of potters that shared stylistic or technological attributes more closely. I suspect that this will be the case but the data collected on the sample in this study was unable to further define pottery production practice and tie it to a specific locale or polity. It is likely that the data and interpretations presented in this study were only able to identify broad, regional patterns of information exchange that may enable researchers to identify vessels produced within the Belize River Valley. Future work will focus on identifying communities of practice within the region and determining the spatial scale of information exchange among these groups.

Distribution

Although this study focused primarily on pottery production, the data provides important information on how pottery was distributed to consumers in terms of both scale and the type of distribution. The method by which households provision themselves has been a topic of debate in Maya archaeology. Some researchers argue for the presence of a market exchange system during the Late Classic Period in the Maya lowlands (Cap 2105; Dahlin et al. 2007; Dahlin et al. 2010; Masson and Freidel 2012; Terry et al. 2000). Artifact analyses that suggest that goods were distributed via market exchange often focus on identifying the presence of long-distance trade items (e.g. obsidian) in households of different status to suggest that all people, regardless of status, had access to these items (Hirth 1998). However, locally produced items, like pottery, were also likely distributed as part of a market system in some regions. It is more difficult to document intraregional exchange in the archaeological record because these items are often made from the same types of raw materials and would be categorized as the same type of ceramic in the type: variety classification system.

The data presented in this dissertation provide insight in to the mechanisms behind the distribution of locally produced ceramic vessels in southern Belize and the Belize River Valley. Only four fabric groups were identified in the household assemblage from Uxbenká versus 34 fabric groups at Baking Pot (Table 5.2). These data suggest that pottery in southern Belize was primarily distributed to non-elite households via intrapolity distribution networks, perhaps via gifting or exchange between pottery producing and non-producing households. Non-local vessels are present but account for such a small percentage of the total assemblage that it is unlikely that ceramics were distributed via market exchange although other items, like salt (McKillop and Aoyama 2018), likely were. At least for southern Belize, it appears that different commodities circulated in different ways during the Late Classic Period. The petrographic data from Baking Pot support the conclusions by other researchers that a system of market exchange was in place during the Late Classic Period in the Belize River Valley (e.g. Cap 2015; Sunahara 2003).

		Possibly			
		Local	Local	Non -Local	TOTAL
Baking Pot					
Households	n	6	22	6	34
	%	75	20.8	4.2	
Uxbenka					
Households	n	3	0	1	4
	%	99	0	1	

Table 5.2. N and Percentage of Local and Non-Local Fabric Groups from Household Contexts at Baking Pot and Uxbenká.

Comparison between the Belize River Valley and Southern Belize

The data presented in this dissertation, in terms of both ceramic production and distribution, indicate that non-elite lowland Maya communities are not monolithic entities. Rather, the composition of these communities and the way that they interact with one another is different and, in the case of Late to Terminal Classic southern Belize and the Belize River Valley, likely resulted from their different historical trajectories and degree of participation in the larger spheres of interaction across the Maya lowlands. The communities of practice approach provides an avenue for evaluating interaction that allows for the consideration of more than just settlement patterns to examine social organization. The earliest polities in the Belize Valley were founded in the Early Preclassic Period (c. 1200 BC; Awe 1992; Ebert 2017; Sullivan and Awe 2013) and the region infilled with large polities and numerous smaller households until peak population density was reached in the Late Classic Period. Most of these polities are located along the Belize River which was a major transportation and trade route connecting the Caribbean Sea to inland modern-day Belize and Guatemala. The presence of marine shell, imported pottery, and other long-distance trade items during the earliest occupation periods in the region (Awe 1992; Awe et al. 1995; Ebert 2017; Hohmann 2002; Horn 2015) are indicative of the vast network of interaction that the inhabitants of the Belize Valley participated in. Local pottery production began around 1200 BC during the Cunil Phase (Awe 1992; Awe and Sullivan 2013; see Ebert 2017 for a consideration of chemical data; see Horn 2015 for a discussion of Middle Preclassic macroscopic data)

and continued for over 2,000 years into the Postclassic Period (Gifford 1976). While pottery styles, both decorative and technological, certainly changed over time, the long history of interaction between potters and their landscape surely influenced the patterns of interaction documented in this study.

By the Late to Terminal Classic Period, the Belize River Valley was a densely settled landscape consisting of large polities, humble households, and a numerous intermediate sized settlements (Driver and Garber 2004; Fedick 1988; Fedick and Ford 1990; Helmke and Awe 2012; Iannone 2004). The presence of a constellation of practice at the level of the region, as I have suggested for the Belize River Valley, is the result of the long history of occupation and densely occupied landscape that set the stage for a sociopolitical environment where non-elites living across the region interacted with one another across the boundaries of the polity and shared information on the pottery production process. The presence of an intraregional market exchange system for the distribution of locally produced vessels is also likely the outgrowth of the same historical processes in which the inhabitants of the region regularly interacted with one another. The inhabitants of Baking Pot, who lived on a major riverine trade route, participated in regular interaction with other people living in the Belize River Valley and in far-flung regions of the lowlands. The presence of vessels produced as far away as the Stann Creek District in southern Belize and Petén, Guatemala points to relationships between the non-elite inhabitants of the Belize Valley and other regions of the Maya lowlands.

The historical trajectory of southern Belize is much different. Uxbenká, established sometime in the Late Preclassic Period (c. 0 to 250 AD), is one of the earliest and longest occupied polities in the region (Braswell and Prufer 2009; Prufer et al. 2011;

Prufer et al. 2017). Evidence of pottery production begins toward the end of the Late Preclassic Period (c. AD 250) which is over 1,000 years later than is documented in the Belize River Valley. Furthermore, the southern Belize region is less densely occupied than the Belize River Valley providing the inhabitants at Uxbenká with fewer opportunities for intraregional interaction. Epigraphic and artifactual evidence indicates that interaction between elites living at different polities did not occur regularly (Braswell and Prufer 2009). The data presented in this dissertation supports the assertion by other researchers that each polity was largely independent and did not engage in regular interaction as attested to by the pottery production and distribution data collected on Uxbenká as well as other polities in the region (Fauvelle 2012; Irish 2017). Information exchange networks among non-elites were likely focused at the level of the polity although they surely interacted with people living across the region, although with less frequency. While additional archaeological research may produce more evidence of interaction it is unlikely that the non-elite people of southern Belize engaged with one another in the same manner as people living in the Belize Valley. A better understanding of the relationship between inland polities and people living along the coast is particularly important for evaluating regional interaction networks in southern Belize. The petrographic data on vessels in burial and cache contexts in the site core of provides information on interaction networks among elites that were heretofore not well-documented at Uxbenká. Elites likely engaged in interaction with polities of the Petén, as suggested by Wanyerka (2009) based on epigraphic evidence, the southern Belize coast as suggested by McKillop (2002), and the Belize Valley previously only documented at

Uxbenká based on the presence of Belize Red volcanic ash ware pottery (Jordan and Prufer 2014).

Avenues for Future Research

The beginning of this chapter discussed the need for a theoretical and methodological approach capable of identifying communities and documenting diachronic change in social boundaries to address questions of cultural stability and change. Future research will focus on examining the effects of societal collapse, regional depopulation, and migration on learning and information exchange networks on non-elite communities in the Belize River Valley. Complex societies decline and regenerate, often resulting in different forms of social organization. However, our understanding of these processes is primarily limited to the social, political, and/or religious institutions of the elite (Schwartz and Nichols 2006; Tainter 1988; Yoffee and Cowgill 1988). After the Lowland Maya collapse (c. AD 900), extensive migration occurred in response to multi-causal disruptions resulting in the transformation of lifeways that had been in place for centuries (Aimers 2007; Chase and Chase 2006; Demarest et al. 2004; Hoggarth et al. 2016; Inomata 2003; Kennett et al. 2012; Masson 1997; Mixter 2017; Pendergast 1986; Sabloff and Rathje 1975). Substantial depopulation of some regions, and the influx of migrants in others, altered the existing social structure and produced new social networks. Future work at Baking Pot will focus on addressing these issues by building directly on the large body of data presented in this dissertation in order to evaluate the effects of collapse on commoner social organization which is not possible by focusing on spatial data alone. The longevity of occupation from the Preclassic into the Postclassic affords the

opportunity to explore the development and transformation of social boundaries relative to collapse. Using the same theoretical and methodological framework discussed throughout this dissertation, future ceramic analyses will target three specific questions: 1) When did non-elite Late Classic regional interaction networks develop, 2) How did collapse affect information exchange and social boundaries, and 3) How did Late Postclassic in-migration affect pottery production practice? While Uxbenká does not play a direct role in my future research plans, the results from that case study provide an alternative model of social organization among non-elites in the Maya lowlands that is potentially applicable to the Postclassic Maya world.

Conclusion

This study employed a theoretical framework and methodological approach that has not previously been used to evaluate pottery production, social boundaries, and interaction in the Maya lowlands. It aids in understanding personal and economic interaction networks among the non-elite Maya and provides an avenue for evaluating change over time. The scale of interaction between non-elite potters in two discrete regions of the Maya lowlands varies from intrapolity interaction in southern Belize to intraregional interaction in the Belize River Valley. Pottery distribution in these two regions can also be characterized in a similar fashion. The difference in both pottery production and consumption is likely due to unique historical trajectories of the two regions and their population densities in the Late to Terminal Classic Period.

Like us, the Maya led multifaceted lives governed by both personal relationships and larger economic and political systems. This work contributes to studies focused on moving beyond notions of the monolithic Maya farmer by analyzing households and their interactions as seen through everyday objects. Significantly, the theoretical and methodological model that I developed bridges the gap between practice and the archaeological record by selecting attributes of material culture that are directly related to human behavior learned within a community of practice. Although I focus on utilitarian vessels, this approach can be applied to all pottery and will contribute to understanding information exchange and the maintenance and transformation of social boundaries, issues fundamental to questions of cultural stability and change.

APPENDIX A

**EXCAVATION CONTEXTS AND DESCRIPTIVE DATA FOR THE BAKING
POT PETROGRAPHIC ANALYSES**

Excavation Contexts

The Baking Pot ceramic sample was excavated by the Belize Valley Archaeological Reconnaissance Project as part of Julie Hoggarth's (2012) dissertation research. All of the samples were recovered from construction fill contexts. While this is not ideal, no middens were encountered in the Baking Pot Settlement. All of the samples come from households located within a single settlement cluster, Settlement Cluster C, with the exception of M-207. There is no evidence of pottery production (Hoggarth 2012: 126) in Cluster C. Thus, the Baking Pot sample represents consumption contexts. All of the material was screened through a ¼ inch mesh screen and taken to the lab for processing. Ceramics were then processed to separate diagnostic from non-diagnostic sherds. Sherds considered non-diagnostic are body sherds that are less than the size of a quarter. My sample was derived from previously separated diagnostic sherds.

The following discussion of the Baking Pot is drawn directly from Hoggarth's (2012) dissertation. Using data obtained during survey, the volume for each group was calculated and used as a proxy measure for social status. These data were used to classify each settlement group as nobles, high-status commoners, and low-status commoners. These classifications do not include the royal court and no ceramics from royal, site-core contexts were analyzed as part of this study. Further, only mounds considered high-status commoners and low-status commoners were sampled. It was assumed that noble households had the ability, either through relationships or economics, to import more

vessels from outside of the study region which could complicate a study of locally produced vessels.

High-Status Commoner Groups (200-600 m³): M-96, M-90, M-108. M-96 is located on a topographic rise in the center of Settlement Cluster C and occupation began in the Late Classic Period. There was some construction during the Terminal Classic and evidence of Early Postclassic activity though no construction during the latter time period. The M-90 Group is composed of M-90, M-91, and M-95. Only M-90 and M-91 were sampled for this study. It is located on a topographic rise in the central area of Cluster C and construction began in the Late Preclassic Period. The final construction episodes occurred during the Terminal Classic and evidence of Postclassic activity is present on the terminal floors. The M-108 group is composed of M-108, M-109, M-110, and M-100. It is located in a slight depression and was abandoned prior to the Postclassic Period. Most of the construction occurred during the Late Classic Period with minor construction during the Terminal Classic Period just before abandonment.

Low-Status Commoner (8-100 m³): M-100, M-184, M-181, M-94. The M-100 group is located on the eastern edge of Settlement Cluster C and includes M-100 and M-101. The two mounds form a small group founded in the Early Late Classic (Tiger Run) Period. Construction ended in the Terminal Classic Period but there is evidence of Postclassic occupation on terminal architecture. M-184 is a single L-shaped mound located in the northern part of Settlement Cluster C. It was founded in the Early Classic Period. It appears that the structure was abandoned due to flooding but construction resumed during the Late Classic Period. Occupation continued into the Postclassic when the mound was raised for the last time. M-94 is a single mound

Macroscopic Ceramic Analysis

Macroscopic analyses and sampling for microscopic analyses occurred in July and August 2014 under the auspices of the Belize Valley Archaeological Reconnaissance Project. Ceramics from were previously analyzed by Dr. Hoggarth for chronological information. I performed my own typological assessment of the material to eliminate issues that may arise from interobserver error. A total of 305 diagnostic Spanish Lookout Complex (Gifford 1976: 225-288) ceramic sherds were analyzed macroscopically. Analyses focused predominantly on Belize Group and Cayo Group rim sherds though other ceramic groups (e.g. Garbutt Creek, and Mount Maloney) were analyzed for comparative data. The following information recorded for each sherd: fragment type, ceramic group, vessel form, rim form, rim thickness, rim diameter, paste group.

Fragment Type

Nearly all fragment types analyzed were rims. Some body sherds were analyzed when ceramic group could be identified.

Type: Variety Analysis

While the primary goal of this analysis is not a comprehensive type: variety analysis, it is important to identify each sherd according to the established system in place in the Belize River Valley (Gifford 1976) for two reasons. First, the system works well for dividing ceramics into chronological periods. It was necessary to place sherds into this system in order to isolate Late Classic ceramics for further study. Second, it is easier to communicate the results of this study with other researchers by sampling within previously established groups. The Spanish Lookout Complex in the Belize River Valley

is equivalent to Tepeu 2 and Tepeu 3 in the Petén, essentially the latter part of the Late Classic Period and Terminal Classic. Tiger Run Complex ceramics (Tepeu 1), the early Late Classic, were not sampled for this study. All sherds were identified to the group level and, in many cases, to the type level. No attempt was made to identify sherds to the variety level. A *type* is a “ceramic unit that is recognizably distinct as to certain visual or tactile characteristics. A type represents an aggregate of distinct ceramic attributes that is indicative of a particular category of pottery produced during a specific time interval within a specific region” (Gifford 1976: 9). A *variety* cannot exist “apart or separately from a type. Because the range of variation encompassed by a type always includes that of its varieties a variety can differ from the type which contains it only in the scope of its internal attribute content. Each variety of a type may be distinguished from all others in the matter of one or a relatively small number of attributes; associated geographical distribution and time span restrictions may be dissimilar in minor ways” (Gifford 1976: 10). The placement of a sherd into a ceramic group or type was based primarily on surface characteristics and form. There was no attempt to type ceramics based on the paste characteristics described in Gifford.

Vessel Form

Vessel form designations are based on the descriptions provided by Sabloff (1975) in the Seibal reports. There are a wide variety of Late Classic rim forms in the Belize River Valley, particularly among Cayo Group jar forms. Researchers have successfully seriated rim forms as a means to refine chronology in tandem with C14 dates (e.g. LeCount et al. 2002); however, no work has been conducted on rim forms as indicative of other phenomena (e.g. social groups, potting groups). It was not feasible to

draw each of the rims analyzed macroscopically. Instead, each sherd was assigned a figure number and letter from Gifford (1976: 278-286) to represent the rim form. In most cases, the rim form was already drawn and represented. If the rim form was not present in Gifford, it was drawn. The rim thickness (mm) was recorded for each sherd to address questions related to standardization of production. Lastly, rim diameter was recorded for each sherd if size permitted. In some cases, the rim diameter was too large for the chart and a recording of 50+ was entered into the database.

Paste Groups

The most important aspect of macroscopic analyses was to create paste groups and assign each sherd to a group to guide subsampling for microscopic analyses. As was noted for Middle Preclassic vessels (Horn 2015: 535-536), paste descriptions for types and varieties are often identical and variation is understudied in favor of highlighting stylistic differences. A total of 14 paste groups were identified for Cayo Group jars at Baking Pot. Macroscopic analyses of paste were conducted using a 10x loupe. Paste groups were assigned based on color; the size, sorting, and angularity of inclusions; and the type of inclusion. The presence of a core was noted but was not used as a means to distinguish a group as it is indicative of a lack of control of firing. Size, sorting, and angularity were determined based on published charts. In some cases (e.g. crystalline calcite) the inclusions were identified. In other, they were just described (e.g. powdery white inclusions resulting in a speckled look) when a positive identification was not possible using only a loupe. The goal of these analyses was to make meaningful choices when subsampling the assemblages for petrographic analyses. A secondary goal was to then apply the petrographic data to the macroscopic paste groups in order to enlarge the

sample. Unfortunately, the fact that the petrographic sample represents a range of variation and nearly all of the samples include carbonate inclusions it is impossible to work backward from the macroscopic groups at this time. All of the macroscopic data are included in the following charts. Ideally, future work will help to rectify the relationship between macroscopic and microscopic paste characteristics in order to aid in ceramic analyses in the Belize River Valley.

Descriptive Data for the Petrographic Sample

Sample #	Fabric Group	Lot	Mound	EU	Level	Ceramic Group	Ceramic Type	Form	Rim Diameter	Munsell Exterior	Munsell Core
BKP 164	Calcite H	1696-2	111A	28	5	Cayo	Cayo	Jar	25	2.5YR-5/6; 5YR-5/4	
BKP 165	Calcite B	1696-3	111A	28	5	Cayo	Cayo	Jar		5YR-6/3	2.5YR-6/6
BKP 163	Calcite B2	1695-1	111A	28	4	Cayo	Cayo	Jar	10	7.5YR-7/4	7.5YR-6/1
BKP 172	Calcite B2	1520-1	184A	21 Ext. A	4	Cayo	Cayo	Jar	17	5YR-5/6	7.5YR-3/1
BKP 170	Calcite G	1518-1	184A	21	6B	Cayo?		Jar		2.5YR-5/6; 5YR-5/4	
BKP 166	Quartz H	1696-4	11A	28	5	Cayo	Cayo	Jar	20	5YR-5/4	
BKP 175	Calcite B3	1696-5	111A	28	5	Cayo	Alexanders	Jar	TS	7.5YR-6/4	7.5YR-3/1
BKP 162	Calcite C	1691-1	111A	28	1	Cayo	Cayo	Jar	25	5YR-5/3	5YR-3/1
BKP 173	Calcite E	1520-2	184A	21 Ext. A	4	Cayo	Alexanders	Jar		7.5YR-7/3	7.5YR-5/1
BKP 171	Calcite B	1518-2	184A	21	6B	Cayo	Alexanders	Jar	35	5YR-6/4; 5YR-5/1(I)	
BKP 167	Calcite A	1967-1	100	100-31	3	Cayo	Alexanders	Jar	TS	7.5YR-5/6	10YR-4/1
BKP 168	Calcite B1	1514-1	184A	21	3	Cayo	Cayo	Jar	15	5YR-6/1	
BKP 169	Calcite D	1517-1	184A	21	6A	Cayo	Cayo	Jar	20	5YR-6/3	
BKP 174	Calcite F	1134-2	207	7	1	Cayo	Cayo	Jar	10	5YR-6/2	
BKP 46	Calcite C	1462-2	91	17	2	Cayo	Cayo	Jar	17	5YR-5/4	5YR-4/1
BKP 47	Calcite C	1462-3	91	17	2	Cayo	Cayo	Jar	25	5YR-7/1; 5YR-5/1 (I)	5YR-4/2
BKP 48	Calcite B2	1462-4	91	17	2	Cayo	Cayo	Jar	25	5YR-5/3	5YR-4/1
BKP 49	Carbonate Sand A	1464-4	91	17	2 Ext. B	Cayo?		Jar	15	5YR-6/4	5YR-6/2
BKP 50	Calcite B	1464-5	91	17	2 Ext.	Cayo	Cayo	Jar	25	2.5YR-6/6; 5YR-6/4(I)	

					B						
BKP 51	Calcite A	1521-1	91	17 Ext. F	1	Cayo	Alexanders	Jar	42	7.5YR-7/4	7.5YR-5/1
BKP 52	Calcite C	1521-2	91	17 Ext. F	1	Cayo	Cayo	Jar	25	7.5YR-6/4	7.5YR-5/1
BKP 53	Calcite D	1521-3	91	17 Ext. F	1	Cayo	Cayo	Jar	15	5YR-6/4	5YR-4/1
BKP 54	Calcite D	1521-4	91	17 Ext. F	1	Cayo	Cayo	Jar	20	5YR-6/4	5YR-5/1
BKP 55	Quartz A	1521-5	91	17 Ext. F	1	Mount Maloney	Mount Maloney Black	Bowl	TS	2.5YR-5/6; 5YR-5/4(I)	
BKP 56	Quartz A	1523-2	91	22	1	Cayo?		Jar	14	2.5YR-5/4	
BKP 57	Quartz E	1523-3	91	22	1	Cayo	Cayo	Jar	20	5YR-7/4	
BKP 58	Carbonate Sand C	1523-4	91	22	1	Dolphin Head	Dolphin Head Red	Dish	25	2.5YR-6/6	5YR-6/3
BKP 59	Calcite B	1522-1	91	20	1	Garbutt Creek	Garbutt Creek Red	Bowl	40	5YR-3/1 (Burned)	
BKP 60	Calcite O	1527-1	91	17	4	Cayo	Cayo	Jar	TS	7.5YR-5/3	2.5YR-5/6
BKP 61	Calcite M	1527-2	91	17	4	Cayo	Alexanders	Jar	TS	2.5YR-5/3; 2.5YR-5/6(I)	
BKP 62	Calcite B1	1527-3	91	17	4	Dolphin Head	Dolphin Head Red	Bowl/Dish	25	5YR-7/3	5YR-6/1
BKP 63	Calcite K	1530-1	91	17 Ext. C	4	Cayo	Cayo	Jar	20	5YR-6/3	
BKP 64	B3	3093-8	91	91-8	2	Cayo	Alexanders	Jar	TS	5YR-7/2	
BKP 65	B3	3093-9	91	91-8	2	Cayo	Alexanders	Jar	30	5YR-6/4	5YR-4/1
BKP 66	B	3093-10	91	91-8	2	Cayo	Alexanders	Jar	TS	7.5YR-7/3	7.5YR-5/1
BKP 67	Carbonate Sand D	3093-11	91	91-8	2	Cayo?		Jar	20	7.5YR-7/3	7.5YR-7/2
BKP 68	Carbonate Sand D	3093-12	91	91-8	2	Cayo?		Jar	20	7.5YR-7/3	7.5YR-7/2
BKP 69	B	3093-13	91	91-8	2	Cayo	Cayo	Jar	27	7.5YR-5/3	
BKP 70	Calcite L	3093-14	91	91-8	2	Cayo	Cayo	Jar	22	7.5YR-5/2	
BKP 71	Quartz F	3093-15	91	91-8	2	Unknown		Bowl	35	7.5YR-5/3	

BKP 72	B1	3093-16	91	91-8	2	Mount Maloney	Mount Maloney Black	Bowl	35	5YR-6/6	7.5YR-5/3
BKP 1	Carbonate Sand D	2005-2	109	3	Fill	Cayo?		Jar	15	5YR-7/6	
BKP 2	Quartz D	2006-1	109	109-4	1	Unknown		Jar	15	5YR-7/6	
BKP 3	Calcite J	1803-1	110	110-26	6	Cayo	Cayo	Jar	20	5YR-5/3	5YR-5/2
BKP 4	Calcite C	1803-2	110	110-26	6	Cayo	Cayo	Jar	18	2.5YR-5/6; 5YR-5/3(I)	5YR-4/1
BKP 5	Calcite B	1886-2	111	111-22	2	Mount Maloney	Mount Maloney Black	Bowl	TS	7.5YR-6/6	7.5YR-5/1
BKP 6	Calcite B	1886-3	111	111-22	2	Cayo	Cayo	Jar	15	2.5YR-5/6; 5YR-5/3(I)	
BKP 7	Calcite A	1887-3	111	111-22	3	Cayo	Alexanders	Jar	40	7.5YR-7/4	7.5YR-6/1
BKP 8	Calcite A2	1887-2	111	111-22	3	Cayo	Alexanders	Jar	40	5YR-5/4	7.5YR-4/1
BKP 9	Calcite D2	1699-5	111-A	28	7	Cayo	Cayo	Jar	15	2.5YR-5/6; 5YR-5/3(I)	
BKP 10	Calcite B3	1699-6	111-A	28	7	Cayo	Cayo	Jar	30	7.5YR-5/4	
BKP 11	Calcite	1699-7	111-A	28	7	Cayo	Cayo	Jar	30	2.5YR-5/6; 5YR-5/3(I)	
BKP 12	Calcite B2	1699-8	111-A	28	7	Cayo	Cayo	Jar	25	7.5YR-7/4	7.5YR-4/1
BKP 13	Carbonate Sand B	1699-9	111-A	28	7	Dolphin Head	Dolphin Head Red	Bowl	25	7.5YR-6/3; 2.5YR-6/6(I)	
BKP 73	Calcite B3	1905-1	101	7A	1	Cayo	Alexanders	Jar	TS	7.5YR-7/4	7.5YR-5/1
BKP 74	Calcite B3	1907-2	101	101 Ext. 1	1	Cayo	Alexanders	Jar	> 50	7.5YR-7/4	7.5YR-5/1
BKP 75	Calcite D	1907-3	101	101 Ext. 1	1	Cayo	Cayo	Jar	28	5YR-5/3	5YR-4/1
BKP 76	Calcite D	1911-11	101	101 Ext. 3	1	Cayo	Cayo	Jar	25	5YR-5/3	
BKP 77	Calcite D	1911-12	101	101 Ext. 3	1	Cayo	Cayo	Jar	30	5YR-7/4	5YR-5/1
BKP 78	Calcite B	1911-13	101	101 Ext. 3	1	Cayo	Cayo	Jar	25	5YR-6/4	7.5YR-4/1
BKP 79	Calcite E	1911-14	101	101 Ext. 3	1	Cayo	Alexanders	Jar	32	5YR-6/3	
BKP 80	Calcite C1	1911-	101	101	1	Cayo	Cayo	Jar	20	5YR-5/4	

		15		Ext. 3							
BKP 81	Calcite C	1911-16	101	101 Ext. 3	1	Cayo		Jar			
BKP 82	Calcite B	1911-17	101	101 Ext. 3	1	Cayo	Cayo	Jar	25	5YR-6/4	5YR-4/1
BKP 83	Calcite B2	1911-18	101	101 Ext. 3	1	Cayo	Cayo	Jar	15	5YR-7/4	
BKP 84	Calcite A	1911-19	101	101 Ext. 3	1	Cayo	Cayo	Jar	35	10YR-7/3	10YR-3/1
BKP 85	Calcite N	1911-20	101	101 Ext. 3	1	Tinaja?		Jar	15	5YR-6/4	2.5YR-6/6
BKP 86	Calcite A	1911-21	101	101 Ext. 3	1	Cayo	Cayo	Jar	TS	7.5YR-7/4	10YR-4/1
BKP 87	Calcite B	1911-22	101	101 Ext. 3	1	Cayo		Jar		7.5YR-6/4	
BKP 88	Calcite A	1911-23	101	101 Ext. 3	1	Cayo	Alexanders	Jar	20	7.5YR-6/6	7.5YR-4/1
BKP 89	Calcite E	1413-1	101	16	2	Cayo	Alexanders	Jar	35	5YR-6/4	
BKP 90	Calcite B1	1914-1	101	101-4-A	1	Garbutt Creek?		Bowl	TS	5YR-7/4	5YR-6/2
BKP 91	Calcite E	1914-2	101	101-4-A	1	Cayo	Cayo	Jar	25	5YR-6/3	
BKP 92	Calcite C	1920-5	101	3	1	Cayo	Alexanders	Jar	30	5YR-6/3	5YR-4/1
BKP 93	Calcite B	1920-6	101	3	1	Cayo	Cayo	Jar	20	2.5YR-6/6	2.5YR-4/1
BKP 94	Calcite B1	1920-7	101	3	1	Mount Maloney	Mount Maloney Black	Bowl	20	2.5YR-6/6	2.5YR-5/1
BKP 95	Calcite E	1977-1	101	101-1A	1	Cayo	Cayo	Jar	TS	5YR-6/3	
BKP 14	Calcite A	1655-1	100	16	3	Cayo	Alexanders	Jar	45	7.5YR-7/4	7.5YR-4/1
BKP 15	Calcite E	1656-4	100	17	1	Cayo	Alexanders	Jar	TS	2.5YR-5/6	
BKP 16	Calcite A	1657-2	100	22	1	Cayo	Cayo	Jar	20	5YR-5/4	5YR-3/1
BKP 17	Calcite B1	1658-1	100	15	3	Garbutt Creek	Garbutt Creek Red	Bowl	30	7.5YR-6/6	7.5YR-7/1
BKP 18	Calcite A	1658-2	100	15	3	Cayo	Alexanders	Jar	45	7.5YR-6/4	7.5YR-3/1
BKP 19	Calcite C	1658-3	100	15	3	Cayo	Cayo	Jar	TS	2.5YR-5/8 (E); 7.5YR-5/4 (I)	7.5YR-5/1

BKP 20	Calcite D1	1658-4	100	15	3	Garbutt Creek	Garbutt Creek Red	Bowl	TS	7.5YR-5/6	
BKP 21	Calcite A	1658-5	100	15	3	Cayo	Alexanders	Jar	45	7.5YR-7/4	7.5YR-4/1
BKP 22	Calcite A	1658-6	100	15	3	Cayo	Alexanders	Jar	45	7.5YR-7/3	7.5YR-4/1
BKP 23	Calcite C	1666-1	100	15	3	Cayo	Cayo	Jar	20	10R-5/6(E); 5YR-5/4(I)	
BKP 24	Calcite B4	1667-1	100	14	3	Mount Maloney	Mount Maloney Black	Bowl	TS	7.5YR-5/2	
BKP 25	Calcite B	1667-2	100	14	3	Cayo	Alexanders	Jar	TS	7.5YR-6/6	5YR-4/1
BKP 26	Calcite B	1667-3	100	14	3	Cayo	Alexanders	Jar	40	7.5YR-6/4	7.5YR-4/1
BKP 27	Calcite A	1667-4	100	14	3	Cayo	Alexanders	Jar	50	7.5YR-7/4	7.5YR-4/1
BKP 28	Calcite B4	1670-4	100	18A	1	Cayo	Cayo	Jar	18	7.5YR-6/3	2.5YR-6/6
BKP 29	Calcite A	1762-1	100	100-14	2	Cayo	Alexanders	Jar	30	10YR-6/6	10YR-3/1
BKP 30	Calcite B3	1762-2	100	100-14	2	Cayo	Alexanders	Jar	TS	7.5YR-5/4	7.5YR-4/1
BKP 31	Calcite C	1766-1	100	8	1	Cayo	Alexanders	Jar	45	7.5YR-6/6	7.5YR-4/1
BKP 32	Calcite A	1767-3	100	21	1	Cayo	Alexanders	Jar	40	7.5YR-7/3	7.5YR-5/1
BKP 33	Calcite I	1767-4	100	21	1	Cayo	Cayo	Jar	15	7.5YR-5/4	
BKP 34	Calcite B	1767-5	100	21	1	Cayo	Cayo	Jar	20	7.5YR-5/4	7.5YR-4/1
BKP 35	Calcite B3	1767-6	100	21	1	Cayo	Alexanders	Bowl	>50	7.5YR-6/4	7.5YR-4/1
BKP 36	Calcite C	1774-1	100	23A	1	Cayo	Cayo	Bowl	25	7.5YR-7/4	7.5YR-5/1
BKP 37	Carbonate Sand F	1774-2	100	23A	1	Cayo?	Cayo	Jar	15	2.5YR-6/6 (E); 5YR-2.5/1	
BKP 38	Calcite A	1778-3	100	24A	1	Cayo	Alexanders	Jar	42	5YR-5/6	7.5YR-5/1
BKP 39	Calcite C	1778-4	100	24A	1	Cayo	Alexanders	Jar	23	7.5YR-6/4	7.5YR-4/1
BKP 40	Carbonate Sand E	1778-5	100	24A	1	Cayo	Cayo?	Jar	10	5YR-7/4	
BKP 41	Calcite B	1778-6	100	24A	1	Cayo	Cayo	Jar	20	7.5YR-6/6	7.5YR-3/1

BKP 42	Calcite B2	1779-1	100	19A	1	Cayo	Cayo	Bowl	30	7.5YR-6/4	7.5YR-4/1
BKP 43	Calcite C1	1779-2	100	19A	1	Cayo	Cayo	Jar	30	5YR-5/4	5YR-4/1
BKP 44	Calcite E	1913-3	100	12A	2	Cayo	Cayo	Jar	32	7.5YR-7/4	7.5YR-5/1
BKP 176	Calcite A	1394-1	184-A	10 Ext B	1	Cayo	Cayo	Bowl	20	10YR-6/4	10YR-4/1
BKP 177	Calcite C	1394-2	184-A	10 Ext B	1	Cayo	Cayo	Jar	25	7.5YR-5/4	7.5YR-4/1
BKP 178	Calcite D	1397-1	184-A	10	3	Cayo	Cayo	Jar	25	5YR-6/6; 7.5YR-6/3 (I)	
BKP 181	Calcite B	1516-1	184-A	21	5	Cayo	Cayo	Jar	22	5YR-5/4	5YR-3/1
BKP 184	Calcite A1	1520-2	184-A	21 Ext. A	4	Silver Creek Impressed		Bowl/Dish	Not a Rim	5YR-6/6	5YR-5/1
BKP 185	Calcite C	1520-3	184-A	21 Ext A	4	Cayo	Cayo	Jar	23	5YR-5/4	5YR-3/1
BKP 186	Calcite B	1520-4	184-A	21Ext A	4	Cayo	Cayo	Jar	30	5YR-5/3	
BKP 187	Calcite C	1520-5	184-A	21 Ext A	4	Cayo	Cayo	Jar	35	5YR-5/4	5YR-3/1
BKP 189	Calcite B	2075-1	184-A	31 Ext H	3	Cayo	Cayo	Jar		5YR-7/4	5YR-5/1
BKP 190	Calcite B3	2075-2	184-A	31 Ext. H	3	Cayo	Alexanders	Bowl	50	7.5YR-7/4	7.5YR-4/1
BKP 191	Calcite C	1695-1	M-11A	28	4	Cayo	Cayo	Jar	20	7.5YR-5/4	
BKP 192	Quartz G	1695-2	M-11A	28	4	Cayo?		Jar	20	2.5YR-4/4	2.5YR-3/1
BKP 193	Calcite B	1695-3	M-11A	28	4	Cayo	Cayo	Jar	20	7.5YR-5/6	
BKP 194	Calcite B4	1697-2	M-11A	28	6	Cayo	Cayo	Jar	20	7.5YR-6/3	
BKP 195	Quartz B	2081-3	M-90	90-1	1	Cayo	Cayo	Jar	20	7.5YR-6/3	2.5YR-6/6
BKP 196	Quartz C	2081-4	M-90	90-1	1	Cayo	Cayo	Jar	20	7.5YR-5/4; 2.5YR-6/6	
BKP 197	Calcite B	2081-5	M-90	90-1	1	Cayo	Cayo	Jar	25		
BKP 198	Carbonate Sand J	1398-4	M-181			Cayo?		Jar			
BKP	Calcite B	1398-	M-181	11	5	Cayo	Cayo	Jar	20	2.5YR-5/4; 7.5YR-5/4 (I)	7.5YR-4/1

199		5									
BKP 200	Carbonate Sand I	1398-6	M-181	11	5	Tinaja?	Cayo	Jar	12	5YR-6/6	
BKP 201	Calcite C	1398-7	M-181	11	5	Mount Maloney	Mount Maloney Black	Jar	15	2.5YR-5/4; 7.5YR-5/4 (I)	7.5YR-4/1
BKP 202	Calcite C	1398-8	M-181	11	5	Cayo	Cayo	Jar		2.5YR-5/4; 7.5YR-5/4 (I)	7.5YR-4/1
BKP 203	Carbonate Sand H	1398-9	M-181	11	5	Tinaja?		Jar	15	5YR-5/4	
BKP 204	Calcite B	1398-10	M-181	11	5	Cayo	Cayo	Bowl		5YR-5/3	5YR-5/1
BKP 205	Calcite A	2097-1	M-90	90-1E	1	Cayo	Alexanders	Jar	50	5YR-6/6	5YR-4/1
BKP 206	Calcite C	2097-2	M-90	90-1E	1	Cayo	Cayo	Jar	25	5YR-5/3	5YR-4/1
BKP 207	Calcite C	2097-3	M-90	90-1E	1	Cayo	Cayo	Jar	25	5YR-5/4	5YR-3/1
BKP 208	Calcite B2	2097-4	M-90	90-1E	1	Cayo	Cayo	Jar	18	5YR-5/3	
BKP 209	Calcite A	1464-1	M-91	17	2	Cayo	Cayo	Jar	25	5YR-5/4	
BKP 210	Calcite A	1464-2	M-91	1464-2	2	Cayo	Alexanders	Jar	50	7.5YR-5/4	7.5YR-4/1
BKP 211	Calcite C	1886-1	M-111	111-22	2	Cayo	Cayo	Jar	23	5YR-6/6; 5YR-4/1 (I)	
BKP 212	Calcite B	1886-2	M-111	111-22	2	Cayo	Cayo	Jar	25	7.5YR-5/3	7.5YR-4/1
BKP 213	Calcite C	1886-3	M-111	111-22	2	Cayo	Cayo	Jar		7.5YR-5/4	
BKP 214	Carbonate Sand G	1699-1	M-111A	27	7	Cayo	Cayo	Jar	20	7.5YR-6/3	
BKP 215	Calcite B2	1699-2	M-111A	27	7	Cayo	Alexanders	Jar	50	7.5YR-6/6	5YR-5/4
BKP14 5	Ash							Jar			

Table A.1. Descriptive Data for the Baking Pot Petrographic Sample

APPENDIX B

REGIONAL GEOLOGY

Belize is a low-lying shelf on the eastern edge of the Yucatan Peninsula of Central America. Together with northern Guatemala and southern Mexico, it forms the Maya (or Yucatan) Block. It is bordered on the west by Guatemala, on the east by the Caribbean Sea, on the north by the Rio Hondo which separates Belize from the Mexican state of Quintana Roo, and on the south by the Sarstoon River which forms the boundary between Belize and Guatemala. Limestones constitute the bedrock of much of the country, with the exception of the Maya Mountains and clastic sedimentary rocks of the Toledo Formation. The majority of the country is hilly and mountainous while the remainder is low lying coastal plain (Wright et al. 1959: 22). In general, Belize can be divided into two main regions: the low-relief northern region and high-relief southern region (Howie 2012). Uxbenká in the Toledo District lies in the southern region. Baking Pot in the Belize River Valley lies near the intersection of these two regions (see Figure B.1 for the major geologic formations in Belize and Figure B.2 for chronological periods).

Detailed published studies of the geology of Belize are limited (King et al. 2004; Schafhauser et al. 2003). The earliest work focused on description and dating of the major geologic features in what was then British Honduras (Ower 1928; Powers 1918). Most studies focus on the Maya Mountains and southern Belize with more limited studies of the limestones north of the Maya Mountains and coastal geology. Fairly detailed studies of the soils exist for most of the county (Baillie et al. 1993; Jenkin et al. 1976; King et al. 1986; King et al. 1989; King et al. 1992; Wright et al. 1959).

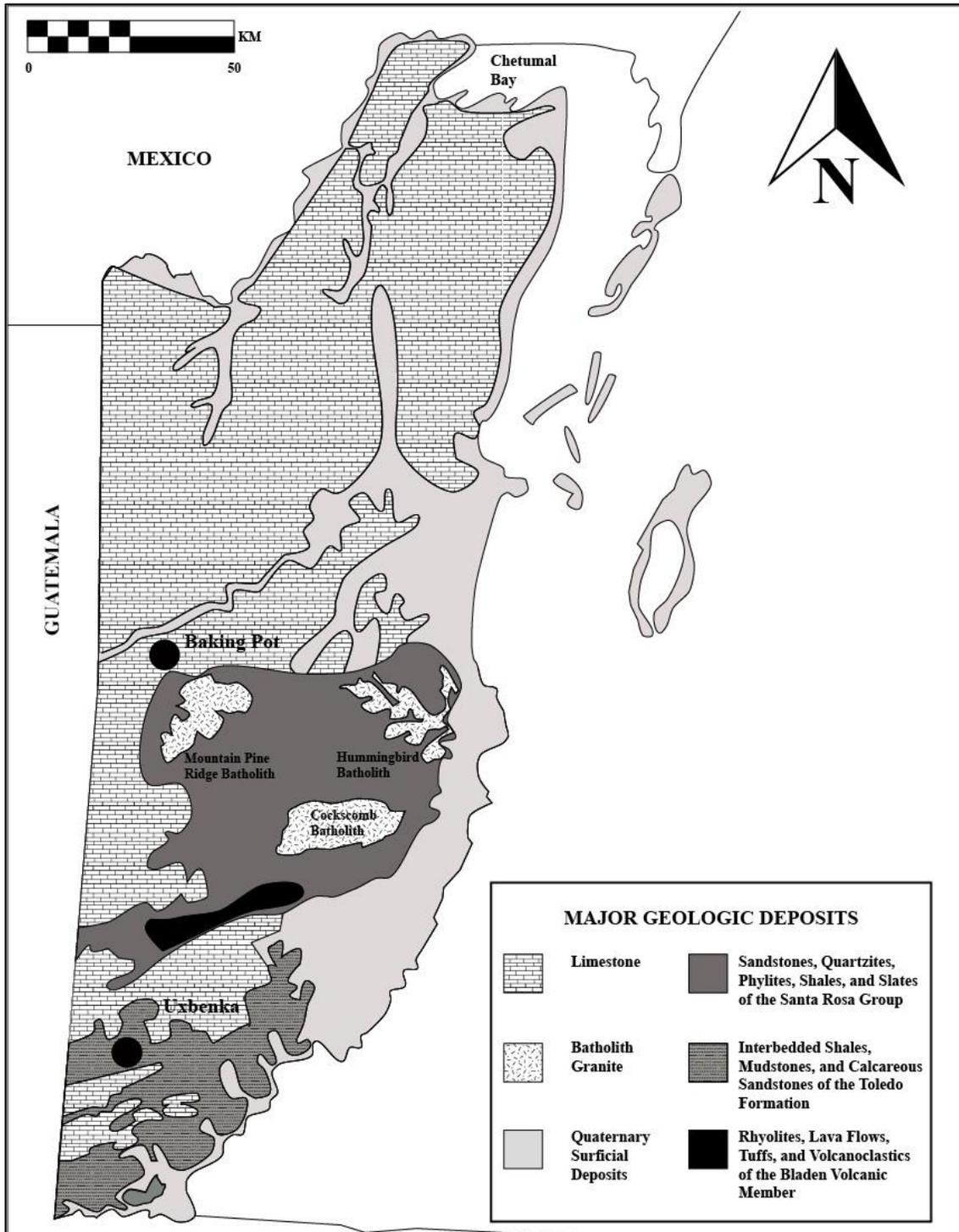


Figure B.1. Belize Geological Deposits (after Cornec 2010).

Most characterizations of the bedrock geology of central and southern Belize are broad generalizations based on limited field work which are not adequate for assessing local ceramic production. The descriptions presented in this section provided a baseline for understanding the geology of the region and guide clay and rock sampling. More detailed descriptions of particular geologic features are provided when it is either in the immediate vicinity of one of the study areas or is the source of geologic material that has been carried by rivers and/or streams. In order to contextualize the geologic information, a brief discussion of depositional environment is provided.

Overview of Depositional Environments

The depositional environment for the earliest rocks in Belize is unclear though occurred sometime between the Cambrian and Silurian. This pre-Devonian basement rock outcrops in the Baldy Beacon area of the Maya Mountains and Martens et al. (2010) propose that the Maya Block was connected to Baltica or Gondwana during the Late Cambrian to Silurian (long before the formation and subsequent breakup of Pangea). In the Silurian, three plutons intruded the pre-Devonian basement rock forming the three batholiths in the Maya Mountains (Steiner 2005). During the Paleozoic Era, most of the accumulation of rock in Belize was sedimentary, marine formations that accumulated when the landmass was covered by a shallow ocean. By the close of the Triassic, the majority of Belize was above sea level. The Jurassic Period is not well-represented in Belize today because this was a time when the early rocks began to break down and carried via rivers into the ocean. During The Cretaceous Period, Belize was once again

covered by a shallow ocean. At this time, large masses of carbonates (limestone, dolomite) and evaporates (gypsum and anhydrite) were deposited in alternating sequences, hundreds of feet thick in some areas. Tectonic activity and receding global ocean levels in the Cenozoic Era once again brought the Belize land mass above sea level. The barrier reef was formed at the latter end of the Cenozoic. During the Tertiary Period, Belize still remained covered by a shallow ocean and the deposition of carbonates was the primary geologic process. Uplift in the Maya Mountains occurred again resulting in the topography that we now associate with the Maya Mountains. The Toledo Beds, composed of clastic sedimentary rocks were deposited during the Tertiary. Many of the limestone, conglomerates and marls of central and northern Belize were also deposited during this time. The main depositional processes during the Quaternary Period (2mya to present) are alluvial. The movement of water formed the cave systems present across Belize, particularly in the Cayo and Toledo Districts (DoE 2006: 14-15).

The Maya Mountains

While the Maya Mountains are not one of the primary study areas, this prominent landform provides geologic material south to the Toledo District and north to the Belize River Valley via rivers and streams that flow through the rugged terrain. The Maya Mountains are located in the central portion of Belize and extend from Guatemala to less than 10 kilometers from the Caribbean Coast in some areas. Early studies in this area were conducted by Ower (1928), Dixon (1956) and Bateson and Hall (1977). In general, the Maya Mountains are “an uplifted block of pre-Cretaceous basement which is geographically isolated from the larger areas of Paleozoic rocks in Guatemala, Honduras and Mexico” (Bateson and Hall 1977: iv). The Maya Mountains are one of the few areas in Central America with large portion of Paleozoic rock of the Maya block are exposed (Martens et al. 2010:815). Correlating the geology of the Maya Mountains with neighboring Guatemala is difficult due to the considerable amount of metamorphism on the Guatemalan side (Bateson and Hall 1977). Dixon (1956: 8-10) describes six principle rock types that comprise the Maya Mountains: granites, quartzites, sandstones, porphyries, shales, and limestones. According to Bateson and Hall (1977: 3), “by far the greater part of the Maya Mountains is composed of variably metamorphosed sediments which have been intruded by a number of mineralogically similar granitic stocks. Lavas and tuffs, which the available evidence suggests are contemporaneous with the main sedimentation of the area, occur in the southern portion of this mountain block.”

The descriptions by Dixon (1956) and Bateson and Hall (1977) are a useful first step in understanding the Maya Mountains and became the accepted model; however,

more recent analyses provide updated dates and interpretations of rock formation. Most notably, the three intrusive granite formations (Mountain Pine, Hummingbird, and Cockscomb batholiths) did not intrude the Santa Rosa formation but predated its deposition (Martens et al. 2010; Steiner and Walker 1996; Steiner 2005). Martens et al. (2010:821) propose a nomenclature based on new geochronological data: (1) Macal Formation (formerly Macal series) for Pennsylvanian-Permian rocks; (2) Bladen Formation (formerly Bladen porphyry or Bladen member) for Lower Devonian rhyolites; and (3) Baldy Beacon for pre-Devonian clastic beds not recognized in earlier studies.

The Santa Rosa Group

Most studies state that oldest sediments in Belize, and much of the Maya Block, are Santa Rosa Group found in the Maya Mountains and parts of southern Belize (Schafhauser et al. 2003: 625). Originally, Dixon (1956) divided the Maya Mountains into three formations: the Maya Series, the Macal Series, and the Bladen Porphyry. The Maya Series, composed of graywackes, quartzites, phyllites, shales, schists, and gneisses, was the older of the two and distinguishable from the Macal Series because they were more metamorphosed and had isoclinal folding (Dixon 1956: 13-15). Subsequent work (Bateson and Hall 1971, 1977) indicated that the Maya Series and Macal Series were actually parts of the same formation that was renamed the Santa Rosa Formation because they are parts of the same formation present in Guatemala and Mexico. According to Bateson (1972:956), "Dixon's Maya and Macal were both part of a [single] sedimentary cycle extending from lower Pennsylvanian to middle Permian without any significant regional breaks." The Bladen Porphyry was renamed the Bladen Volcanic Member and is considered a member of the Santa Rosa Group. The Santa Rosa group is Late

Pennsylvanian to Middle Permian and is one area of the Yucatan block where Permian metasediments are exposed. It is composed of conglomerates, sandstones, shales, limestones, phyllites, slates, and quartzites; these rocks make up 80% of the Maya Mountains (Steiner 2005). Dating of the Santa Rosa group is based on fossil evidence: “These include crinoids, brachiopods, bivalves, bryozoa, goniatites, cephalopods (e.g., *Perrinites hilli*), and foraminifera (e.g., *Schwagerina gruperensis* and *Eoverbeekina americana*) of Pennsylvanian to middle Permian age” (Martens et al. 2010: 817).

Baldy Beacon

Analyses conducted in the Baldy Beacon area of the Maya Mountains indicate that the sedimentary rocks of the Santa Rosa Formation are not the oldest sediments in Belize. According to Martens et al. (2010: 817), “in the Baldy Beacon area, clastic sedimentary rocks include white sandstones, lithic sandstones, and conglomerates containing cobbles of sandstones, quartzites, and phyllites, but not granite (Simmons, 1972; Fig. 1B). In the gorge of the Macal River, most rocks are successions of conglomerate, coarse-to-fine sandstone, and minor interbedded shale. Unlike Baldy Beacon sedimentary strata, Macal sandstones are very immature, and Macal conglomerates contain volcanic and granitic cobbles, possibly derived from exposed granites and the Bladen Formation.” Zircons from the Baldy Beacon unit that date to 613-517 Ma were likely “derived from a Pan-African, Brasiliano, or Avalonian source. This implies that the Baldy unit was deposited sometime between the Cambrian and the Early Devonian volcanism of the Bladen volcanics, in the ca. 517–406 Ma range.” (822). Thus, the batholith granites intruded the Baldy Beacon unit and *not* the Santa Rosa Formation.

The Batholiths

Early studies (e.g. Bateson and Hall 1977) state that the Santa Rosa formation was intruded by igneous rocks in the Triassic Period forming the three major batholiths of the Maya Mountains: Mountain Pine, Cockscomb, and Hummingbird. These studies describe the Santa Rosa group as regionally metamorphosed to the greenschist facies with more metamorphism as the margins of the plutons. Due to issues with dating, the higher grade metamorphism was interpreted as contact metamorphism; the two eastern plutons (Hummingbird and Cockscomb) show evidence of higher grade metamorphism due to the presence of chiastolite. The long-held interpretation that the plutons intruded the Permian-Carboniferous Santa Rosa group is based on an older K-Ar dates that dated the plutons to the Triassic. The more recent U/Pb dates indicate that all three plutons were in place prior (Late Silurian) to the deposition of Santa Rosa group rocks thus metamorphism near the three batholiths cannot be attributed to contact metamorphism. According to Steiner (2005:460), "it is probable that the metamorphic aureoles around all three igneous complexes and the resetting of the K/Ar systems occurred in response to a Triassic hydrothermal event, most likely in relationship to early rifting between North and South America during initial Pangean breakup." Fluid flowed between the sedimentary and igneous rocks creating what was originally believed to be the result of contact metamorphism. Martens et al. (2010) consider the metamorphism evident around the three batholiths as contact metamorphism between the Silurian plutons and the pre-Devonian Baldy Beacon unit.

The batholiths are often referred to as granites though there is mineralogical and chemical variation and not all are true granites (Kesler et al. 1974). Their mineralogical

composition is of interest in this study because many of the rivers that flow into the Belize River Valley pass through these batholiths, carrying geologic material into the study area (see Table B.1 for mineralogical variability). The *Mountain Pine Batholith* is located between cretaceous limestones and the northwestern extent of the Santa Rosa Group Formation. The granite of the Mountain Pine Batholith is “generally characterised by being medium-grained, nonporphyritic, nonfoliated, and leucocratic. It exhibits, however, a number of different mineralogical facies which are thought to indicate several phases of intrusion” (Bateson and Hall 1977: 14).

Shipley (1978: 13-28) identified five granitic phases in the Mountain Pine Batholith: 1.) A coarse-grained granite composed of quartz, plagioclase, orthoclase, biotite with pyrite, muscovite, fluorite, sphene and possible monazite accessory minerals, 2.) A quartz-monzonite porphyry composed of quartz, potassium feldspar (perthitic or granophyric with quartz), sericitized plagioclase, biotite that is partly altered to chlorite with monazite, sphene, fluorite, and zircon accessory minerals, 3.) A muscovite-granite porphyry composed of quartz, potassium feldspar (perthitic), sericitized plagioclase, and muscovite with no accessory minerals, perhaps due to recrystallization, 4.) A granodiorite composed of quartz, sericitized plagioclase, orthoclase and microcline (more abundant than orthoclase), hornblende and biotite with apatite, muscovite, monazite and pyrite accessory minerals, and 5.) A dacite with a groundmass composed of felsic intergrowth of quartz, feldspar, and biotite with phenocrysts composed of quartz, plagioclase (some sericitized), and potassium feldspar (some perthitic). A more recent study (Jackson et al. 1995) identifies four petrographic types of granitic rocks present in the Mountain Pine Batholith: biotite leucogranite, muscovite leucogranite, granodiorite, and tonalite.

In this area, the rocks of the Santa Rosa Group surrounding the Mountain Pine Batholith are composed phyllites, graywackes, quartzites, and quartz conglomerates. Gneiss, quartz latite, welded tuff are also present in the area (Shipley 1976:29-37). Both the batholith and Santa Rosa Formation “are overlain uncomformably by well-bedded, gently dipping, Cretaceous carbonate rocks” of the Coban Formation (Jackson et al. 1995: 29). Where faulting has occurred, chlorite is present and feldspars are weathered and fractured. This is particularly true in the Barton Creek area “where phenocrysts of feldspar are characteristic” (16). Lastly, tourmaline is present in an area north of Guacamallo. The Mountain Pine Batholith outcrops in the Macal River drainage before it joins with the Mopan to form the Belize River, thus, contributing geologic material to the Belize River Valley study area.

The *Cockscomb Batholith* is completely surrounded by Santa Rosa Formation rocks in a large basin south of the Cockscomb Mountains (Bateson and Hall 1977; Kesler et al. 1974). It is comprised of “coarsely porphyritic, modal granodiorites with euhedral to subhedral laths of oligoclase in a matrix of anhedral quartz, alkali feldspar, biotite and muscovite” (Kesler et al. 1974: 550). Shipley (1978: 38-40) describes the Cockscomb granite as the largest single intrusive phase in the Maya Mountains. It is composed of quartz, orthoclase or microcline, plagioclase, and biotite with muscovite, pyrite, magnetite, sphene, zircon, and monazite accessory minerals. A recent study by Potter (2019) for the Stann Creek Regional Archaeology Project (SCRAP) provides detailed petrographic descriptions of rocks from the Cockscomb Batholith and details additional mineralogical variability and rock types than previously discussed for the region.

The *Hummingbird Batholith* is located primarily in Santa Rosa Group formations where the Maya Mountains meet coastal, post-cretaceous sediments west of the modern village of Dangriga. The Hummingbird Batholith ranges from a muscovite quartz monzonite to a quartz granodiorite (Kesler et al. 1974) though considerably less information exists compared to the other two intrusive igneous formations of the Maya Mountains. Shipley (1978: 41-46) describes the Hummingbird Batholith as composed of at least three different rock types: 1). A muscovite granite composed of quartz (typically strained), microcline (commonly poikilitic), plagioclase (almost completely sericitized), muscovite, and recrystallized biotite with pyrite, apatite, and monazite accessory minerals, 2). A quartz monzonite composed of quartz (some strained), potassium feldspar (some sericitized), plagioclase (some sericitized), and biotite (altered almost completely to chlorite), and 3). A granodiorite composed of quartz, plagioclase (heavily sericitized), potassium feldspar (heavily sericitized; likely both microcline and orthoclase), and chlorite (both chloritized biotite and hornblende) with pyrite, sphene, zircon, and apatite accessory minerals.

	Mountain Pine	Cockscomb	Hummingbird
General	Modal granitic and potassic quartz monzonite (Kesler et al. 1974)	Coarsely porphyritic, modal granodiorites with anhedral to subhedral laths of oligoclase in a matrix of anhedral quartz, alkali feldspar, biotite, and muscovite (Kesler et al. 1974)	Range from muscovite quartz monzonite to biotite granodiorite (Kesler et al. 1974).
Rock Types	Coarse grained granite, quartz monzonite porphyry, muscovite granite porphyry, granodiorite, dacite (Shipley 1978)		Muscovite granite, quartz monzonite, granodiorite (Shipley 1978)
Mica	Predominantly biotite with some muscovite. Biotite is green, pleochroic, and occurs in clumps of small crystals. Muscovite associated with Biotite and may be leached Biotite (B&H 1977). Subhedral biotite and muscovite as accessory minerals	Primarily biotite with some muscovite. Biotite is a dark, brown, pleochroic variety. Muscovite occurs as scattered cleavage fragments. In some thin sections, the biotite shows an abundance of needlelike rutile inclusions.	Primarily muscovite with some biotite that is almost completely altered to chlorite (Shipley 1978)
Feldspar	Large, anhedral crystals of perthite and microperthite with some plagioclase. Plagioclase occurs as discrete crystals with carlsbad-albite and simple albite twinning. The composition is close to oligoclase-andesine boundary. Plagioclase is often altered to sericitic mica, sometimes no evidence of twinning remains. Potash feldspar more abundant than plagioclase.	Mixture of perthite, some microcline and orthoclase with some smaller crystals of plagioclase that often show carlsbad/albite twinning. The composition of plagioclase is near the oligoclase-andesine boundary. Many have a clear outer rim of albite. Alteration of plagioclase is common with many crystals completely replaced with muscovite.	Plagioclase, microcline and orthoclase (all sericitized); microcline with poikilitic texture (Shipley 1978)
Quartz	Occurs as small pools of slightly strained grains and as small grains in the matrix. Likely in excess of 10% of the rock (B&H 1977). Anhedral, interstitial quartz.	Occurs in large pools and sufficiently abundant to be classified as a granite.	Occurs as groups of interstitial grains rather than large pools and makes up a smaller proportion of the rock (B&H 1977); Many of the grains are strained (Shipley 1978)
Other Minerals	Apatite and Magnetite; Chlorite (near faulting); Tourmaline (B&H 1977); Hornblende in quartz; Fluorite as anhedral masses near chloritized biotite	Accessory and alteration minerals associated with biotite clusters; Apatite (euhedral crystals); zircons (center of pleochroic halos in biotite); Chloritic minerals (near faulting); Monzonite (rare); Clinzoisite (rare) (B&H 1977) Hornblende; pyroxene (partially altered to biotite); Magnetite (Shipley 1978)	Apatite; Zircon; Magnetite (B&H 1977); Pyrite; Monazite; Sphene (Shipley 1978)

Table B.1. Mineralogical Variability in the Maya Mountain Batholiths.

Bladen Volcanic Member of the Santa Rosa Group

The Bladen Volcanic Member, formerly the Bladen Porphyry (Dixon 1956), is “a thick sequence of volcanic rocks outcrops along the southern margin of the Maya Mountains extending in a roughly east-west belt for about 50 km and varying in widths from about 3 to 10 km” (Bateson and Hall 1977: 9). It also outcrops in the Baldy Beacon area (Martens et al. 2010). The Bladen Volcanic Member is comprised of lavas, pyroclastic rocks, and volcanic sediments (Bateson and Hall 1977); more specifically, it primarily comprised of rhyolitic-dacitic lava flows and tuffs (Martens et al. 2010:818). Textural variation exists but the rocks are chemically similar across the region. Porphyritic rocks contain feldspar and quartz phenocrysts. The feldspars are primarily alkaline orthoclase, sanidine, perthitic microcline with some plagioclase as an accessory mineral. Biotite is occasionally present and chlorite is likely altered mafics, which are rare. Accessory minerals include zircon, epidote, sphene and apatite. Devitrified glass is also present in large proportions in many of the rocks. In addition to the lavas, there are pyroclastic rocks and volcanic sediments. There are vitric and lithic tuffs interbedded with the lavas but breccias comprised almost entirely of felsitic fragments are found around the margins of the lava masses.

The Belize River Valley

The Belize River Valley is located in the central portion of the country between the Cretaceous limestone hills flanking the Maya Mountains to the south and the Miocene escarpment and plains to the north. Jenkin et al. (1976: 70-78) divide the region into four

primary landforms: Southern Uplands, Escarpments and Plains, Major River Valleys, and Coastal Deposits. In the Upper Belize River Valley, all of the primary landforms with the exception of Coastal Deposits are present. It is important to note that description of the location and spatial extent of these groups is vague and often conflicting. Adding to the confusion is the tendency of some researchers to refer to formations by their equivalent Guatemalan nomenclature without reference to Belizean nomenclature. The carbonate group descriptions (e.g. El Cayo group) are primarily based on Flores' (1952) and the location of these groups in the Belize Valley are based on Cornec's (2010) most recent geologic map of Belize. While the Cornec map presents these formations as occurring in discrete areas, the reality more complicated, and King et al. (2004:302) state that this map is "perhaps more schematic than detailed in northern Belize." The numerous shifts in sea level from the Cretaceous to Tertiary produced marine formations of different ages that were then uplifted by tectonic activity resulting in a complicated stratigraphy for the region. The many drainages and seasonal flooding of the region further complicates attempts at sourcing geologic material in the Belize River Valley.

Major Landforms

The southern uplands landform system is located between the Maya Mountains and the Belize River in the Upper Belize River Valley. Jenkin et al. (1976:70) divide the Southern Uplands into four landform complexes: foothills of the Vaca Plateau and Mountain Pine Ridge, Upland areas south of the Belize River and west of Central Farm, Upland areas south of the Belize River and east of Central Farm, and Valleys of the Mopan River, Barton Creek, and Roaring Creek. The southern uplands are composed primarily of Cretaceous and Eocene limestones described as "an area of dissected hills

showing well developed cone and tower karst topography with domed summits, collapsed caverns and intermittent drainage lines. The beds are fragmented and contain a certain amount of iron oxide and silica and the soils have a reddish colour. Between the hills on flatter land, fairly extensive areas of marl have been deposited” (Jenkin et al. 1976: 48). There are also two distinct groups of Miocene Cayo Series marls to the south of the river: Red Bank and Boulder. The Escarpment and Plains consist of a vast area of limestone north of the Belize River to northern Belize and stretching from Guatemala to the Caribbean Sea (Jenkin et al. 1976: 74). The limestone in this region “form a series of escarpments with a north-north-east to south-south-west strike, dipping to the north-west, and these are separated by flat areas of marl. The marls are believed to attain thickness of 12m (39ft) and over and were deposited by rivers flowing from the Maya Mountains and eroding cretaceous limestones. They consist of unconsolidated calcareous material together with white quartz sand beds and gypsiferous beds” (Jenkin et al. 1976: 48). The Escarpment and Plains landform system is divided into 5 landform complexes: upland areas, escarpments and vales, gently undulating areas with groups of hills, undulating areas north and west of the upper Belize River, gently undulating areas and hills north of the lower Belize River, gently undulating to undulating areas south of the lower Belize River (Jenkin et al. 1976:73-76).

Cretaceous Limestone Formations

Cretaceous limestone formations are located between the Maya Mountains and the Tertiary formations that flank the Belize River. Cornec (2010) describes the Coban, Campur, and Barton Creek Formations as undifferentiated. Most studies divide the Cretaceous into the earlier Coban Formation and Later Campur Formation (Vinson 1962)

though Flores (1952 a,b) only documented Late Cretaceous rocks that he named the Barton Creek Formation. It is likely that Flores' Barton Creek Formation subsumes part of the Coban and Campur Formation though the terminology varies between Belize and Guatemala and, in some cases is used interchangeably, making descriptions difficult. Flores (1952b: 408) describes upper Cretaceous rocks as "a series of limestones, dolomitic limestones, and dolomites with a thin bed of sandstone at the base of the exposed section. The facies of deposition of this carbonate series seems to have remained practically unchanged throughout. The limestone contains a restricted fauna typical of lagoonal to back-reef deposits. There is also some suggestion of reefoid facies which may have been cyclical in nature." The limestones are dense, hard, tan to cream, and micritic. The dolomites is off-white to buff, sometimes chalky and porous (Flores 1952 a,b).

Early Tertiary Limestone Formations

The majority of the bedrock in the Upper Belize River Valley is Tertiary in age (Cornec 2010; Flores 1952a,b; King et al. 20014; Reeder et al. 1996; Smith 1998). In general, the depositional environment for these limestones is varying marine environments from active, shallow beach deposits, to reefs, to lagoons, to deeper marine. The spatial extent of Tertiary limestone groups is likely much more complex than the Cornec (2010) map suggests; the descriptions for Tertiary limestones are generally based on Flores' (1952a) descriptions (see also King et al. 2004) or by comparison with the same groups located in Guatemala (Reeder et al. 1996). Reeder et al. (1996) state that the majority of the Tertiary limestones of the Belize Valley are part of the Santa Amelia/Lacandon Formation. According to Millan (1979: 78), the Lacandon Formation is "a thick series of detrital carbonates of late Cretaceous to early Tertiary occurring in the

Lacandon region of northwestern Petén.” There is a distinct unconformity between the Cretaceous and early Tertiary Formations in parts of Guatemala. Flores originally believed there is an unconformity in Belize though more recent work suggests that this is not the case in some regions. In Belize, the boundary between the Cretaceous and Tertiary exhibits evidence of the Chicxulub impact event in the form of spheroid beds evident in sections at the Albion Formation, the village of Armenia, and the foothills of the Maya Mountains (termed “Pook’s pebbles”) (King et al. 2004: 296-297).

The El Cayo/Doubloon Bank Formations are equivalent to the Sepur/ Lacandon Formations in Guatemala. The El Cayo group is Paleocene to Middle Eocene in age and formed as a coastal plain located north of the Maya Mountains (King et al. 2004: 297). According to Flores (1952a: 16), “the lithology and fauna suggest a shallow water, warm lagoonal environment of back reef type” though reef and evaporate environments also occur (King et al. 2004). The depositional environment was very similar to the Upper Cretaceous with the addition of a belt of “evenly grained, medium crystalline, porous limestone east of Gallon Jug” (Flores 1952a: 15) though it is unclear if this belt is also present in the Belize Valley region. The El Cayo group is comprised primarily of limestones (light buff to white cream and white, dense, and evenly grained) though there dolomite, marl, gypsum and black or dark grey chert is also present (Cornec 2010; King et al. 2004). The Doubloon Bank formation is limestone with large chert nodules (>3 feet in diameter) (Cornec 2010) and the chert is generally black or brown (Flores 1952a:17). According to Flores (1952a:17), “the limestone is cream to buff, yellow to orange, dense, hard, almost lithographic in texture, shows a slight marly content and a choncoidal or sub-choncoidal fracture. Foraminifera are in general well preserved and relatively

abundant.” According to Cornec (2010), the Lacandon Formation is equivalent to the early Tertiary El Cayo and Doubloon Bank Formations while the Santa Amelia Formation is equivalent to the Red Bank and Orange Walk Formations; however, the depositional environments for these formations in Belize and Guatemala are often disparate. According to Millan (1979:78), the Lacandon Formation is “a thick series of detrital carbonates of late Cretaceous to early Tertiary occurring in the Lacandon region of northwestern Petén.....the formation, as proposed by Vinson, consists primarily of whitish detrital limestone (very fine to coarse calcarenites), which are locally associated with algal beds and microcrystalline limestones of light gray and light yellow to light cream colour (80).” The Santa Amelia formation is a shelf formation characterized by calcarenites and planktonic assemblages deposited as part of an active marine environment (Reeder et al. 1996; Millan 1979; Vinson 1962). A vague description of calcarenites in the region states that these rocks are not weathered much (DoE 16) though the exact location of these outcrops is not discussed.

Late Tertiary Limestone Formations

The descriptions and timing of deposition suggests that the Santa Amelia Formation (Guatemala) and Red Bank Formation (Belize) are the same. The Santa Amelia formation is a shelf formation characterized by calcarenites and planktonic assemblages deposited as part of an active marine environment (Reeder et al. 1996; Millan 1979; Vinson 1962). The Redbank Group, exposed in some areas between Cayo and Roaring Creek, is composed of grey calcareous clays and gypsum rich red clays that were likely deposited as part of a shallow sea. This group is directly overlain by the Boulder Group is comprised of white powdery marl with bands of limestone pebbles and

boulders likely deposited as an alluvial fan off of the Maya Mountains (Dixon 1956 in Fedick 1988: 81; Jenkin et al. 1976: 48).

The Orange Walk Formation is composed of marl, micritic, coral and coquina limestones (with corals, gastropods, oysters, pelecypods, fish scales, echinoid spines, and chara seeds), gypsum, (clay, sand) (Cornec 2010). There are five groups within the Orange Walk Formation but only three (San Lorenzo, Louisville, and Orange Walk) are in the vicinity of the Belize Valley. The other two (Corozal and Ambergis) are located closer to the coast. See Table B.2 for a description of the groups in the Orange Walk Formation. This formation is the likely source of the sparry calcite that is abundant in the pottery. Cornec (2010) indicates that this group is primarily located to the north of the river; however, given the abundance of this type of limestone in the pottery I suspect that this limestone formation is more abundant in the Belize Valley than previously thought.

Formation	Group	Description	Depositional Environment
Orange Walk	Miocene- Pleistocene		
	San Lorenzo	Yellow brown, hard, sandy limestone (up to 30% quartz) and calcareous sandstone	Sandy Beach
	Louisville	White, soft, marly limestone	Shallow lagoon, brackish to normal marine
	Orange Walk	White to cream, sandy limestone; coquinal limestone	Shallow beach to lagoon
Red Bank	Oligocene- Miocene	Sand, gypsum, chert, chalcedony	
	Iguana Creek	Oligocene	Limestone conglomerate (rounded Talus and beach facies chert and limestone)
Doubloon Bank	Middle Eocene	Dense, tan fossiliferous limestone with some marl; large chert nodules (up to ft) and lenses	Warm normal marine (50-200m)
El Cayo	Paleocene- Lower Eocene	Dense to crystalline, buff to pink to cream limestone. Dolomite, gypsum, bedded chert	Shallow water, warm lagoonal backreef; possible reef and evaporite
Barton Creek	Upper Cretaceous	Dense tan, hard to crystalline limestone and dolomite.	Shallow water, warm lagoonal backreef; occasional reef and questionable evaporite

Table B.2. Summary of the Major Limestone Formations in the Belize Valley.

Major Drainages

The Belize River begins at the confluence of the Macal River and the Mopan River, known locally as Branch Mouth, located approximately 2.5 kilometers north of San Ignacio town. The Belize River, Macal River, Mopan River, Barton Creek and Roaring Creek flow year-round and provide fresh water to the inhabitants of the Belize River Valley. Each of these waterways has a different source area. The difference in source area is potentially distinguishable in the compositional variability of riverbank clays and clayey soils. A description of the five perennial waterways follows.

The *Mopan River* begins in the Chiquibul and runs through eastern Guatemala before joining with the Macal River in the Cayo District (DoE: 25). It flows over carbonate rocks, specifically Cretaceous and Tertiary marine carbonates (Smith 1998). This carbonate bedrock is responsible for the tufa accumulations noted along the Mopan. The Mopan Valley is steep sided (Jenkin et al. 1976:74). Sands collected by along the banks of the Mopan River included micrite, calcite, muscovite, quartz, and biotite. A grey brown clay was comprised of micrite, calcite, quartz, plagioclase, and biotite (Sunahara 2003: 113-114). The *Macal River* drains from the northern and central Maya Mountains, originating near Baldy Sibun (DoE: 25). It flows over igneous and metamorphic rocks until Negroman where it begins to flow over limestone and dolomite (Smith 1998: 4). Of the three major Triassic batholiths present in the Maya Mountains, the Mountain Pine Ridge Batholith is the only one that outcrops in the Macal drainage (Smith 1998: 17). Unlike the Mopan River, the Macal does not accumulate tufa because most of the river is underlain by non-carbonate rock. The Macal valley is narrow and deep and the Macal River is prone to extreme flooding events. Gravel bar deposits of the Macal River are

composed of Paleozoic metamorphic rocks of the Santa Rosa Group and Triassic Granites which outcrop in the Maya Mountains (Smith 1998: 57). Sands collected by Sunahara (2003: 113-114) along the banks of the Macal River included quartz, perthite, microperthite, orthoclase, muscovite, plagioclase, consistent with the composition of the Mountain Pine Batholith. A yellow green clay contained micrite, crystalline calcite, and trace amounts of quartz while a brown clay contained quartz, opaques, muscovite, calcite, and muscovite, consistent with the composition of the Santa Rose Group and Mountain Pine Ridge Batholith.

Barton Creek originates in the northwest portion of the Maya Mountains near the Santa Rosa Group and Mountain Pine Ridge. It flows over Cretaceous (Campur and Coban) and Early Tertiary (El Cayo and Doubloon Bank) Carbonates before joining the Belize River near the modern village of Georgeville slightly upriver of Lower Dover. The Barton Creek Valley is steep sided (Jenkin et al. 1976:74).

The *Roaring Creek River* meets the Belize River just west of Belmopan in the village of Roaring Creek. The source area for the Roaring Creek River is approximately 22 kilometers to the south at Hidden Valley Falls near the foothills of the Maya Mountains. Many tributaries originating in the Maya Mountains empty into the Roaring Creek River (Helmke 2009). Granites, slates, pyrite, hematite, other metamorphic stones have been identified along the banks of the Roaring Creek River (Helmke 2009: 201) in addition to chert and various types of limestone in the form of pebbles, cobbles, and boulders. The Roaring Creek joins the Belize River upstream of Baking Pot. It was not sampled for this study but should be for future work focused on the production and circulation of ceramic vessels in the Belize River Valley.

Soils

Baking Pot is located on Holocene and Pleistocene River Deposits (Jenkin et al. 1976: 51) on the southern bank of the Belize River, part of the Major River Valleys Landform. In general, the Upper Belize River Valley has four terraces though the separation between these terraces may not be distinct along its length. The lowest and youngest terrace is the current floodplain of the Belize River and floods nearly annually. The second terrace is also comprised of young deposits but only floods during severe storms. Both the first terrace and second terrace are considered part of the current floodplain. The third and fourth terraces are considerably older, likely comprised of Pleistocene deposits, and are not subject to flooding in the present day (Fedick 1988: 86-87). Upper terraces were preferred for prehistoric settlement (Willey et al. 1965).

Unlike studies of the bedrock geology, soils research is much more detailed for the country of Belize. Most studies are based on Wright et al.'s (1959) seminal study that classified soils for the entire country. More recent studies in the Belize River Valley (Jenkin et al. 1976) and the Toledo District (King et al. 1986) are based on the Wright et al. 1959 study. The revised soils classification (Baillie et al. 1993) is used in this study though it is noted when soils have been changed and/or reclassified in the updated study.

Soils of the Alluvial Bottomlands. Melinda Suite soils are found along the major river valleys and “includes all of the moderately and well-drained soils derived from river alluvium. It encompasses considerable variability of parent material grain size and age” (Baillie 1993: 39). Within the Melinda Suite are two main subsuites associated with different river terraces. The Quamina subsuite is found on recent alluvial deposits (first and second terrace) and the Canquin (formerly Redbank) subsuite is found on older

deposits (third and fourth terrace) (Jenkin et al. 1976: 83). Quamina silty clay loams are located between limestone hills and “on recent sediments derived partly from limestone and partly from quartz-rich alluvium” (Wright et al. 1959: 82). These soils are grey and brown in color and are high in silt and muscovite content. This alluvium is “of mixed siliceous and calcareous origins, or it is mainly siliceous but is regularly inundated and suffused with hard was from calcareous catchments” (Baillie 1993: 39). The Quamina subsuite includes some of the most fertile soils in the Belize River Valley and have a clay content of 30-40% with a similar to slightly larger silt content (Jenkin et al. 1976: 85). The lowest terraces of the upper Belize Valley are comprised of Garbutt and Branch Mouth series while the next highest terrace is comprised of Young Girl and Barton Ramie Series (Jenkin et al. 1976:84). The Canquin (formerly Redbank) Subsuite is composed of dark brown topsoil with red to yellowish subsoil with yellowish mottling and loamy or clay texture. Though these soils are more weathered than the younger Quamina soils, silt and muscovite flakes are still present (Baillie et al. 1993: 41). Baking Pot is positioned atop soils of the Listowel Series of the Canquin Subsuite. The Young Girl Series soil profile, taken near the Baking Pot ferry, contains abundant quartz and feldspar grains and some mica throughout the profile (Jenkin et al. 1976:310) soil profile information for the Young Girl Series near the Baking Pot ferry. Quartz and feldspar grains of varying sizes are present throughout the soil profile.

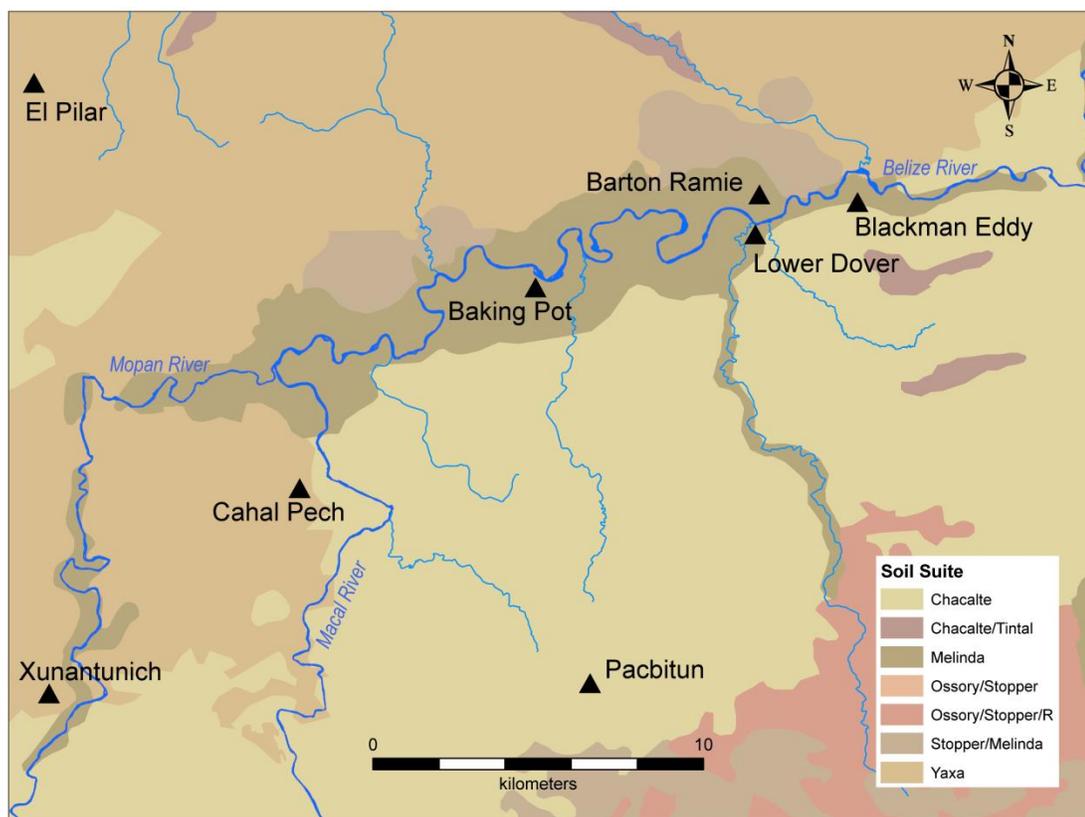


Figure B.3. Soils of the Belize River Valley. (Map by C.E. Ebert).

Soils of the Foothills. The soils in the foothills are of the Yaxa Suite. Yalbac subsuite soils are generally located to the north of the Belize River while Cuxu Subsuite soils are located in the foothills to the south (Jenkin et al. 1976:83). Two primary soil types are present in the Yaxa Suit and they form on slightly different types of calcareous bedrock. Rendzinas (or lime rich soil formed atop a soft calcareous bedrock) form directly atop weathered limestone while vertisols (clay rich soil that forms in regions with distinct wet and dry season) form atop a layer of marl derived from the limestone (Jenkin et al. 1976:88). These soils, as opposed to those formed on alluvium, are chalky and full of carbonate inclusions (Wright et al. 1959:69). This distinction (i.e. the presence or

absence of coarse silt to fine sand sized carbonate inclusions) is important for identifying the location of clay extraction in the Belize Valley.

Southern Belize

Southern Belize is located in the Belize Basin and, together with the Petén Basin, “form the southern edge of the Maya Block and the southernmost part of the North American Plate” (Schafhauser et al. 2003: 625). The collision of the North American Plate and the Caribbean Plate (located to the south on the opposite side of the Motagua Fault) created a large foreland basin that subsequently infilled with clastic material deriving from the Maya Mountains, Motagua Fault System, and Cretaceous marine limestones. Uxbenká is located atop the Tertiary Toledo formation (Sepur formation in Guatemala) composed of the clastic materials that accumulated in the foreland basin. The Toledo formation is composed of interbedded mudstones, sandstones, and conglomerates. To the south, in an area known locally as the “Rock Patch”, there is a 250 high meter karst composed of Cretaceous limestone of the La Cumbre formation “composed of shallow water subangular clastics as well as massive limestones” (Meredith 2014: 22). Cretaceous limestones also outcrop disconformably within the Toledo formation. Geologic literature in the region is minimal though the Mesozoic stratigraphy is similar to that of the Petén Basin. The most described formations are the Coban and Campur limestone formations and the interbedded clastic Toledo (Sepur) Formation (see Figure B.3).

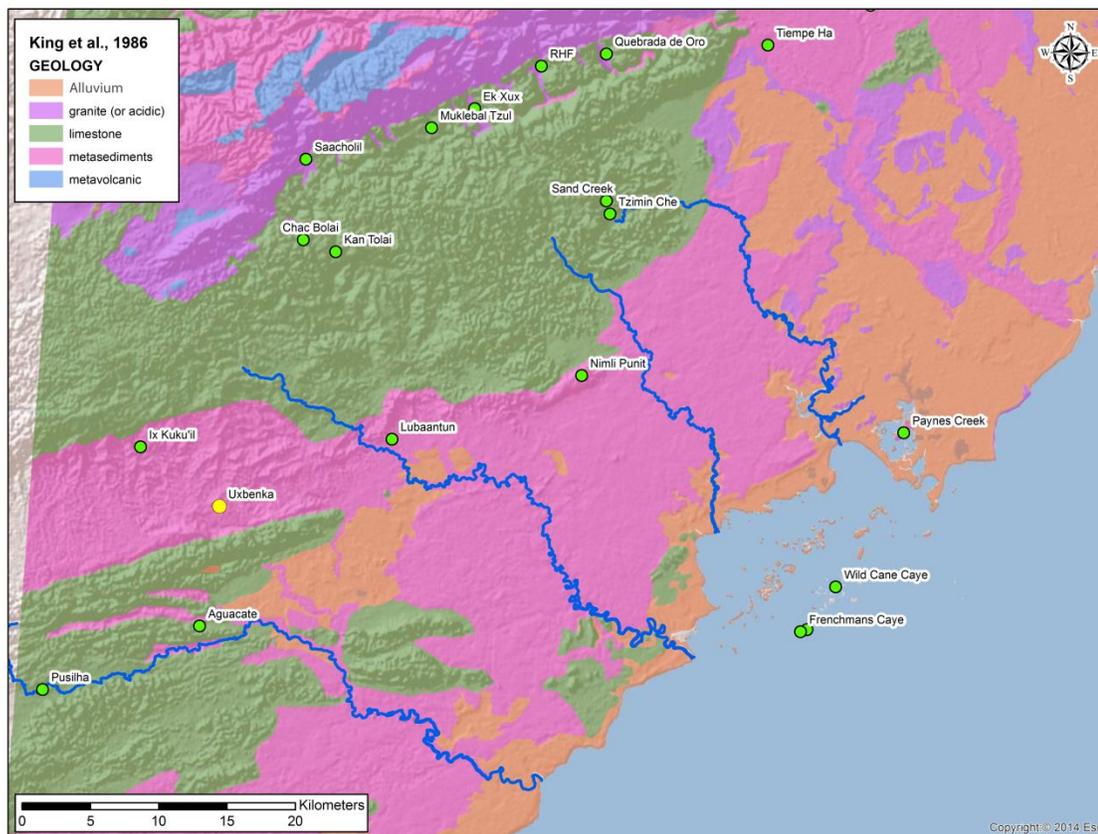


Figure B.4. Southern Belize Landforms. (Map by A.E. Thompson *after* King et al. 1986)

The Coban and Campur Formation

Southern Belize is comprised predominantly of marine limestones and clastic sedimentary rocks. The Aptian-Santonian (Cretaceous) Coban Formation in the region is composed of evaporates, dolomites, micritic limestones, and stromatolitic dolomites deposited as part of lagoons and sabkhas (coastal flats that experience periodic flooding and evaporation) in a shallow carbonate platform. The Coban Formation in the Belize Basin also has layers of Benthonic shales. The Aptian-Albanian Punta Gorda Formation is volcanoclastic. The Campur Formation overlies the Coban Formation and likely dates to the Campanian to Maastrichtian (Cretaceous) though the dates are not well defined.

The Campur Formation in southern Belize is composed of shallow-water bioclastic limestones and rudists (Schafhauser et al. 2003: 625-626).

The Toledo (Sepur) Formation

The Toledo Formation, known as the Sepur Formation in Guatemala, marks a change from a “stable carbonate platform to a mobile orogenic belt” (Schafhauser et al. 2003: 627). This Formation was first identified by Ower (1926) and described as thin bedded shales and mudstones with blue calcareous sandstones. Dixon (1956: 24) also notes the presence of interbedded limestones. The Toledo Formation developed after the Maya Block collided with the Greater Antillean Arc during the Paleocene creating the siliciclastic flysch basin (deep marine sedimentary rocks deposited in a foreland basin) present in southern Belize and the South Petén Basin of Guatemala. Milan (1979:101-102) describes the type locality of the Sepur Formation, located in the southeastern Peten, as “repetitious interbedded sequences of claystones and siltstones with lesser sandstones, calcarenites, calcisilites, and limestone conglomerates.” The clastic sedimentary rocks (claystones, siltstones, and sandstones) are chocolate-brown to olive-gray and olive-brown and some are yellow, red, black, and green. The calcarenites contain igneous grains as well as limestone.

The large limestone clasts of the earlier Campur Formation present in the Toledo Formation are evidence of tectonic activity. The composition of the Toledo Formation is described by Schafhauser et al. (2003: 629) as consisting of “rhythmically bedded shales, siltstones, and thin-bedded, size-graded calcareous sandstones and polymict breccias, in addition to limeclast breccias. The limeclast breccias consist of subangular clasts of biopelmicrite and biomicrite limestones. Clast diameters range from 0.2 cm to 15 cm.

The biomicritic limestones contain benthic foraminifers (e.g., orbitoids), which suggests derivation from the Campur Formation. The framework is grain-supported, and spar calcite cement is nearly absent between the clasts. Similar limestone debris-flow breccias have been described from Cretaceous/Tertiary boundary transects in Guatemala (e.g., Hildebrand et al., 1993; Stinnesbeck et al., 1997; Fourcade et al., 1999), but they are also present in the Paleocene sequence. The size-graded layers comprise incomplete Bouma sequences with basal polymict breccia layers and laminated calcareous sandstones at the top. The clasts consist of micritic and biosparitic limestones and marls, as well as isolated bioclasts of echinoderms, gastropods, benthic foraminifers (e.g., orbitoids), and rudists. Noncarbonate clasts of basalt, volcanic glass, and serpentinite also are abundant and indicate a provenance from a nearby volcanic source, probably the Santa Cruz Ophiolite Complex in Guatemala.”

There are unconformities between the Toledo Beds and underlying limestone at least in some place (Dixon 1956). Uxbenká is situated in the foothills of the Maya Mountains near a discontinuity between Cretaceous limestones and the Toledo Beds. The karstic limestone ridge to the south of Uxbenká, “the rock patch”, is evidence of this disconformity. Around Uxbenká, the Toledo Beds are expressed as large mudstone and sandstone beds forming natural terraces (Culleton 2012). The beds weather to a chocolate brown color due to the ferruginous material in the detritus (Dixon 1956: 25). The thinly bedded clastic rocks around Toledo are macroscopically similar to those described by Milan (1979) in the southeastern Petén.

Soils

The inhabitants of Santa Cruz make a broad distinction between two types of soils based on their productivity for particular types of crops. The *box lu'um* (black soil) are “well-drained black clay loams largely distributed to the north of the village and at the base of the rock patch” (Culleton 2012: 95) while *chik lu'um* (red soil) are “poorly-drained oxidized red soils primarily found in the village itself and to the south within ~500-700 m of Rio Blanco” (Culleton 2012: 95). *Box lu'um* is the more agricultural productive soil that can support nearly every crop while *chik lu'um* is used for dry rice crops. While pottery production is no longer practiced in Santa Cruz village, community members report that *chik lu'um* was used to produce ceramic vessels in the past. There were no reports of river clays being used in Santa Cruz village though river clays were used by other villages as recently as the 1960s (Hughes-Hallett 1970).

In general, soils in southern Belize are divided into lime-rich and lime-poor groups (Hammond 1975: 18; Wright et al. 1959). Uxbenká is located on a landform called the Toledo Uplands atop soils atop soils of the Toledo Suite described as generally shallow, clays and loams predominant, greys and browns are the dominant color but redder soils also exist (Baillie et al. 1993; King et al. 1986). The Aguacate and Santa Cruz subsuites (King et al. 1986) have been combined to just the Santa Cruz subsuite (Baillie et al. 1993) and the Waika subsuite has been reclassified as Cimin. In general, the soils of the Cimin subsuite are shallow and brown while those of the Aguacate (and Manfredi) subsuite are a deep red, sandy clay.

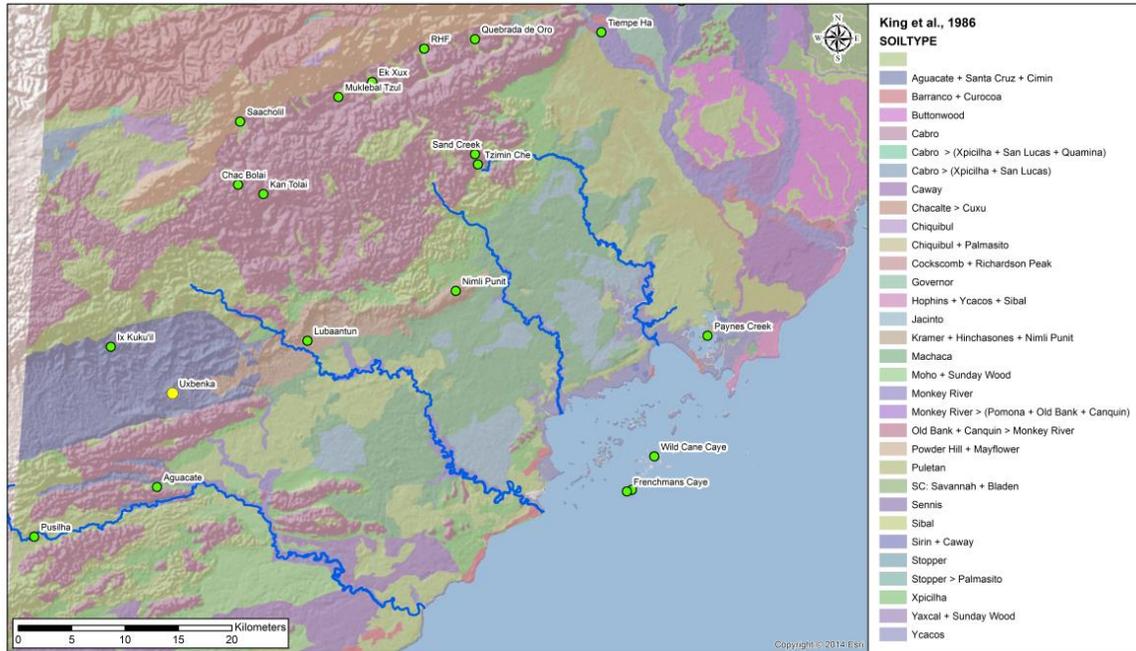


Figure B.5. The Soils of Southern Belize (Map by A.E. Thompson *after* King et al. 1986)

APPENDIX C

ANALYSIS OF CLAY AND ROCK SAMPLES

Clay Processing Methods

All clay samples were transported to the University of New Mexico in 3x5" WHIRL-PAK sealable sample bags. A duplicate set of clay samples is stored at the UAP storage facility in Big Falls, Belize. Some clay samples arrived nearly dry while some were still wet and pliable. All clays were dried for three days prior to any laboratory processing. Munsell colors and organics/inclusions were recorded for the dry clays. The clays were then soaked in water and screened through fine mesh to remove all large inclusions and organic materials. Once the samples settled, the majority of the water was drained off until just a slight (<1cm) water/clay slurry remained on top. The samples were allowed to dry until they were once again workable consistency (6-9 days).

Munsell colors and texture/workability were recorded for each of the wet clays. The clays were wedged and formed into two briquettes per sample. The size of the briquettes varied but averaged 2x2x7cm. A 5cm line was incised into each sample to measure linear shrinkage after drying and firing. Each sample was also weighed to measure weight shrinkage after drying and firing. Each briquette was air dried for two days before being placed into a Fisher Isotemp 500 Series drying oven for 2 days at 100°C and air drying for another 3 days. One dried briquette was saved for future analyses and one was fired.

Due to the abundance of calcite in many of the clays, particularly the Belize Valley samples, firing loosely followed methods described by Howie (2005:484). All clay tiles were fired in a Lindberg/Blue BF51700 Series 1100°C Box Furnace. The kiln was brought to 300°C and held there for 2 hours. The kiln was increased to 450°C after this and held at 450°C for an hour. The temperature was increased to the maximum temperature (750°C) at a rate of 100°C per hour. The maximum temperature was held for 30 minutes before allowing the kiln to cool naturally to room temperature. A small chip was removed from each fired briquette using a diamond saw to save for future analyses.

Belize Valley Geology Survey

The level of detail included in geologic and soils reports is inadequate for a petrographic ceramic study. Sunahara (2003) documented mineralogical inclusions from many natural clay sources across the Belize River Valley though did not provide additional information (e.g. abundance, size, sorting). Geologic sampling in the Belize River Valley was regional in scope because little is known about ceramic production and distribution of finished products in the region. Given that most of the polities in the region are located near navigable waterways, vessels may have been regularly exchanged. Samples taken from around Lower Dover mark the eastern extent of the survey region while samples taken from Xunantunich mark the western extent (Figure D.1). A total of 17 soils samples and 7 rock samples were collected (Table D.1). Clays are abundant in the Belize River Valley so the sampling strategy focused on collecting clays from different geologic and environmental areas in order to document

compositional variability. This study focused primarily on riverine and floodplain clays. Future work will focus on sampling clays located in the foothills as this was the likely source of clay used to produce jars in the Late Classic Belize Valley. The approach to describing the clay samples was devised by Howie (n.d.) for the examination of geologic samples to complement the descriptive system approach to ceramic thin sections.

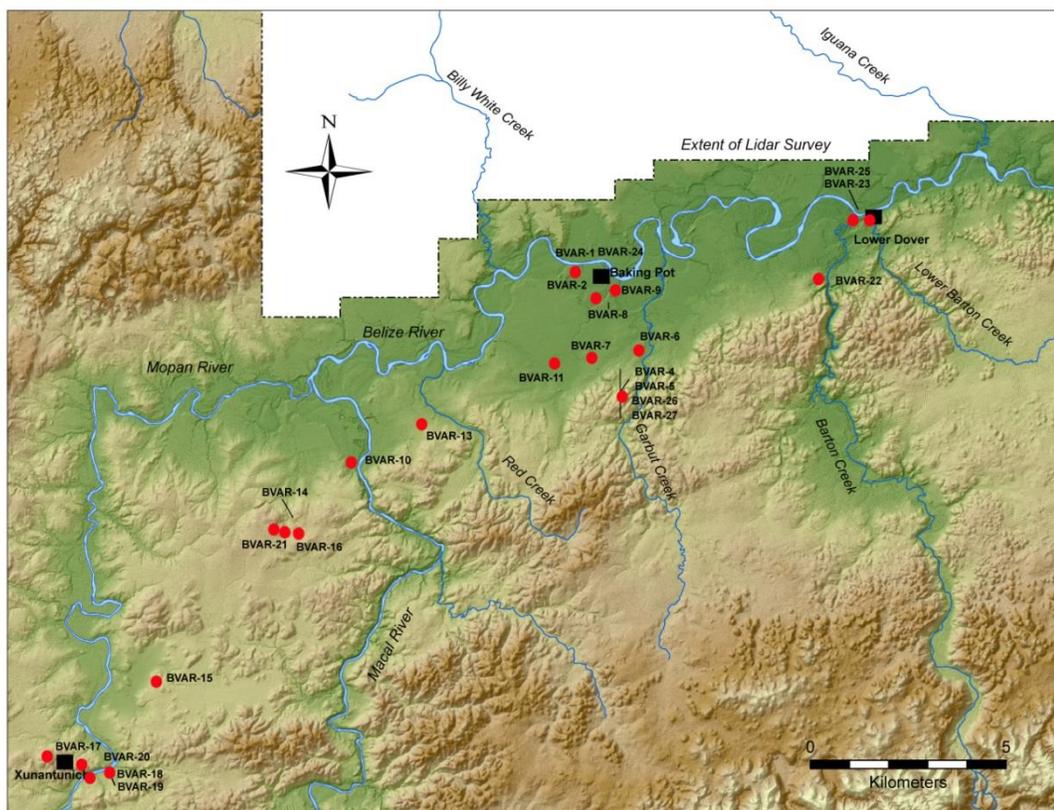


Figure C.1. Location of Belize Valley Clay and Rock Samples. (Map by C.E. Ebert)

Project	Sample #	Site	Type of Sample	Environment	Drainage System	Depth	Northing	Easting
BVAR	1	Baking Pot	Clay	Floodplain	Belize	23cm	1903350	285856
BVAR	2	Baking Pot	Clay Loam	Floodplain	Belize	36cm	1903234	285858
BVAR	4	Baking Pot	Limestone Micrite	Foothills		Surface	1900583	287000
BVAR	5	Baking Pot	Mud	Foothills		Surface	1900583	287000
BVAR	6	Baking Pot	Clay	River	Garbutt Creek	1m	1901262	287483
BVAR	7	Baking Pot	Clay Loam	Floodplain	Unnamed	20cm	1900911	285242
BVAR	8	Baking Pot	Clay	Floodplain	Unnamed	75cm	1902533	286350
BVAR	9	Baking Pot	Clay	Floodplain	Aguada	30cm	1902654	286375
BVAR	10	San Ignacio	Clay	River	Macal	1m	1898386	280095
BVAR	11	Baking Pot	Clay	Floodplain		20 cm	1901075	286226
BVAR	13	Baking Pot	Clay	River Foothills	Red Creek	15 cm	1899574	281880
BVAR	14	Cahal Pech	Clay	(Drainage)	Unnamed	40cm	1896738	278399
BVAR	15	Actuncan	Clay	Foothills Foothills		3m	1892898	275058
BVAR	16	Cahal Pech	Clay	(Drainage)	Unnamed	Surface	1896512	278723
BVAR	17	Xunantunich	Clay	Foothills		Surface	1890689	272290
BVAR	18	Xunantunich	Limestone	Foothills		Surface	1890492	273467
BVAR	19	Xunantunich	Limestone	Foothills		Surface	1890492	273467
BVAR	20	Xunantunich	Marl	Foothills		2 m	1890611	273340
BVAR	21	Cahal Pech	Limestone	Foothills		1.5m	1896725	278180
BVAR	22	Lower Dover	Sandy Clay	River	Upper Barton Creek	15cm	1903149	292027
BVAR	23	Lower Dover	Clay	River	Belize	3m	1904587	292878
BVAR	24	Baking Pot	Clay	River	Belize	15cm	1903393	286205
BVAR	25	Lower Dover	Clay	River Terrace	Belize	10cm	1904587	292878
BVAR	26	Baking Pot	Chert	Foothills		Surface	1900583	287000
BVAR	27	Baking Pot	Chert	Foothills		Surface	1900583	287000

Table C.1. Location of Belize Valley Clay and Rock Samples.

Belize Valley Clay Analysis

Sample #	Munsell (Dry)	Inclusions	Days to Dry until Workable	Munsell (Wet)	Texture/Workability	Munsell (Dry after Processing)
BVAR-1	7.5YR-5/2	Very few roots/rock inclusions	7	10YR-4/2	Smooth, very sticky, poor workability	10YR-6/6
BVAR-2	10YR-3/2	Very few roots/rock inclusions	6	10YR-3/2	Gritty, moderate workability	10YR-4/2
BVAR-6	10YR-3/1	Few roots, abundant sand and small limestone fragments	7	10YR-3/1	Gritty (abundant limestone), moderately sticky, good workability	10YR-4/1
BVAR-7	10YR-2/1	Many small root and rock inclusions	6	10YR-2/1	Very dense, slightly gritty, great workability	10YR-3/1
BVAR-8	10YR-4/2 (with red mottling)	Some very small rocks	6	10YR-4/2	Gritty, sticky, musty odor, poor workability	2.5Y-5/3
BVAR-9	10YR-3/2	Some roots and abundant pebble sized rocks	7	10YR-3/2	Smooth, very sticky, moderate workability	10YR-4/1
BVAR-10	10YR-5/4	Minimal roots and no visible inclusions	6	10YR-4/3	Slightly gritty, sticky, poor workability	10YR-6/2
BVAR-11	7.5YR-5/6	Small roots and no visible inclusions	7	7.5YR-5/6	Smooth, moderately sticky, good workability	7.5YR-6/4
BVAR-13	7.5YR-5/6	Abundant roots and some sand sized inclusions	7	7.5YR-5/8	Gritty, crumbly, poor workability	7.5YR-6/6
BVAR-14	10YR-6/1	Abundant limestone and rock fragments	7	5YR-5/1	Very gritty, sticky, good workability	10YR-7/1
BVAR-15	7.5YR-6/6	Many roots/grasses and no visible inclusions	9	7.5YR-5/6	Smooth, great workability	7.5YR-7/4
BVAR-16	10YR-6/1 (with bl. and wh. mottling)	Some roots, some small limestone inclusions	7	7.5YR-5/1	Smooth, sticky, good workability	10YR-7/1
BVAR-17	10YR-4/2	Some root and rock fragments	7	10YR-4/2	Gritty, sticky, good workability	10YR-5/2
BVAR-22	10YR-4/2	Few roots, abundant sand	7	10YR-4/3	Very gritty, very poor workability. Likely won't make it to firing.	10YR-4/3
BVAR-23	7.5YR-5/4	Small roots and organics, some sand	7	10YR-4/6	Slightly gritty, sticky, moderate workability	10YR-6/4
BVAR-24	7.5YR-5/2	Abundant roots, some sand	7	10YR-4/3	Smooth, slightly sticky, good workability	10YR-6/2
BVAR-25	10YR-6/6	Some roots, no visible inclusions	7	10YR-4/6	Smooth, great workability	10YR-6/4

Table C.2. Belize Valley Macroscopic Clay Characteristics.

Sample #	Weight Before Drying (g)	Weight After Drying (g)	Shrinkage Before Drying		Condition After Drying	Weight After Firing	Shrinkage After Firing	Condition After Firing	Munsell After Firing
			Drying (mm)	Shrinkage After Drying					
BVAR-1	Tile 1: 57.0	Tile 1: 41.5	Tile 1: 50	Tile 1: 42.34	No Change	Tile 1: 36.4	Tile 1: 40.85	No Change	2.5YR-6/4
	Tile 2: 62.4	Tile 2: 45.4	Tile 2: 50	Tile 2: 39.71					
BVAR-2	Tile 1: 54.1	Tile 1: 49.5	Tile 1: 50	Tile 1: 41.74	No Change	Tile 2: 49.7	Tile 2: 43.24	Minimal Cracking	2.5YR-5/6
	Tile 2: 58.7	Tile 2: 53.0	Tile 2: 50	Tile 2: 44.08					
BVAR-6	Tile 1: 51.6	Tile 1: 41.6	Tile 1: 50	Tile 1: 43.9	No Change	Tile 1: 36.4	Tile 1: 43.43	Some Crumbling	2.5YR-6/4
	Tile 2: 55.2	Tile 2: 44.4	Tile 2: 50	Tile 2: 40.2					
BVAR-7	Tile 1: 55.3	Tile 1: 42.4	Tile 1: 50	Tile 1: 42.36	Cracking	Tile 1: 37.3	Tile 1: 41.31	No Change	2.5YR-6/6
	Tile 2: 55.4	Tile 2: 42.5	Tile 2: 50	Tile 2: 42.52					
BVAR-8	Tile 1: 58.8	Tile 1: 51.7	Tile 1: 50	Tile 1: 42.81	Cracking	Tile 1: 46.9	Tile 1: 44.44	Cracking/Crumbling	2.5YR-6/8
	Tile 2: 75.8	Tile 2: 66.4	Tile 2: 50	Tile 2: 43.62					
BVAR-9	Tile 1: 45.6	Tile 1: 32.9	Tile 1: 50	Tile 1: 42.0	Cracking	Tile 1: 29.2	Tile 1: 42.5	No Change	5YR-5/6
	Tile 2: 50.3	Tile 2: 36.5	Tile 2: 50	Tile 2: 40.46					
BVAR-10	Tile 1: 47.2	Tile 1: 40.5	Tile 1: 50	Tile 1: 41.35	No Change	Tile 1: 37.3	Tile 1: 40.12	Cracking/Crumbling	5YR-6/6
	Tile 2: 45.8	Tile 2: 41.35	Tile 2: 50	Tile 2: 42.34					
BVAR-11	Tile 1: 47.2	Tile 1: 39.8	Tile 1: 50	Tile 1: 44.34	Crumbling	Tile 2: 43.3	Tile 2: 42.26	Some Crumbling	2.5YR-5/8
	Tile 2: 56.0	Tile 2: 46.8	Tile 2: 50	Tile 2: 42.46					
BVAR-13	Tile 1: 65.8	Tile 1: 58.9	Tile 1: 50	Tile 1: 45.74	No Change	Tile 1: 51.6	Tile 1: 45.74	Cracking/Crumbling	2.5YR-5/8
	Tile 2: 67.2	Tile 2: 60.1	Tile 2: 50	Tile 2: 44.92					
BVAR-14	Tile 1: 52.9	Tile 1: 39.8	Tile 1: 50	Tile 1: 41.61	No Change	Tile 2: 34.9	Tile 2: 45.74	Cracking	10YR-8/1
	Tile 2: 53.1	Tile 2: 40.2	Tile 2: 50	Tile 2: 41.31					
BVAR-15	Tile 1: 54.5	Tile 1: 40.6	Tile 1: 50	Tile 1: 42.61	No Change	Tile 2: 39	Tile 2: 43.18	No Change	2.5YR-6/6
	Tile 2: 57.5	Tile 2: 42.9	Tile 2: 50	Tile 2: 42.35					
BVAR-16	Tile 1: 70.2	Tile 1: 54.4	Tile 1: 50	Tile 1: 41.92	No Change	Tile 2: 56.2	Tile 2: 41.8	Crumbling	10YR-8/1
	Tile 2: 81.3	Tile 2: 63.0	Tile 2: 50	Tile 2: 42.14					
BVAR-17	Tile 1: 42.2	Total: 58.4	Tile 1: 50		Completely cracked			In Pieces	5YR-6/6
	Tile 2: 49.8		Tile 2: 50						
BVAR-22	Tile 1: 58.2	Tile 1: 49.0	Tile 1: 50	Tile 1: 40.04	No Change	Tile 2: 44.2	Tile 2: 42.64	Abundant Crumbling	2.5YR-5/8
	Tile 2: 58.0	Tile 2: 48.6	Tile 2: 50	Tile 2: 39.19					
BVAR-23	Tile 1: 70.9	Tile 1: 55.2	Tile 1: 50	Tile 1: 39.6	Crumbling	Tile 2: 53.3	Tile 2: 43.81	Some Crumbling	2.5YR-5/8
	Tile 2: 74.3	Tile 2: 57.7	Tile 2: 50	Tile 2: 43.43					
BVAR-24	Tile 1: 50.7	Tile 1: 37.5	Tile 1: 50	Tile 1: 43.5	Cracking	Tile 2: 31.8	Tile 2: 43.69	No Change	2.5YR-6/6
	Tile 2: 50.4	Tile 2: 37.2	Tile 2: 50	Tile 2: 41.69					
BVAR-25	Tile 1: 69.3	Tile 1: 55.6	Tile 1: 50	Tile 1: 43.01	No Change	Tile 1: 51.3	Tile 1: 43.07	No Change	2.5YR-5/8
	Tile 2: 69.9	Tile 2: 55.9	Tile 2: 50	Tile 2: 42.67					

Table C.3. Belize Valley Clay Shrinkage Study Data.

Sample #	Weight Shrinkage after Drying (%)	Linear Shrinkage after Drying (%)	Weight Shrinkage after Firing (%)
BVAR-1-1	27.19	15.32	12.29
BVAR-1-2	27.24	20.58	
BVAR-2-1	8.5	16.52	
BVAR-2-2	9.71	11.84	0
BVAR-6-1	19.38	12.2	12.5
BVAR-6-2	19.57	19.6	
BVAR-7-1	23.33	15.28	12
BVAR-7-2	23.29	14.96	
BVAR-8-1	12.07	14.38	9.3
BVAR-8-2	12.4	12.76	
BVAR-9-1	27.85	16	11.25
BVAR-9-2	27.44	19.08	
BVAR-10-1	14.2	17.3	7.9
BVAR-10-2	13.1	15.32	
BVAR-11-1	15.68	11.32	
BVAR-11-2	16.4	15.08	7.48
BVAR-12-2	16.42	15.08	
BVAR-13-1	10.49	8.52	12.49
BVAR-13-2	10.57	10.16	
BVAR-14-1	24.67	16.78	
BVAR-14-2	24.29	17.38	13.18
BVAR-15-1	25.5	14.78	
BVAR-15-2	25.39	15.3	9
BVAR-16-1	22.51	16.16	
BVAR-16-2	22.51	15.76	10.79
BVAR-17-1	--	--	--
BVAR-17-2	--	--	--
BVAR-22-1	15.81	19.92	
BVAR-22-2	16.21	21.62	9
BVAR-23-1	22.14	20.8	
BVAR-23-2	22.34	13.14	7.6
BVAR-24-1	26.04	13	
BVAR-24-2	26.19	16.62	14.52
BVAR-25-1	19.77	13.98	7.73
BVAR-25-2	20.03	14.66	14.52
MIN	8.5	8.52	0
MAX	27.85	21.62	14.52
MEAN	19.6433333	15.4909091	10.0911765

Table C.4. Belize Valley Clay Shrinkage Study Results.

	BVAR1	BVAR2
Location	BR Floodplain at BKP	BR Floodplain at BKP
Soil Suite	Melinda	Melinda
Soil Subsuite	Quamina	Quamina
Textural Characteristics		
Color (PPL)	Tan	Reddish Brown
Color (XPL)	Golden Tan	Golden Reddish Brown
Coarse (>.125mm):Fine	20:80	50:50
Inclusion Packing	Closed to Single Spaced	Closed to Single Spaced
Inclusion Sorting	Moderate	Poor
Characteristics of Inclusions		
Roundness	Rounded to Angular	Rounded to Angular
Size (mm) Largest of all/ range of 98%	1.5mm/.15mm-.45mm	1.2mm/.2mm-.72mm
Mode size (mm)	.35mm (medium sand)	.4mm (medium sand)
Inclusions (Mineralogy and Proportions)		
Crystalline Calcite	Rare	None
Sparite	Very Rare	None
Micrite	Frequent (Rounded)	None
Quartz	Dominant	Dominant
Chert	Few	Few
Chalcedony	Rare	Few
Muscovite	Common	Common
Biotite	Rare	Rare
Polycrystalline Quartz	Rare	Rare
Quartzite	Rare	Rare
Quartz+Mica	Very Rare	Rare
Perthite	Very Rare	Rare
Feldspar	Very Rare	Few
Zircon	Very Rare	Very Rare
Shell	Very Rare	None
Mudstone/Siltstone	Very Rare	None
Schist	None	None
Volcanic Ash	Very Rare	None
Clay Related Compositional Features		
Textural Concentration Features	Rare, brown clay pellets with quartz inclusions, rounded, equant to elongated (mode size: 25mm)	Rare, red clay pellets with quartz inclusions, rounded, equant to elongated (mode size: 25mm)
Amorphous Concentration Features	Common reddish brown to black, rounded, equant to elongated high optical density; Rare phytoliths (mode size: .1mm)	Few reddish brown to black, rounded, high optical density (mode size: .1mm)

Table C.5. Petrographic Results: Clay Samples BVAR1 and BVAR2.

	BVAR6	BVAR7
Location	Garbutt Creek	Anthrop. Drainage at BKP
Soil Suite	Creek	Melinda
Soil Subsuite	Norland	Canquin
Textural Characteristics		
Color (PPL)	Brown	Golden Brown
Color (XPL)	Golden Brown	Golden Reddish Brown
Coarse (>.125mm):Fine	50:50	10:90
Inclusion Packing	Closed to Single Spaced	Double to Open Spaced
Inclusion Sorting	Very Poor	Well Sorted
Characteristics of Inclusions		
Roundness	Rounded to Angular	Rounded to Subrounded
Size (mm) Largest of all/ range of 98%	1.35mm/.3mm-1mm	.8mm/.05mm-.25mm
Mode size (mm)	.6mm (coarse sand)	.15mm (fine sand sand)
Inclusions (Mineralogy and Proportions)		
Crystalline Calcite	Few	None
Sparite	Absent	None
Micrite	Dominant (All types)	None
Quartz	Few	Dominant
Chert	Few	Rare
Chalcedony	Very Few	Rare
Muscovite	Very Rare	Few
Biotite	Very Rare	None
Polycrystalline Quartz	Very Few	Very Rare
Quartzite	Very Few	Rare
Quartz+Mica	Rare	Very Rare
Perthite	Very Rare	Very Rare
Feldspar	Very Rare	Very Rare
Zircon	None	Rare
Shell	Very Rare	None
Mudstone/Siltstone	Rare	None
Schist	None	None
Volcanic Ash	None	None
Clay Related Compositional Features		
Textural Concentration Features	Rare, red to brown clay pellets, rounded to elongated, some with quartz inclusions (mode size: .125mm)	Very rare, red to brown clay pellets, rounded, some with quartz inclusions (mode size: .15mm)
Amorphous Concentration Features	Few reddish brown to black, rounded, high optical density (mode size: .1mm)	Common, red to brown, rounded, equant, high optical density (mode size: .1mm)

Table C.6. Petrographic Results: Clay Samples BVAR6 and BVAR7.

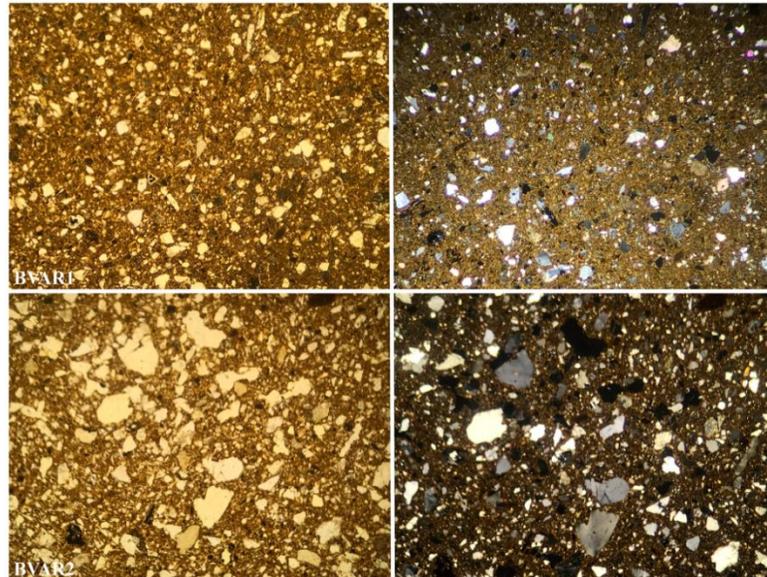


Figure C.2. Photomicrographs of BVAR1 (PPL in Upper Right, XPL in Upper left) and BVAR2 (PPL in Lower Left, XPL in Lower Right) (2.5x magnification).

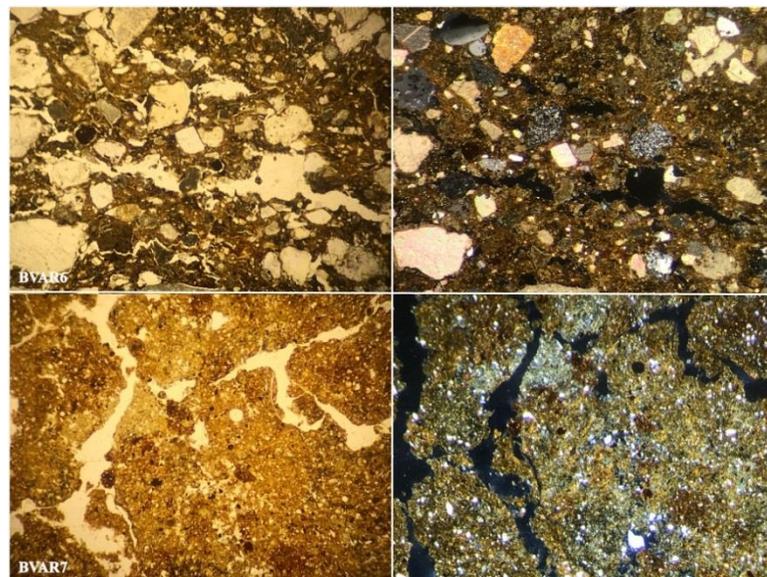


Figure C.3. Photomicrographs of BVAR6 (PPL in Upper Right, XPL in Upper left) and BVAR7 (PPL in Lower Left, XPL in Lower Right) (2.5x magnification).

	BVAR8	BVAR9
Location	Anthrop. Drainage at BKP	Aguada at BKP
Soil Suite	Melinda	Melinda
Soil Subsuite	Canquin	Canquin
Textural Characteristics		
Color (PPL)	Deep Red Brown	Red Brown
Color (XPL)	Golden Red Brown	Golden Red Brown
Coarse (>.125mm):Fine	10:90	20:80
Inclusion Packing	Double to Open Spaced	Single to Double Spaced
Inclusion Sorting	Well Sorted	Moderately Well Sorted
Characteristics of Inclusions		
Roundness	Rounded to Subrounded	Rounded to Subangular
Size (mm) Largest of all/ range of 98%	.8mm/.05mm-.25mm	1.5mm/.15mm-.4mm
Mode size (mm)	.15mm (fine sand sand)	.15mm (fine sand)
Inclusions (Mineralogy and Proportions)		
Crystalline Calcite	None	None
Sparite	None	None
Micrite	None	None
Quartz	Dominant	Dominant
Chert	Very Few	Rare
Chalcedony	Very Few	Rare
Muscovite	Few	Few
Biotite	None	None
Polycrystalline Quartz	None	Rare
Quartzite	Very Few	Rare
Quartz+Mica	Very Rare	Very Rare
Perthite	None	Very Few
Feldspar	Rare	Few
Zircon	Very Rare	Very Rare
Shell	None	None
Mudstone/Siltstone	None	None
Schist	None	None
Volcanic Ash	None	None
Clay Related Compositional Features		
Textural Concentration Features	Very Few, brown to reddish brown clay pellets, rounded, equant to irregular, some with quartz inclusions (mode size: .55mm)	None
Amorphous Concentration Features	None	Common, reddish brown, rounded, equant, moderate optical density (mode size: .1mm)

Table C.7. Petrographic Results: Clay Samples BVAR8 and BVAR9.

	BVAR10	BVAR11
Location	Macal River	BR Floodplain at BKP
Soil Suite	Cuxu	Melinda
Soil Subsuite	Unknown	Canquin
Textural Characteristics		
Color (PPL)	Red Brown	10:90
Color (XPL)	Dark Red Brown	Red
Coarse (>.125mm):Fine	40:60	Deep Red
Inclusion Packing	Closed to Single Spaced	Single to Open Spaced
Inclusion Sorting	Poorly Sorted	Well Sorted
Characteristics of Inclusions		
Roundness	Rounded to Subrounded	Rounded to Subrounded
Size (mm) Largest of all/ range of 98%	.9mm/.2mm-.5mm	.48mm/.02mm-.4mm
Mode size (mm)	.35mm (medium sand)	.2mm (fine sand)
Inclusions (Mineralogy and Proportions)		
Crystalline Calcite	Very Rare	None
Sparite	None	None
Micrite	Few	Very Few
Quartz	Dominant	Dominant
Chert	Few	Very Few
Chalcedony	Very Few	Rare
Muscovite	Common	Common
Biotite	Few	None
Polycrystalline Quartz	Rare	None
Quartzite	Common	Few
Quartz+Mica	Very Few	Very Rare
Perthite	Few	Very Rare
Feldspar	Few	Very Rare
Zircon	Rare	Very Rare
Shell	None	None
Mudstone/Siltstone	Very Rare	Very Rare
Schist	Very Rare	None
Volcanic Ash	Very Rare	None
Clay Related Compositional Features		
Textural Concentration Features	Rare, brown to reddish brown clay pellets, rounded, equant to irregular, some with quartz inclusions (mode size: .25mm)	None
Amorphous Concentration Features	Common, reddish brown to black, rounded, equant, moderate optical density (mode size: .1mm)	Common, reddish brown, rounded, equant, moderate optical density, quartz inclusions (mode size: .25-.55mm)

Table C.8. Petrographic Results: Clay Samples BVAR10 and BVAR11.

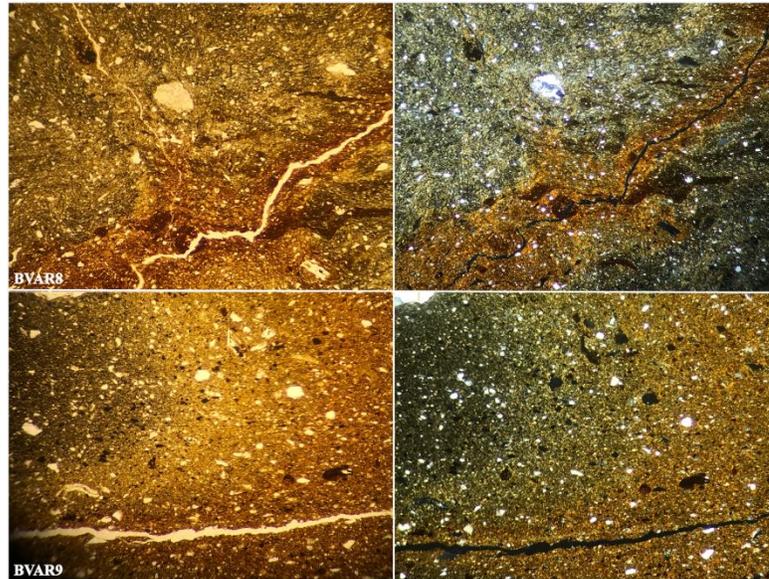


Figure C.4. Photomicrographs of BVAR8 (PPL in Upper Right, XPL in Upper left) and BVAR8 (PPL in Lower Left, XPL in Lower Right) (2.5x magnification).

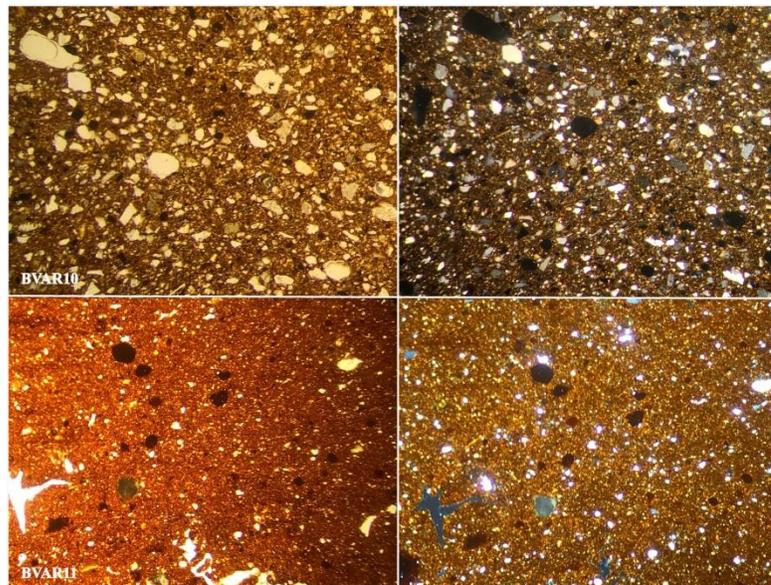


Figure C.5. Photomicrographs of BVAR10 (PPL in Upper Right, XPL in Upper left) and BVAR11 (PPL in Lower Left, XPL in Lower Right) (2.5x magnification).

	BVAR13	BVAR14
Location	Red Creek	Unnamed Drainage by CHP
Soil Suite	Creek	Unknown Micritic Clay
Soil Subsuite	Norland	Unknown Micritic Clay
Textural Characteristics		
Color (PPL)	Reddish Brown	Light Grey
Color (XPL)	Deep Reddish Brown	Light Grey
Coarse (>.125mm):Fine	40:60	20:80
Inclusion Packing	Closed to Single Spaced	Single to Open Spaced
Inclusion Sorting	Very Poorly Sorted	Moderately Sorted
Characteristics of Inclusions		
Roundness	Rounded to Subangular	Rounded to Subrounded
Size (mm) Largest of all/ range of 98%	1.15mm/.15mm-.85mm	1.7mm/.25mm-1.25mm
Mode size (mm)	.35mm (medium sand)	.8mm (coarse sand)
Inclusions (Mineralogy and Proportions)		
Crystalline Calcite	Very Rare	Rare
Sparite	None	Rare
Micrite	Very Rare (Rounded)	Dominant (All types)
Quartz	Predominant	Very Few
Chert	Very Rare	Rare
Chalcedony	Very Rare	Rare
Muscovite	Very Few	Very Rare
Biotite	Very Rare	None
Polycrystalline Quartz	Few	Rare
Quartzite	Very Rare	None
Quartz+Mica	Very Rare	None
Perthite	Very Few	Very Rare
Feldspar	Very Rare	None
Zircon	Rare	None
Shell	None	Rare
Mudstone/Siltstone	Very Rare	Rare
Schist	None	None
Volcanic Ash	None	None
Clay Related Compositional Features		
Textural Concentration Features	None	Very Rare, reddish brown, rounded, equant clay pellets (mode size: .24mm)
Amorphous Concentration Features	Common, reddish brown, rounded, equant, high optical density (mode size: .1mm); larger features have quartz inclusions	Very rare, dark reddish brown, high optical density nodule, full of quartz inclusions, rounded, elongated (.88mm)

Table C.9. Petrographic Results: Clay Samples BVAR13 and BVAR14.

	BVAR15	BVAR16
Location	Road Cut by ACT	Unnamed Drainage by CHP
Soil Suite	Melinda	Unknown Micritic Clay
Soil Subsuite	Canquin	Unknown Micritic Clay
Textural Characteristics		
Color (PPL)	Reddish Brown	Light Grey
Color (XPL)	Reddish Brown	Light Grey
Coarse (>.125mm):Fine	30:70	10:90
Inclusion Packing	Double to Open Spaced	Double to Open Spaced
Inclusion Sorting	Well Sorted	Moderately Sorted
Characteristics of Inclusions		
Roundness	Rounded to Subrounded	Rounded to Subrounded
Size (mm) Largest of all/ range of 98%	.25mm/.06mm-.15mm	1mm/.1mm-.65mm
Mode size (mm)	.1mm (very fine sand)	.35mm (medium sand)
Inclusions (Mineralogy and Proportions)		
Crystalline Calcite	Rare	Rare
Sparite	None	Very Rare
Micrite	Few	Common (All types)
Quartz	Frequent	Rare
Chert	Few	Very Rare
Chalcedony	Few	Very Rare
Muscovite	Dominant	Very Rare
Biotite	Very Few	None
Polycrystalline Quartz	Very Rare	None
Quartzite	Few	None
Quartz+Mica	Rare	None
Perthite	Very Rare	Very Rare
Feldspar	Very Rare	None
Zircon	Very Rare	Very Rare
Shell	None	Very Rare
Mudstone/Siltstone	None	None
Schist	None	None
Volcanic Ash	None	None
Clay Related Compositional Features		
Textural Concentration Features	Few, reddish brown, rounded, equant clay pellets, some with quartz inclusions (mode size: .32mm)	Common, greyish brown, rounded, equant clay pellets (mode size:.16mm)
Amorphous Concentration Features	Few, reddish brown, rounded, equant, high optical density (mode size: .1mm)	None

Table C.10. Petrographic Results: Clay Samples BVAR15 and BVAR16.

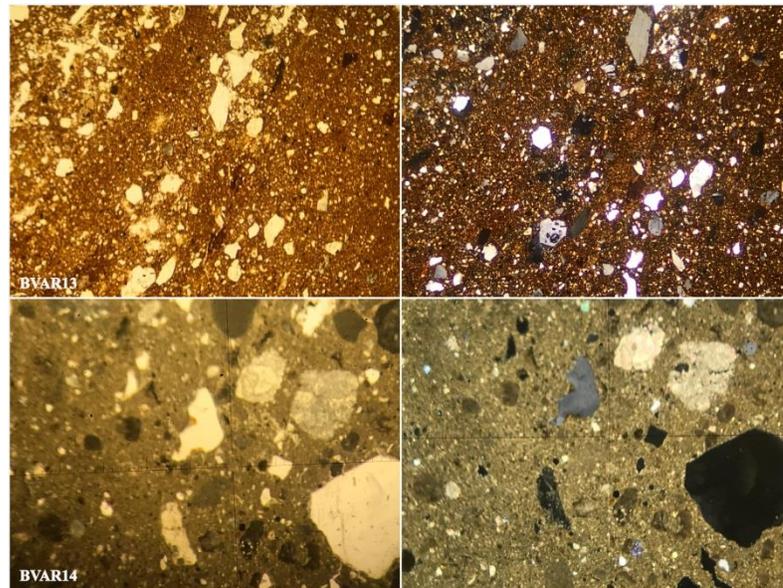


Figure C.6. Photomicrographs of BVAR13 (PPL in Upper Right, XPL in Upper left) and BVAR14 (PPL in Lower Left, XPL in Lower Right) (2.5x magnification).

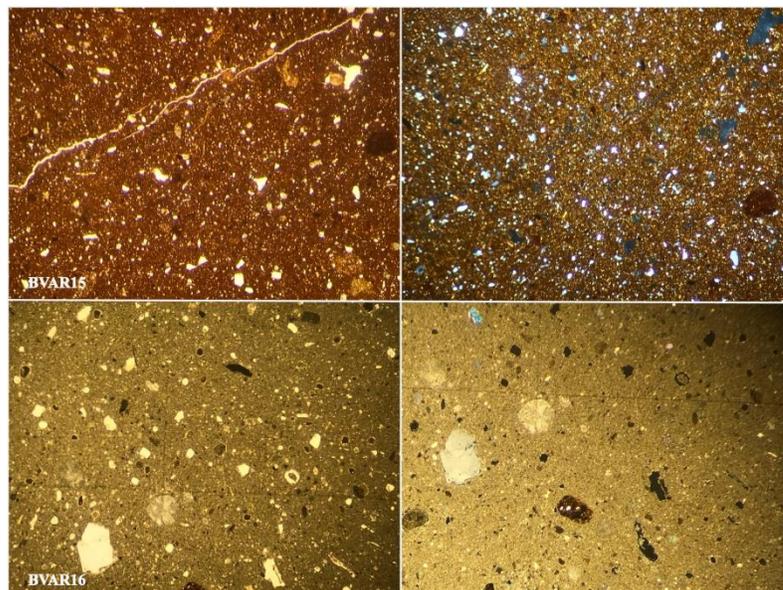


Figure C.7. Photomicrographs of BVAR15 (PPL in Upper Right, XPL in Upper left) and BVAR16 (PPL in Lower Left, XPL in Lower Right) (2.5x magnification).

	BVAR17	BVAR22
Location	Frieze Clay at XUN (Mopan)	Barton Creek
Soil Suite	Cuxu	Creek
Soil Subsuite	Unknown	Norland
Textural Characteristics		
Color (PPL)	Yellow Brown	Reddish Brown
Color (XPL)	Yellow Brown	Reddish Brown
Coarse (>.125mm):Fine	20:80	55:45
Inclusion Packing	Single to Open Spaced	Closed to Single Spaced
Inclusion Sorting	Moderately Sorted	Very Poorly Sorted
Characteristics of Inclusions		
Roundness	Rounded to Subangular	Rounded to Subangular
Size (mm) Largest of all/ range of 98%	.9mm/.1mm-.6mm	1.5mm/.15mm-.9mm
Mode size (mm)	.3mm (medium sand)	.5mm (coarse sand)
Inclusions (Mineralogy and Proportions)		
Crystalline Calcite	Very Rare	Very Rare
Sparite	None	None
Micrite	Very Rare (Rounded)	None
Quartz	Few	Predominant
Chert	Rare	Very Rare
Chalcedony	Very Rare	None
Muscovite	Rare	Few
Biotite	None	Very Few
Polycrystalline Quartz	Very Few	Rare
Quartzite	None	Few
Quartz+Mica	Very Rare	Very Few
Perthite	None	Few
Feldspar	Very Rare	Few
Zircon	Very Rare	Very Rare
Shell	None	None
Mudstone/Siltstone	None	Very Rare
Schist	None	None
Volcanic Ash	None	None
Clay Related Compositional Features		
Textural Concentration Features	None	Very Few, brown to reddish brown clay pellets, rounded, equant to irregular, some with quartz inclusions (mode size: .55mm)
Amorphous Concentration Features	Common, reddish brown, rounded, equant, high optical density (mode size: .1mm); larger features have quartz inclusions; Concentric circle features	Few, dark reddish brown, high to moderate optical density nodule, rounded, equant (.88mm)

Table C.11. Petrographic Results: Clay Samples BVAR17 and BVAR22.

	BVAR23	BVAR24
Location	BR Floodplain at LWD	BR Floodplain at BKP
Soil Suite	Melinda	Melinda
Soil Subsite	Quamina	Quamina
Textural Characteristics		
Color (PPL)	Reddish Brown	Yellow Brown
Color (XPL)	Reddish Brown	Yellow Reddish Brown
Coarse (>.125mm):Fine	20:80	15:85
Inclusion Packing	Single to Double Spaced	Single to Open Spaced
Inclusion Sorting	Moderately Well Sorted	Well Sorted
Characteristics of Inclusions		
Roundness	Rounded to Subangular	Rounded to Subangular
Size (mm) Largest of all/ range of 98%	.45mm/.05-.35mm	.45mm/.02-.22mm
Mode size (mm)	.1mm (fine sand)	.06mm (very fine sand)
Inclusions (Mineralogy and Proportions)		
Crystalline Calcite	None	Very Rare
Sparite	None	Very Rare
Micrite	None	Common
Quartz	Dominant	Dominant
Chert	Rare	Very Few
Chalcedony	Rare	Very Few
Muscovite	Common	Common
Biotite	Very Rare	Rare
Polycrystalline Quartz	Rare	Very Few
Quartzite	None	None
Quartz+Mica	Very Rare	Very Rare
Perthite	Very Rare	Very Rare
Feldspar	Very Rare	Rare
Zircon	Very Rare	Very Rare
Shell	None	Very Rare
Mudstone/Siltstone	None	Rare
Schist	None	None
Volcanic Ash	None	None
Clay Related Compositional Features		
Textural Concentration Features	None	None
Amorphous Concentration Features	Common, reddish brown, rounded, equant, moderate to high optical density (mode size: .1mm); larger features have quartz inclusions	Common, reddish brown, rounded, equant, moderate to high optical density (mode size: .1mm); larger features have quartz inclusions

Table C.12. Petrographic Results: Clay Samples BVAR23 and BVAR24.

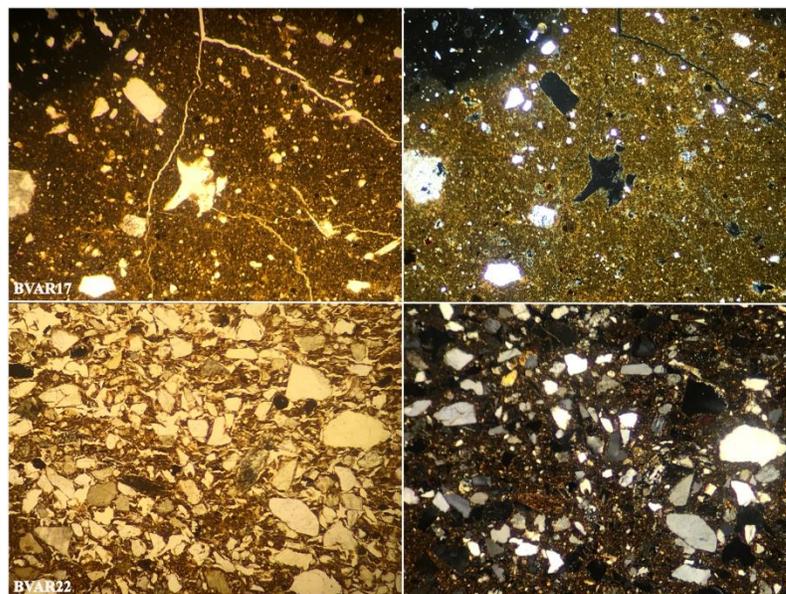


Figure C.8. Photomicrographs of BVAR17 (PPL in Upper Right, XPL in Upper left) and BVAR22 (PPL in Lower Left, XPL in Lower Right) (2.5x magnification).

	BVAR25
Location	BR Floodplain at BKP
Soil Suite	Melinda
Soil Subsuite	Quamina
Textural Characteristics	
Color (PPL)	Red
Color (XPL)	Red
Coarse fraction: fine fraction	5:95
Inclusion Packing	Double to Open Spaced
Inclusion Sorting	Very Well Sorted
Characteristics of Inclusions	
Roundness	Rounded to Subrounded
Size(mm) Largest of all/ range of 98%	.4mm/.15mm-.3mm
Mode size (mm)	.24mm (find sand)
Inclusions (Mineralogy and Proportions)	
Crystalline Calcite	None
Sparite	None
Micrite (Rounded, Irregular, and/or Bioclastic)	None
Quartz	Frequent
Chert	Rare
Chalcedony	Rare
Muscovite	Common
Biotite	None
Polycrystalline Quartz	Very Few
Quartzite	None
Quartz+Mica	Very Rare
Perthite	None
Feldspar	None
Zircon	None
Shell	None
Mudstone/Siltstone	None
Schist	None
Volcanic Ash	None
Clay Related Compositional Features	
Textural Concentration Features	None
Amorphous Concentration Features	Common, reddish brown, rounded, equant, moderate to high optical density (mode size: .1mm); larger features have quartz inclusions

Table C.13. Petrographic Results: Clay Sample BVAR25.

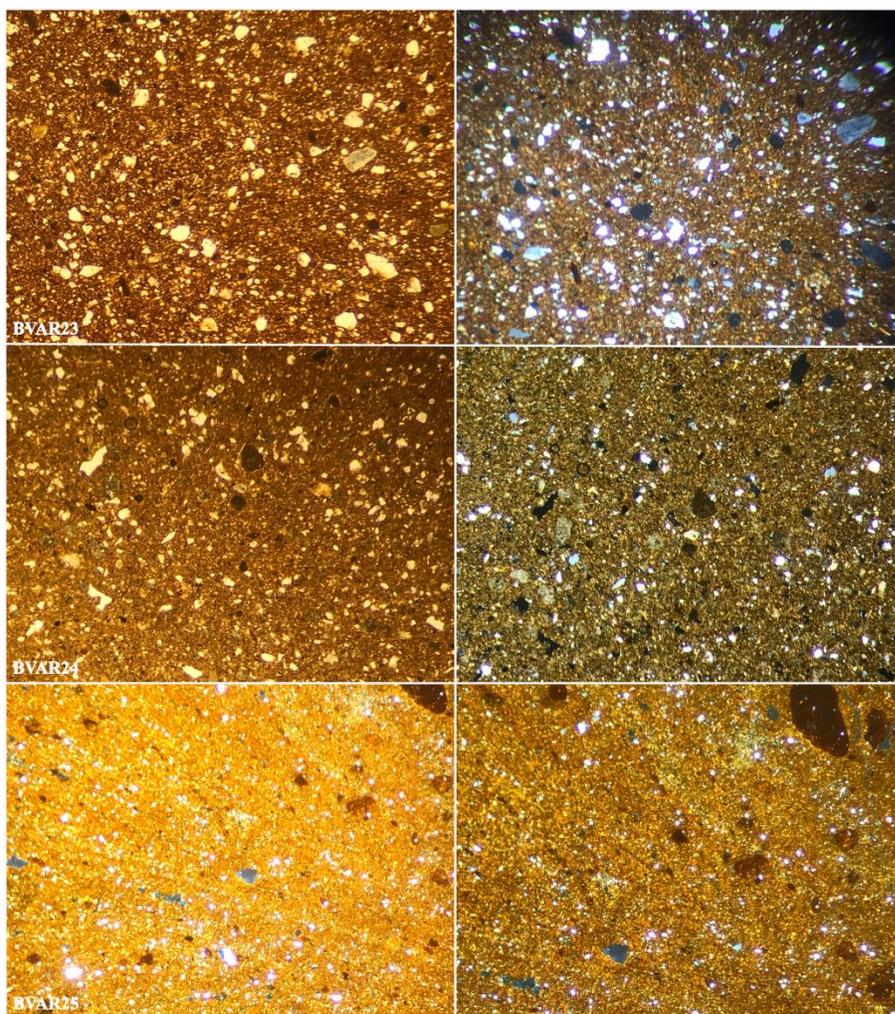


Figure C.9. Photomicrographs of BVAR23 (PPL in Upper Right, XPL in Upper left), BVAR24 (PPL in Middle Right, XPL in Middle Left) and BVAR25 (PPL in Lower Left, XPL in Lower Right) (2.5x magnification).

Belize Valley Rock Analysis

Sample Number	Rock Description
BVAR18	Fossiliferous micrite (Light Grey)
BVAR19	Fossiliferous micrite (Light Grey)
BVAR21	Packed biopelmicrite intermixed with biopelsparite (Light Grey)
EP1	Micrite in very fine calcarenite/micritic matrix
EP3	Finely crystalline sparry calcite (predominant) with coarsely crystalline sparry calcite and micrite
EP4	Medium crystalline to coarsely crystalline sparry calcite
EP5	Packed biomicrite, attached to fine to medium crystalline sparry calcite, crystalline calcite intraclasts (Dark brownish grey)

Table C.14. Rock Sample Descriptions.

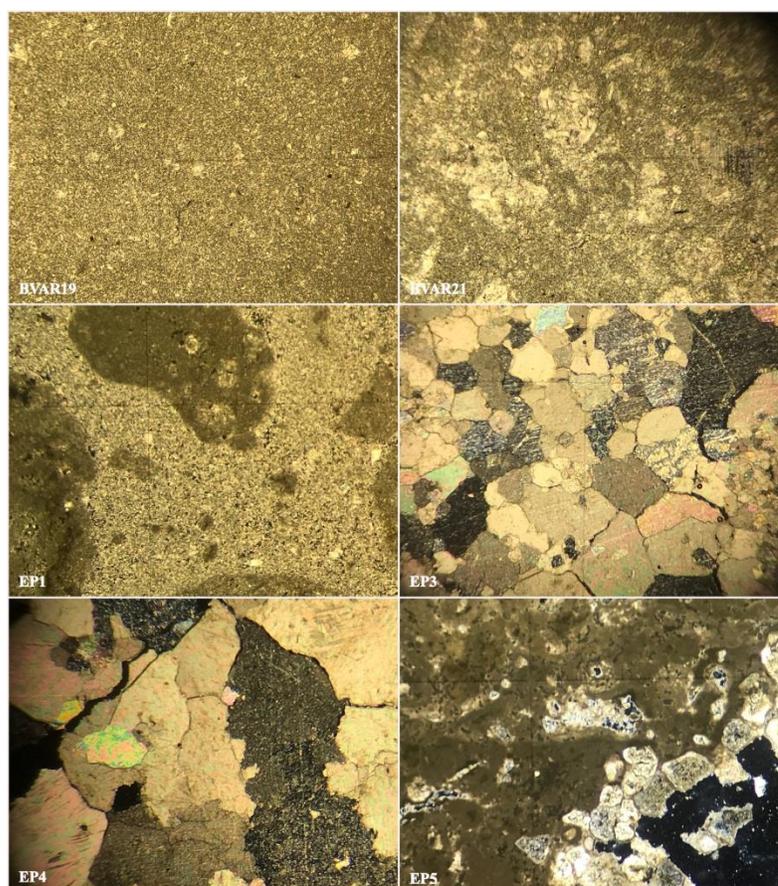


Figure C.10 Photomicrographs of Rock Samples (BVAR19, BVAR21, EP1, EP3, EP4, EP5)(2.5xmagnifaction, XPL).

Uxbenká Geology Survey

The sampling strategy from Uxbenká was smaller in scope based on studies suggesting that each polity in the region produced their own pottery with limited exchange. A total of 8 clay samples and 4 rock samples were collected from the immediate vicinity of Uxbenká. Clay samples were collected from minor drainages and on land; the major drainage in the vicinity, the Rio Blanco, is rocky and does not contain easily accessible clay on its banks. A sample of the major rock types (e.g. sandstone, siltstone, mudstone) of the Tertiary Toledo Beds was collected to assess variability. The clay sampling methodology around Uxbenká was based primarily on the distinction between *box lu'um* and *chik lu'um* and then correlated with soil classification data. *Box lu'um* corresponds to the Cimin Subsuite while *chik lu'um* corresponds to the Aguacate and Manfredi Subsuite. Geologic samples were collected from general three areas on the landscape (Figure C.10 and Table C.15). The clay samples are represented entirely *chik lu'um* sandy, red clays of the Aguacate and Manfredi soil subsuites.

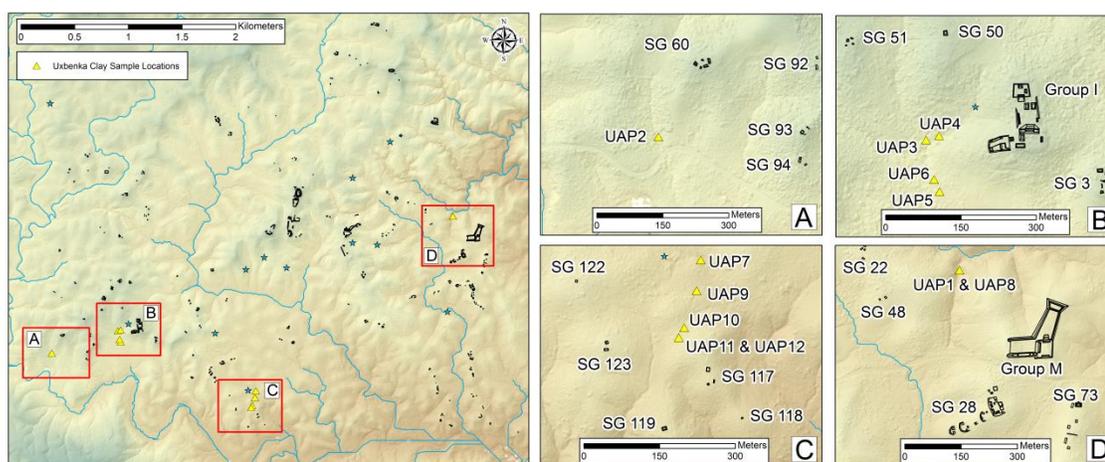


Figure C.11. Location of the Uxbenká Clay and Rock Samples. (Map by A.E. Thompson)

Uxbenká Clay Analysis

Project	Sample #	Site	Type of Sample	Environment	Drainage System	Depth	Northing	Easting
UAP	1	Uxbenka	Clay	Drainage	Unnamed	1.5m	279708	1796834
UAP	2	Uxbenka	Clay	Drainage	Unnamed	50cm	275969	1795559
UAP	3	Uxbenka	Travertine	Drainage	Unnamed	Surface	276586	1795766
UAP	4	Uxbenka	Clay	Foothills		40cm	276612	1795774
UAP	5	Uxbenka	Clay	Foothills		50cm	276613	1795663
UAP	6	Uxbenka	Clay	Foothills		50cm	276602	1795687
UAP	7	Uxbenka	Clay	Foothills		Surface	277871	1795207
UAP	8	Uxbenka	Siltstone	Drainage	Unnamed	Surface	279708	1796834
UAP	9	Uxbenka	Clay	Foothills		Surface	277863	1795146
UAP	10	Uxbenka	Clay	Foothills		Surface	277838	1795073
UAP	11	Uxbenka	Sandstone	Foothills		Surface	277827	1795053
UAP	12	Uxbenka	Mudstone (Nib)	Foothills		Surface	277827	1795053

Table C. 15. Location of Uxbenká Clay and Rock Samples.

Sample #	Munsell (Dry)	Inclusions	Days to Dry until Workable	Munsell (Wet)	Texture/Workability	Munsell (Dry after Processing)
UAP-1	10YR-3/4	Abundant pebble sized sandstone fragments	7	10YR-3/4	Slightly gritty, great workability	7.5YR-5/3
UAP-2	10YR-4/4	Abundant pebble sized sandstone fragments, abundant sand	7	10YR-5/4	Slightly gritty, good workability	10YR-6/4
UAP-4	10YR-3/2	Abundant sand, some sandstone pebbles	7	10YR-3/3	Gritty, sticky, moderate workability	10YR-5/3
UAP-5	10YR-4/4	Some roots, abundant sand, some sandstone pebbles	6	10YR-5/6	Slightly gritty, slightly sticky, great workability	10YR-6/4
UAP-6	10YR-5/4	Very small roots, abundant sand, some sandstone pebbles	7	10YR-5/4	Very gritty, moderately sticky, great workability	10YR-7/4
UAP-7	5YR-5/6	Large roots, abundant sand	6	7.5YR-5/6	Gritty, moderately sticky, good workability	7.5YR-5/6
UAP-9	5YR-5/8	Some very small roots	7	5YR-5/8	Slightly gritty, great workability	7.YR-5/6
UAP-10	5YR-4/3	Some large roots, abundant sand	7	5YR-4/6	Slightly gritty, very sticky, good workability	5YR-5/6

Table C.16. Uxbenká Macroscopic Clay Characteristics.

Sample #	Weight Before Drying (g)	Weight After Drying	Shrinkage		Condition After Drying	Weight After Firing	Shrinkage After Firing	Condition After Firing	Munsell After Firing
			Before Drying (mm)	Shrinkage After Drying					
UAP-1	Tile 1: 49.8	Tile 1: 36.2	Tile 1: 50	Tile 1: 40.94	No Change	Tile 1: 32	Tile 1: 38.55	No Change	2.5YR-5/6
	Tile 2: 52.6	Tile 2: 38.1	Tile 2: 50	Tile 2: 40.29					
UAP-2	Tile 1: 42.9	Tile 1: 33.3	Tile 1: 50	Tile 1: 44.34	Minimal Cracking	Tile 1: 29.8	Tile 1: 45.07	Minimal Crumbling	2.5YR-5/8
	Tile 2: 39.2	Tile 2: 30.6	Tile 2: 50	Tile 2: 44.38					
UAP-4	Tile 1: 51.1	Tile 1: 37.3	Tile 1: 50	Tile 1: 40.83	No Change	Tile 2: 33.7	Tile 2: 38.75	No Change	2.5YR-5/6
	Tile 2: 51.1	Tile 2: 37.3	Tile 2: 50	Tile 2: 40.23					
UAP-5	Tile 1: 49.6	Tile 1: 39.4	Tile 1: 50	Tile 1: 41.41	Some Crumbling	Tile 1: 34.9	Tile 1: 40.91	No Change	2.5YR-5/6
	Tile 2: 56.5	Tile 2: 45.4	Tile 2: 50	Tile 2: 41.96					
UAP-6	Tile 1: 56.0	Tile 1: 40.2	Tile 1: 50	Tile 1: 42.16	Some Crumbling	Tile 1: 36.2	Tile 1: 40.03	Some Crumbling	5YR-5/6
	Tile 2: 57.4	Tile 2: 41.3	Tile 2: 50	Tile 2: 42.24					
UAP-7	Tile 1: 45.5	Tile 1: 35.6	Tile 1: 50	Tile 1: 40.09	No Change	Tile 2: 32.1	Tile 2: 37.04	No Change	2.5YR-5/8
	Tile 2: 46.6	Tile 2: 36.4	Tile 2: 50	Tile 2: 38.56					
UAP-9	Tile 1: 56.2	Tile 1: 40.7	Tile 1: 50	Tile 1: 40.86	No Change	Tile 1: 36.7	Tile 1: 39.03	No Change	2.5YR-5/6
	Tile 2: 61.6	Tile 2: 44.0	Tile 2: 50	Tile 2: 44.47					
UAP-10	Tile 1: 63.4	Tile 1: 42.0	Tile 1: 50	Tile 1: 36.47	Some Crumbling	Tile 1: 37.5	Tile 1: 37.33	No Change	2.5YR-5/8
	Tile 2: 52.9	Tile 2: 35.0	Tile 2: 50	Tile 2: 37.78					

Table C.17. Uxbenká Clay Shrinkage Study Data.

Sample #	Weight Shrinkage after Drying (%)	Linear Shrinkage after Drying (%)	Weight Shrinkage after Firing (%)
UAP-1-1	27.31	18.12	11.6
UAP-1-2	27.57	19.42	
UAP-2-1	22.38	11.32	10.5
UAP-2-2	22.7	11.24	
UAP-4-1	27	18.34	
UAP-4-2	27	19.54	9.7
UAP-5-1	20.56	17.18	11.4
UAP-5-2	19.65	16.08	
UAP-6-1	28.21	15.68	10
UAP-6-2	28.05	15.52	
UAP-7-1	21.76	19.82	
UAP-7-2	21.89	22.88	11.8
UAP-9-1	27.58	18.28	9.8
UAP-9-2	28.57	11.06	
UAP-10-1	33.76	27.06	10.7
UAP-10-2	33.84	24.44	
MIN	19.65	11.06	9.7
MAX	33.84	27.06	11.8
MEAN	26.114375	17.87375	10.6875

Table C.18. Uxbenká Clay Shrinkage Study Results.

	UAP 1	UAP 2
Location		
Soil Suite	Toledo	Toledo
Soil Subsuite	Aguacate	Aguacate
	Chik lu'um	Chik lu'um
Textural Characteristics		
Color (PPL)	Golden Reddish Brown	Golden Reddish Brown
Color (XPL)	Dark Golden Red	Dark Golden Red
Coarse (>.125mm):Fine	20:80	40:60
Inclusion Packing	Single to Open Spaced	Single to Open Spaced
Inclusion Sorting	Moderately Sorted	Moderately Sorted
Characteristics of Inclusions		
Roundness	Rounded to Subangular	Rounded to Subangular
Size (mm) Largest of all/ range of 98%	.75mm (IRF)/.04mm to .45mm	1.5mm (mudstone)/.04mm to 1mm
Mode size (mm)	.2mm (fine sand)	.8mm (coarse sand)
Inclusions (Mineralogy and Proportions)		
Quartz	Dominant	Common
Quartzite	Very Few	Very Few
Polycrystalline Quartz	Few	Few
Chert	Very Few	Very Rare
Chalcedony	Rare	Very Rare
Plagioclase	Few	Few
Muscovite	Common	Common
Biotite	Few	Few
Sandstone	Few	Few
Mudstone	Few	Dominant
Igneous Rock Fragments (IRF)	Common	Few
Zircon	Absent	Very Rare
Clay Related Compositional Features		
Textural Concentration Features	Dominant iron rich clay pellets, reddish brown, rounded, equant to elongated to irregular, moderate optical density (mode size: .45mm); contain quartz, plagioclase, and muscovite inclusions	Very few iron rich segregations/impregnations, reddish brown, rounded, equant, moderate optical density (mode size: .15mm); contain quartz, plagioclase, and muscovite
Amorphous Concentration Features	Very few, black nodules, rounded, equant, high optical density (mode size: .2mm)	Very few, red and black nodules, rounded, equant, high optical density (mode size: .2mm); clay hypocoatings on voids and inclusions

Table C.19. Petrographic Results: Clay Samples UAP1 and UAP2.

	UAP 4	UAP 5
Location		
Soil Suite	Toledo	Toledo
Soil Subsuite	Aguacate	Aguacate
	Chik lu'um	Chik lu'um
Textural Characteristics		
Color (PPL)	Golden Reddish Brown	Brown
Color (XPL)	Dark Golden Red	Golden Brown
Coarse (>.125mm):Fine	40:60	30:70
Inclusion Packing	Closed to Open Spaced	Single to Open Spaced
Inclusion Sorting	Moderately Well Sorted	Moderately sorted
Characteristics of Inclusions		
Roundness	Rounded to Subangular	Rounded to Subrounded
Size (mm) Largest of all/ range of 98%	.9mm (quartz)/.04mm to .5mm	.75mm (mudstone)/.04mm to .5mm
Mode size (mm)	.3mm (medium sand)	.25mm (medium sand)
Inclusions (Mineralogy and Proportions)		
Quartz	Dominant	Predominant
Quartzite	Very Few	Very Few
Polycrystalline Quartz	Few	Few
Chert	Few	Very Few
Chalcedony	Rare	Very Few
Plagioclase	Few	Very Few
Muscovite	Few	Very Few
Biotite	Absent	Absent
Sandstone	Few	Very Few
Mudstone	Few	Very Few
Igneous Rock Fragments (IRF)	Few	Absent
Zircon	Very Rare	Absent
Clay Related Compositional Features		
Textural Concentration Features	Rare iron rich clay pellets, reddish brown, rounded, equant, moderate optical density (mode size: .15mm); contain quartz, plagioclase, and muscovite	Very few iron rich clay pellets, reddish brown, rounded, equant to elongated to irregular, moderate optical density (mode size: .45mm); contain quartz, plagioclase, and muscovite inclusions
Amorphous Concentration Features	Very few, dark red nodules, rounded, equant, high optical density (mode size: .2mm); clay hypocoatings on voids and inclusions	Common, reddish brown nodules, rounded, equant to elongated to irregular, high optical density (mode size: .2mm); clay hypocoatings on voids and inclusions

Table C.20. Petrographic Results: Clay Samples UAP4 and UAP5.

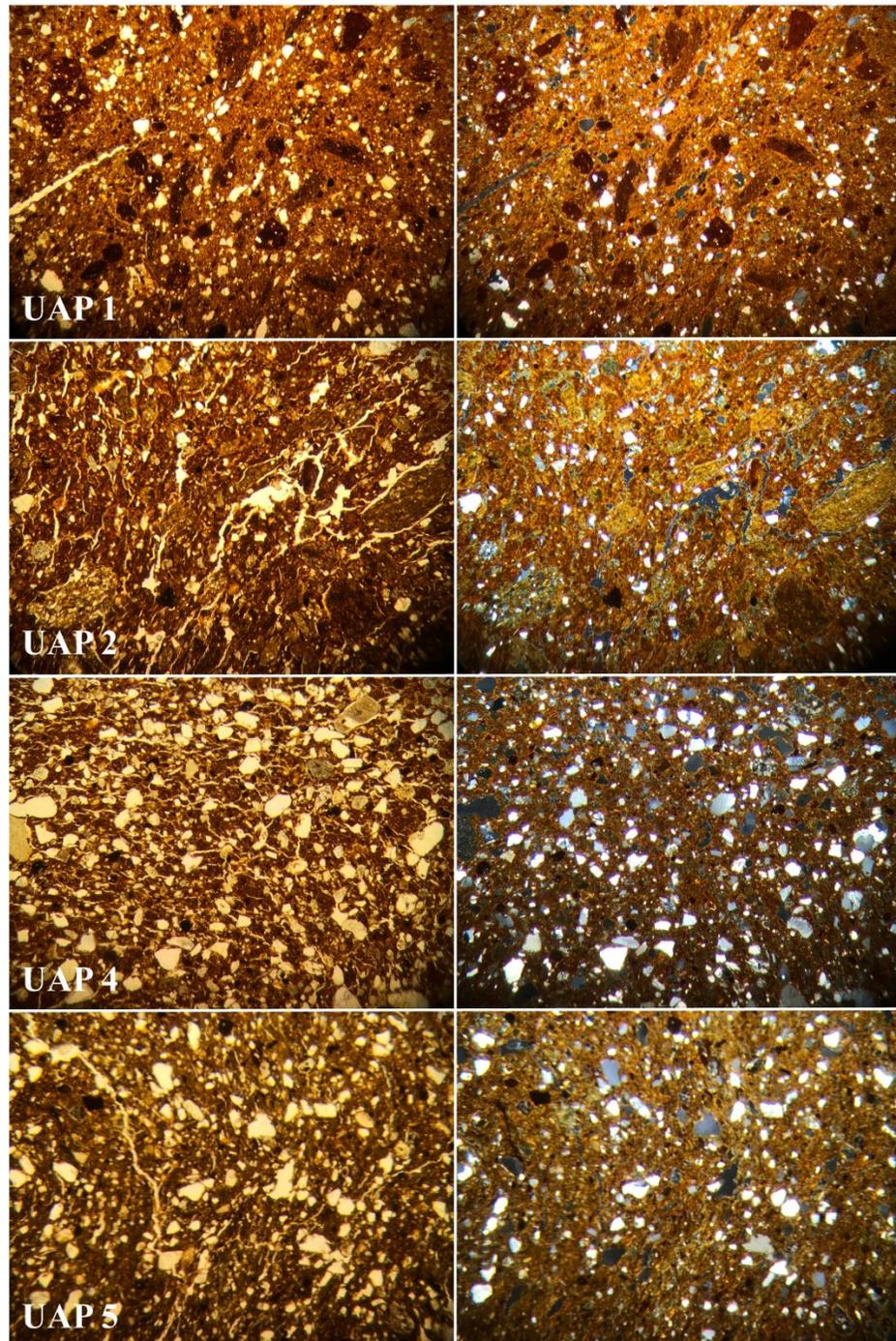


Figure C.12. Photomicrographs of UAP1 (PPL in Upper Right, XPL in Upper left); UAP2 (PPL in Upper Middle Left, XPL in Upper Middle Right); UAP 4 (PPL in Lower Middle Left, XPL in Lower Middle Left); UAP 5 (PPL in Lower Left, XPL in Lower Right) (2.5x magnification).

	UAP 6	UAP 7
Location		
Soil Suite	Toledo	Toledo
Soil Subsuite	Aguacate	Aguacate
	Chik lu'um	Chik lu'um
Textural Characteristics		
Color (PPL)	Brown	Golden Reddish Brown
Color (XPL)	Golden Brown	Dark Golden Red
Coarse (>.125mm):Fine	40:60	20:80
Inclusion Packing	Closed Spaced to Double Spaced	Single to Open Spaced
Inclusion Sorting	Poorly Sorted	Moderately Well Sorted
Characteristics of Inclusions		
Roundness	Rounded to Subrounded	Rounded to Subangular
Size (mm) Largest of all/range of 98%	2mm (quartzite)/.04mm to 1.2mm	.5mm (quartz)/.04mm to .4mm
Mode size (mm)	.3mm (medium sand) and .8mm (coarse sand)	.3mm (medium sand)
Inclusions (Mineralogy and Proportions)		
Quartz	Common	Dominant
Quartzite	Common	Very Few
Polycrystalline Quartz	Common	Few
Chert	Few	Few
Chalcedony	Very Few	Absent
Plagioclase	Few	Few
Muscovite	Few	Few
Biotite	Few	Few
Sandstone	Common	Very Few
Mudstone	Common	Very Few
Igneous Rock Fragments (IRF)	Common	Very Few
Zircon	Very Rare	Absent
Clay Related Compositional Features		
Textural Concentration Features		Very few rich clay pellets, reddish brown, rounded, equant to elongated to irregular, moderate optical density (mode size: .45mm); contain quartz, plagioclase, and muscovite inclusions
Amorphous Concentration Features	Common iron rich clay pellets, reddish brown, rounded, equant to elongated to irregular, moderate to high optical density (mode size: .5mm); contain quartz, plagioclase, muscovite, and lithic inclusions; clay hypocoatings on voids and inclusions	Common, red to reddish brown, rounded, equant, moderate to high optical density (mode size: .2mm); clay hypocoatings on voids and inclusions

Table C. 21. Petrographic Results: Clay Samples UAP6 and UAP7.

	UAP 9	UAP 10
Location		
Soil Suite	Toledo	Toledo
Soil Subsuite	Aguacate	Aguacate
	Chik lu'um	Chik lu'um
Textural Characteristics		
Color (PPL)	Golden Reddish Brown	Golden Reddish Brown
Color (XPL)	Dark Golden Red	Dark Golden Red
Coarse (>.125mm):Fine	30:70	20:80
Inclusion Packing	Closed Spaced to Double Spaced	Single to Open Spaced
Inclusion Sorting	Well Sorted	Moderately Well Sorted
Characteristics of Inclusions		
Roundness	Rounded to Subrounded	Rounded to Subangular
Size (mm) Largest of all/ range of 98%	.5mm (quartz)/.04mm to .3mm	.5mm (quartz)/.04mm to .4mm
Mode size (mm)	.2mm (fine sand)	.3mm (medium sand)
Inclusions (Mineralogy and Proportions)		
Quartz	Common	Dominant
Quartzite	Few	Very Few
Polycrystalline Quartz	Few	Few
Chert	Very Few	Few
Chalcedony	Very Few	Absent
Plagioclase	Few	Few
Muscovite	Dominant	Few
Biotite	Common	Few
Sandstone	Few	Very Few
Mudstone	Few	Very Few
Igneous Rock Fragments (IRF)	Few	Very Few
Zircon	Very Rare	Absent
Clay Related Compositional Features		
Textural Concentration Features		Very few rich clay pellets, reddish brown, rounded, equant to elongated to irregular, moderate optical density (mode size: .45mm); contain quartz, plagioclase, and muscovite inclusions
Amorphous Concentration Features	Common, red to reddish brown, rounded, equant, moderate to high optical density (mode size: .2mm); clay hypocoatings on voids and inclusions	Frequent, red to reddish brown, rounded, equant, moderate to high optical density (mode size: .2mm); clay hypocoatings on voids and inclusions

Table C.22. Petrographic Results: Clay Samples UAP9and UAP10.

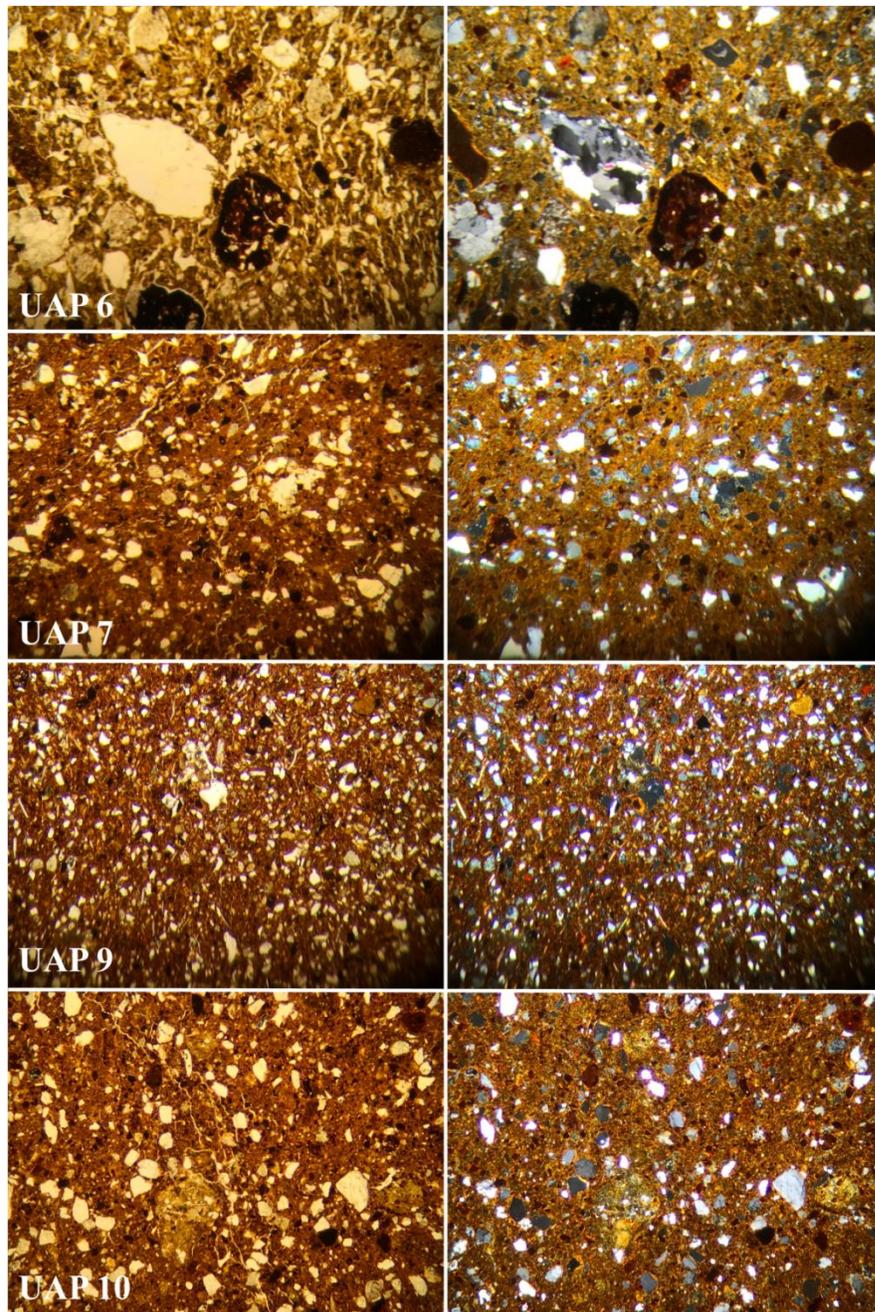


Figure C.13. Photomicrographs of UAP6 (PPL in Upper Right, XPL in Upper left); UAP7 (PPL in Upper Middle Left, XPL in Upper Middle Right); UAP 9 (PPL in Lower Middle. Left, XPL in Lower Middle Left); UAP 10 (PPL in Lower Left, XPL in Lower Right) (2.5x magnification).

Uxbenká Rock Analysis

Sample Number	Rock Description
UAP 3	Travertine
UAP 8	Laminated calcareous sandstone, siltstone, and mudstone
UAP 11	Fine grained calcareous sandstone
UAP 12	Calcareous sandstone

Table C.23. Uxbenká Rock Descriptions

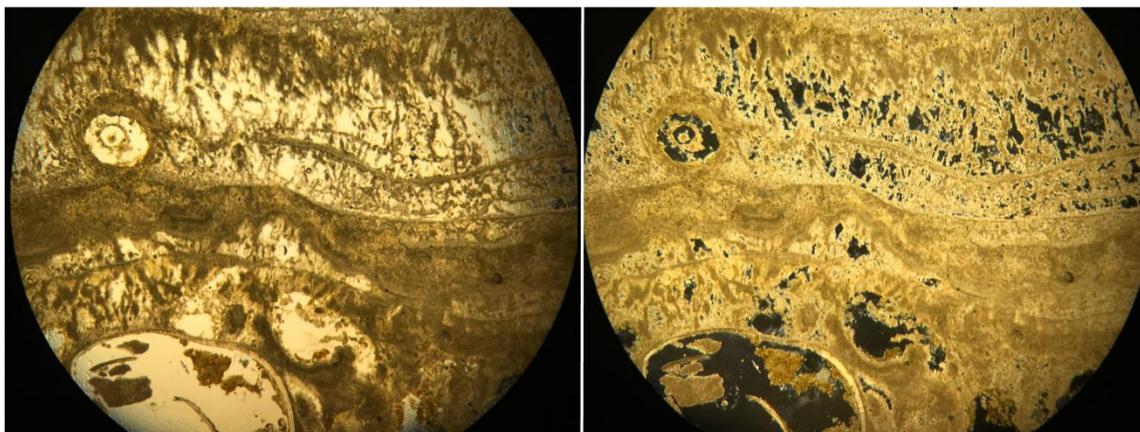


Figure C.14. Travertine, UAP 13 (PPL on the left, XPL on the right).

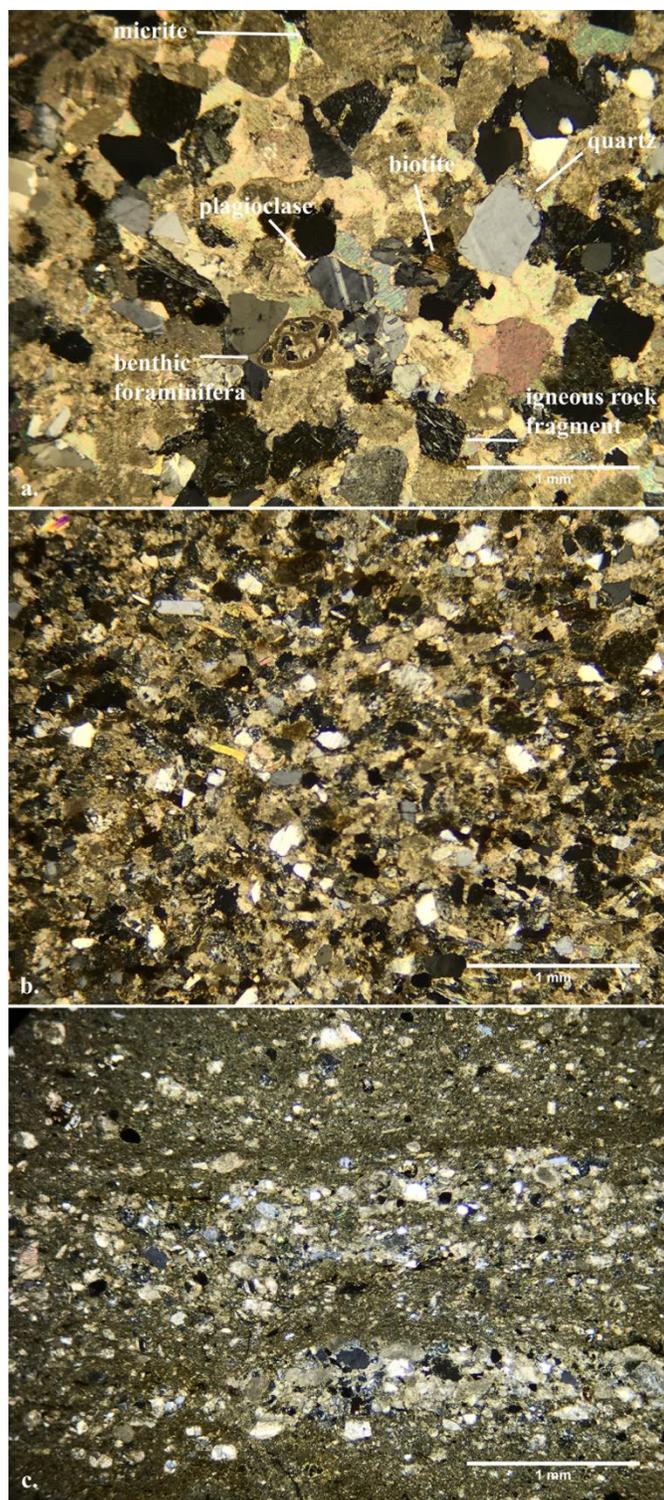


Figure C.15. Local Rock Samples Micrographs: a. Calcareous Sandstone (UAP12, XPL); b. Fine-grained calcareous sandstone (UAP11, XPL); c. Laminated calcareous sandstone, siltstone, and mudstone (UAP8, XPL)

APPENDIX D

BAKING POT FABRIC DESCRIPTIONS

Fabric descriptions follow the standards described by Whitbread (1995, 2017); see Howie (2012) and Sanchez Fourtoul (2018) for the use of the descriptive system in the Maya Lowlands. All measurements were taken on the long diameter of the inclusion. The names used in this study (e.g. sparry calcite and micrite) are those commonly used in petrographic descriptions of ceramics in the Maya lowlands. However, these general descriptions can have a variety of meanings in geologic studies and do not provide adequate information on the type and energy of depositional environment. Because limestone descriptions in the Belize Valley do not generally contain petrographic information (Flores 1952; King et al. 2004), understanding the depositional environment helpful when assessing provenance in order to relate ceramic thin sections to the geologic literature. The terms used in this study are defined here using both the Folk (1959) and Dunham (1962) classification systems for clarity. Measurements of grain size (e.g. finely crystalline versus coarsely crystalline) are based on Folk (1959:164). The Dunham classification is more appropriate for more specific discussions of provenance because “the terms reflect environmental ‘energy’ and thus convey genetic information’ (Scholle and Ulmer-Scholle 2003:286). For example, micrite is a carbonate mudstone in the Dunham classification and is described as a mud-supported rock with less than 10% grains that was likely formed in a low energy environment. However, the term micrite (a Folk classification term) is used in this dissertation because it is more often used in ceramic petrography studies. The Dunham classification system is used widely by

petroleum geologists who are responsible for most of the carbonate classifications used in Belize today. The following characterizations explain what is meant by each term, the likely depositional environment, and possible limestone source(s) in the Belize Valley based on available descriptions.

Monocrystalline Calcite: Monocrystalline calcite refers to calcite grains without an internal mosaic structure. In many cases the crystalline calcite is rhombic. In some cases the crystalline limestone is angular suggesting it was broken up and added as temper. In other cases, it is subrounded to subangular and was likely part of the natural clay.

Sparry Calcite: The general term sparry calcite (or sparite) refers to “a mosaic of calcite crystals, formed either as cement or by neomorphic processes, sufficiently coarsely crystalline to appear fairly transparent in thin section, as contrasted to dark, cloudy appearing carbonate mud or micrite. Commonly simply termed ‘spar’” (Scholle and Ulmer-Scholle 2003:458). The sparry calcite in this study is composed of older carbonate rocks allochems (as opposed to ooids or peloids) and generally does not contain any carbonate mud between the grains. The size of the grains (finely, medium, or coarsely crystalline) is based on Folk and is noted in each description. The sparry calcite in this study is grain supported unless otherwise noted (e.g. in a micrite matrix). Grain supported sparry calcite is formed in high energy depositional environments and is equivalent to a siliciclastic rock with no silt or clay matrix. Mud supported sparry calcite is formed in a lower energy environment. However, grain supported sparry calcite can also be part of a rock “that has undergone substantial post-depositional compaction that was originally mud- or grain-supported” (Scholle and Ulmer-Scholle 2003: 287). The

most likely source is the San Lorenzo formation of the Orange Walk group described as calcareous sandstones deposited as part of a sandy beach environment. Other potential sources are other Orange Walk formations, the Red Bank group, and the Iguana Creek formation (talus and beach facies); less likely sources are the Doubloon Bank (warm normal marine) and El Cayo Groups (shallow lagoon, backreef). In many cases, sparry calcite is present as part of the same rock as micrite suggesting a lower energy depositional environment. In these cases, the possible sources are the same as those listed above.

Terminal Grade Calcite: Terminal grade calcite refers to the crystals that compose sparry calcite that have broken off of the original rock fragment. They range in size from finely to coarsely crystalline. It is likely that terminal grades present in ceramic fragments were broken off the original grains during the processing of temper material though they may also occur naturally in the clay. The depositional environment and possible provenance are the same as sparry calcite.

Micrite: The term micrite refers to “carbonate mud” comprised of calcite grains that are less than 62 μ m or too small to see individual grains. Folk (1959) refers to this material as microspar and it is often referred to as marl or *sascab* (the traditional Maya term) (Howie 2005:135) in geology and archaeology reports in the Maya lowlands. Much of the micrite in Belize Valley pottery is bioclastic. Micrite is deposited in a low energy depositional environment. Likely sources for micrite are abundant and include lagoonal and back-reef deposits of the Orange Walk group (e.g. the Orange Walk coquina limestones or Louisville marls), El Cayo Group, and less likely the Barton Creek group.

Dolomite: Thin sections in this study were not stained with Alizarin Red to identify dolomite. As a result, this inclusion type is likely underrepresented in this study. When crystals contain internal, concentric rhombic ghosts dolomite is considered. Also, rhombs with dark centers and clear rims are noted as possible coarsely crystalline, subhedral, zoned, replacement dolomite (Scholle and Ulmer-Scholle 2003:378). Dolomite is present in the Tertiary Iguana Creek Formation and El Cayo Group and all of the Cretaceous formations (Barton Creek, Yalbac and Hill Bank).

CALCITE A

Samples: 7, 14, 16, 18, 21, 22, 27, 29, 32, 38, 51, 84, 86, 88, 167, 176, 205, 209, 210
(n=19)

I. Microstructure

- (a) ***Voids:*** Few to common voids, predominantly mesochannels with few microchannels and few to very few mesovughs. All samples except 84, 86, 176, 7, and 209 contain carbonate shaped voids. In most cases the voids are located along the exterior margin of the samples. The void margins range in thickness from 0.24mm (sample 51) to 7.2mm (sample 22). Sample 16 does not contain any carbonate inclusions. All of the voids maintain the shape of the carbonate inclusions. Samples 7 and 209 show evidence of degraded carbonate on the exterior margins.
- (b) ***c/f related distribution:*** Closed-spaced to single-spaced, porphyric related distribution.
- (c) ***Preferred orientation:*** Voids are parallel to vessel margins, including at the lip where the voids become perpendicular to the body (all samples). Inclusions are weakly developed parallel to vessel margins (all samples).

II. Groundmass

- (a) ***Homogeneity:*** There is variation across the group with respect to: the orientation of voids and inclusions, the presence of carbonate shaped voids, the abundance of larger limestone temper, the composition of limestone temper, and the presence of concentric nodule amorphous concentration features. Within an individual fabric, voids evenly distributed and inclusions are unevenly distributed with the occasional larger quartz, chert, or chalcedony inclusion. The color varies on most samples due to the presence of a dark core.
- (b) ***Micromass:*** Slightly optically active. The b-fabric is random striated. The color in PPL is a very dark brown with a slightly lighter brown margin. The color in XPL is a dark gray brown with a slightly more golden yellow brown margin (x40). All of the samples display different colors between the core and margins. The thickness varies from very thick (12mm) to thin (3mm). The core is a dark brown with medium brown margins in PPL and a very dark grey brown with dark yellow grey margins (x40). The difference in color between the core and margin is not abrupt; rather the color gradually grades from dark in the center to a lighter color near the vessel walls. Sample 209 does not have a dark core.
- (c) ***Inclusions:*** The size distribution is bimodal with an upper size class (>0.1mm) composed primarily of calcite terminal grades with few to very few sparry calcite and monocrystalline quartz; very few to rare crystalline calcite, micrite, dolomite, polycrystalline quartz, chert, and chalcedony. Very Rare limestones composed of calcite+monocrystalline quartz, calcite+chalcedony, and sparry calcite in a micrite matrix. Feldspar is also very rare in the coarse fraction. The lower size class (<0.1mm) is composed of calcite, monocrystalline quartz, micrite, chert, polycrystalline quartz, feldspar and zircon. The dominant terminal grade calcite in the coarse fraction and the dominant crystalline calcite in the fine fraction contribute to this fabric groups very packed appearance. The largest inclusion is 2.56mm (rhombic

crystalline calcite) and 98% of the inclusions range in size from 0.1mm (very fine sand) to 1.5mm (coarse sand) with a mode size of .3mm (medium sand). Calcite terminal grades and sparry calcite are subrounded to subangular because they break apart at the boundaries of discrete grains that comprise the sparry calcite. Crystalline calcite is generally rhombic, subrounded to angular. Micrite is both rounded and irregular and bioclastic. Occasionally micrite is attached to sparry calcite. Quartz is angular to rounded. The angular quartz may be the result of crushing limestone with quartz inclusions for use as temper. All other inclusions (monocrystalline and polycrystalline quartz, chert, chalcedony, feldspar, rock fragments) are subrounded to subangular, equant to elongated. Sorting is poor across all samples.

c:f:v 10 μ = 80:10:10 to 85:10:5

c:f:v 100 μ = 70:20:10 to 75:20:5

Coarse Inclusions (>0.1mm)

Dominant

Terminal Grade Calcite: Subrounded to subangular, predominantly equant to irregular, with a few elongated grains, they range in size from 0.1mm (very fine sand) to 0.95mm (very coarse sand) with a mode size of 0.25mm (medium sand).

Few to Very Few

Sparry Calcite (Fine to very coarsely crystalline mosaics, predominantly medium to very coarsely crystalline): Subrounded to subangular, equant to elongated to irregular. They range in size from 0.3mm (medium sand) to 2mm (granule) with a mode size of 0.75mm (coarse sand). Sparry calcite is rare in 21, 27 and 32.

Monocrystalline quartz (undulose): Rounded to angular, equant to elongated to irregular grains. They range in size from 0.1mm (very fine sand) to 2.4mm (granule) with a mode size of 0.4mm (medium sand). The largest particles size is rare but occurs across the sample (e.g. 14, 51). The quartz grains are frequently brown in PPL suggesting that they formed within the pore space of limestone. They also frequently have an iron oxide coating, or are infilled along fissures with iron oxide.

Very Few to Rare

Crystalline Calcite: Subangular to angular, equant to elongated, most have the typical crystalline calcite rhombic shape. They range in size from 0.3mm (medium sand) to 2.56 mm (granule) with a mode size of 0.75mm (coarse sand). In some cases the rhombic calcite is attached to sparry crystalline calcite indicating that these were part of the same limestone formation.

Micrite: Rounded to subangular, equant to elongated to irregular grains. They range in size from 0.1mm (very fine sand) to 0.4mm (medium sand) with a mode size of 0.25mm (medium sand). The samples also contain bioclastic micrite that is subrounded, irregular, they range in size from 0.4mm (medium sand) to

1.25mm (very coarse sand) with a mode size of 0.7mm (coarse sand). Some of the micrite lumps are attached to sparry calcite (samples 18, 21, 32, 38, and 176) with the same morphology as those described above indicating that the crystalline and micritic limestones are from the same formation.

Dolomite: Only present in Samples 14, 38, 167, 176, and 209. Subangular to angular, equant (rhombic) to irregular, they range in size from 0.25mm (medium sand) to 0.75mm (coarse sand) with a mode size of 0.3mm (medium sand). The dolomite is zoned with a darkened, inclusion rich core and clear rim.

Polycrystalline Quartz: Rounded to subangular, equant to elongated, they range in size from 0.3mm (medium sand) to 0.85mm (coarse sand) with a mode size of 0.35mm (medium sand). Polycrystalline quartz frequently has iron oxide between the quartz grains. One example (14) has a very high relief, high birefringent mineral within the quartz (possibly a zircon inclusion).

Chert (Secondary): Rounded, elongated, they range in size from 0.35mm (medium sand) to 1.15mm (coarse sand) with a mode size of 0.4mm (medium sand). All chert in this group is a light brown in PPL suggesting that the chert was precipitated out of the limestone rather than formed in a vein (i.e. bedded chert). They occasionally have an iron oxide coating, or are infilled along fissures with iron oxide.

Chalcedony (Secondary): Rounded, equant, they range in size from 0.15mm (fine sand) to 0.4mm (medium sand) with a mode size of 0.35mm (medium sand). All chalcedony in this group is a light brown in PPL suggesting that the chert was precipitated out of the limestone rather than formed in a vein (i.e. bedded chert). They occasionally have an iron oxide coating, or are infilled along fissures with iron oxide.

Very Rare

Sparry Calcite in Micrite Matrix Limestone: Only present in Samples 38, 167, 209. Subrounded to subangular, equant to elongated, they range in size from 0.25mm to 1.15 mm with a mode size of .35mm.

Quartz + Calcite Rock Fragment: Only present in sample 14. Angular, irregular, 0.5mm (coarse sand).

Quartz + Chalcedony Rock Fragment: Only present in sample 51 and 209. Subrounded, irregular, 1.15mm (very coarse sand)

Feldspar: Rounded to subrounded, equant, 0.1 mm (very fine sand) to 0.15mm (fine sand) with a mode size of 0.1mm (very fine sand) (14, 18, 21, 22, 27, 176).

Fine Inclusions (<0.1mm)

Common: Crystalline calcite (rounded to angular)

Few to Very Few: Monocrystalline quartz (rounded to angular)

Very Few to Very Rare: Polycrystalline quartz, chert, micrite, zircon, feldspar (rounded to subrounded)

III. Textural Concentration Features

Rare to very are textural concentration features. These features may be clay pellets with a granular microstructure. They are dark brown in PPL and brown to golden brown in XPL and have a medium to high optical density. They have silt to very fine sand sized quartz inclusions that are discordant with the orientation of features in the surrounding fabric. They also contain dark red to brown amorphous concentration features within them. In some pellets, the red to brown concentration features occupy over 90% of the textural concentration feature. They are rounded to equant to irregular. The boundaries are sharp to diffuse and most have a complete to partial channel void surrounding them. They range in size from fine sand to very coarse sand with a mode size of coarse sand.

Very rare depletion features (present only in Sample 22). The feature is similar to the textural concentration features described above except that they are grey in XPL. The feature is moderately impregnated, rounded, equant, and 2mm (granule).

IV. Amorphous Concentration Features

Few black to reddish brown amorphous concentration features with a high optical density. The black concentration features are more common in the core while the reddish brown features are more common in the margins. This color variation suggests that these are Fe-rich features and the color may be dictated by firing atmosphere (i.e. black is reducing, reddish-brown is oxidizing). They are predominantly rounded and equant to elongated though some are irregularly shaped. They have sharp to merging boundaries with rare channel voids around them. They range in size from .02mm (silt) to 0.6mm (coarse sand) with a mode size of 0.45mm (medium sand) (All Samples).

Very Few larger (0.3mm to 0.5mm), rounded, equant, black amorphous concentration features with silt sized inclusions that are discordant with the orientation of features in the surrounding fabric. These features have sharp boundaries and are partially to completely surrounded by channel voids (21, 22, 27, 38, 83).

Samples 7, 8, 29, 84, 167, 176, and 210 have amorphous concentration features characterized by concentric layers. This features are rounded, equant, dark brown to black, with a high optical density. Boundaries are sharp to merging and it is partially surrounded by a channel void. They are coarse sand sized and occasionally contain silt sized quartz inclusions that are discordant with the orientation of features in the surrounding fabric.

Calcite A: Subgroup 1
Abundant, Large Quartz Inclusions Variant

Samples: 184

Calcite A, Subgroup 1 is the same as Calcite A in all respects except for the few, large (largest is 1.5mm; very coarse sand) monocrystalline and polycrystalline quartz inclusions and a sandstone fragments. They are rounded to angular, equant to elongated to irregular. Given their size and uneven distribution, the quartz appears to have been added as temper along with the carbonate inclusions added as temper discussed as part of Calcite A.

Calcite A, Subgroup 2
Sandy, Sparse Temper Variant

Samples: 8

Calcite A, Subgroup 2 is the same as Calcite A in all respects except that this subgroup is sparsely tempered and includes a carbonate sand component. The c/f related distribution this subgroup is single-spaced to open-spaced. The carbonate sand is rounded, equant, and ranges in size from 0.15mm (fine sand) to 0.3mm (medium sand).

COMMENTS

Paste Technology

Calcite A can be characterized as a poorly sorted, calcareous clay containing primarily calcite with smaller quantities of micrite, monocrystalline quartz, polycrystalline quartz, chert, chalcedony, feldspar, and zircon that is tempered with limestone. The micromass is a dark, dense brown in PPL and a dark, grey brown in XPL. The limestone rock temper occurs as large fragments composed primarily of sparry calcite with smaller quantities of different types of limestone including dolomitic limestone and sparry calcite with a micritic component as well as limestone with chert and chalcedony inclusions. Crystalline calcite is also present as temper. The bimodal and uneven distribution of these aplastics, in conjunction with their angularity, indicates that they were added as tempering material. Terminal grade calcite that comprises the majority of the coarse fraction in Calcite A has a similar crystal morphology to the discrete grains that comprise the finely to coarsely crystalline, sparry calcite limestone. These terminal grades are likely the result of processing the limestone, perhaps by crushing, for temper. The general lack of micrite in the fine fraction suggests that the micrite was processed as part of the limestone and added as temper, rather than being an abundant component in the natural clay. The larger quartz, chert, and chalcedony inclusions may have been added as part of the limestone temper though the smaller inclusions are almost certainly part of the natural clay. The quartz, chert, and chalcedony are most often brown in PPL suggesting that they formed in the pore space in the limestone. Other minerals in the fine fraction (e.g. feldspar, polycrystalline quartz) are also small and rounded indicating they were also part

of the natural clay. Quartz, polycrystalline quartz, and feldspars frequently have iron oxide coatings and iron oxide infilling fissures in monocrystalline quartz, between quartz grains in polycrystalline quartz, and along cleavage planes in feldspar.

Provenance

The inclusions in Calcite A are consistent with the geology of the Belize River Valley. Sparry calcite mosaics are present in all of the samples suggesting that this was the preferred tempering material though the limestones are variable across the group indicative of different, but still local, provenance. The abundance of small, rounded crystalline calcite in the fine fraction suggests that this clay formed directly atop (or very near to) limestone bedrock. The presence of concentric nodule amorphous concentration features indicate that the clay was formed in an area that was seasonally inundated. Concentric nodules “are typical and are believed to reflect moisture regimes with repeated seasonal wet/dry cycles” (Kovda and Mermut 2010: 117) and are common in vertic soils. According to Kovda and Mermut (2010: 116), “the high water retention properties and low permeability of the dense clayey vertic materials are responsible for humid or water-saturated environments and consequently for the reduction and consequently for the reduction and mobilization of Fe and Mn, resulting in the formation of Fe and Mn oxide pedofeatures.” Vertisols (or soils with vertic properties; Beach et al. 2018) are commonly found in the hills located to the north and the south of the Belize Valley. The presence of concentric nodules suggests that this clay formed in depressions in the foothills where water was retained periodically. In summary, this group is variable across the samples but the data indicate that the clay for the Calcite A fabric group was retrieved from the foothills, likely from depressions that held water seasonally. Crushed limestone temper is used and sparry calcite was the preferred type of limestone temper. The variation in limestone suggests different source locations. These data, in conjunction with their abundance, suggests a provenance local to the Belize Valley although the exact location is unknown.

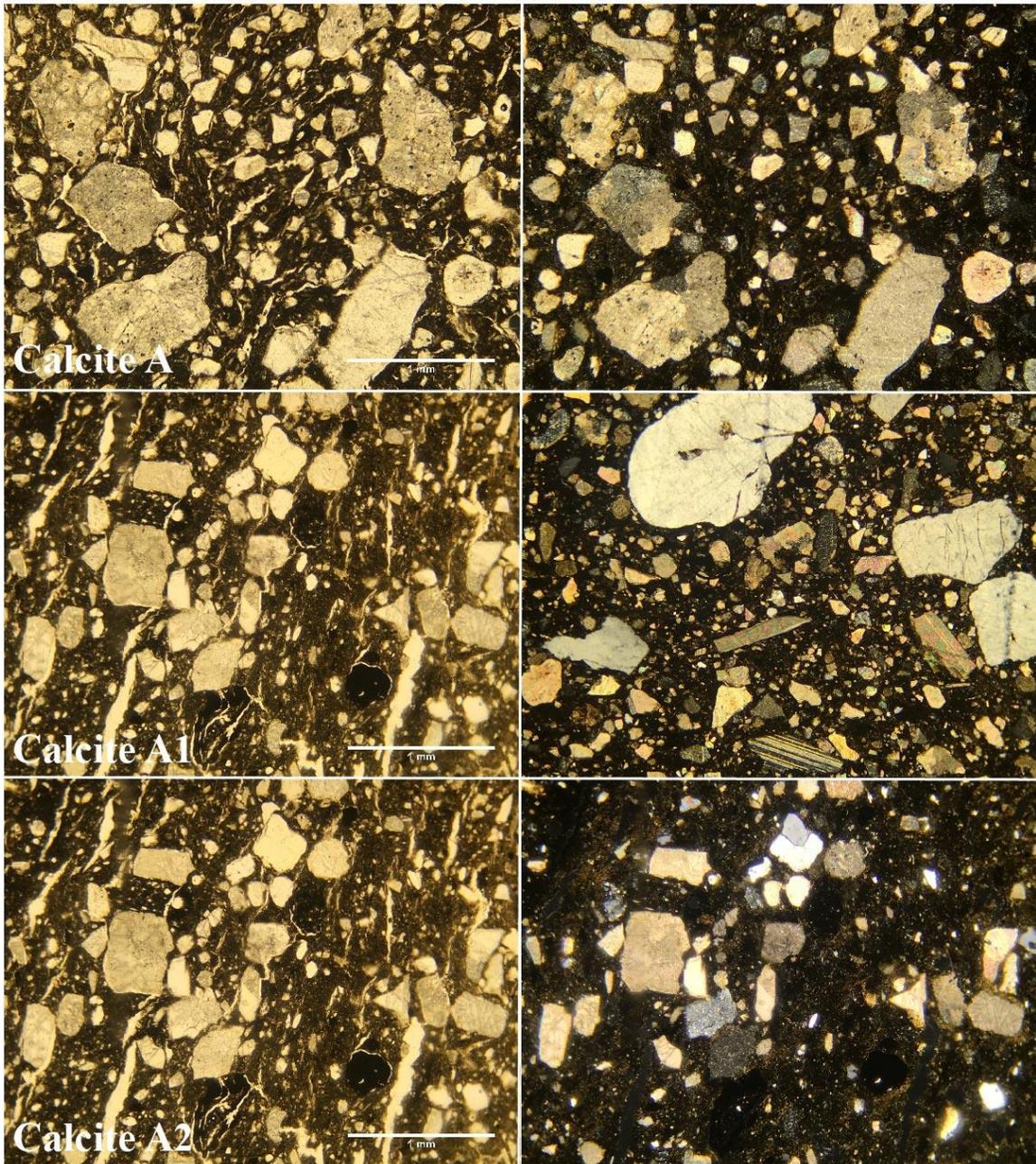


Figure D.1. Calcite A, BKP 18 (Upper Left: PPL, Upper Right: XPL); Calcite A1, BKP 184 (Middle Left: PPL, Middle Right: XPL); Calcite A2, BKP 8 (Lower Left: PPL, Lower Right: XPL).

CALCITE B

Samples: 6, 25, 26, 34, 41, 50, 59, 66, 69, 78, 82, 87, 93, 165, 171, 181, 186, 189, 193, 194, 197, 199, 204, 212 (n=24)

I. Microstructure:

- (a) ***Voids:*** Very few to common voids, predominantly mesochannels with few to very few microchannels, few to very few mesovughs. The amount and relative frequency of the types of voids present varies continuously across the group but channels (both micro- and meso-) are most abundant across all of the samples. All samples except 59, 66, 165, 171, 181, 186, 189, 199 and 204 contain carbonate shaped voids. In most cases the voids are located along the exterior margin of the samples. The voids maintain the shape of the carbonate inclusions. Samples 50 and 69 show evidence of degraded carbonate on the exterior margins.
- (b) ***c/f related distribution:*** Closed-spaced to single-spaced, porphyric related distribution.
- (c) ***Preferred Orientation:*** There is variation across the group with respect to the orientation of both voids and inclusions. Voids are parallel to vessel margins, including at the lip where the voids become perpendicular to the body; oblique (at a 45° angle) and parallel to the vessel margins; weakly oriented parallel to vessel margins. Inclusion orientation is weakly developed parallel to vessel margins to moderately developed parallel to vessel margins.

II. Groundmass:

- (a) ***Homogeneity:*** There is variation across the group with respect to: the orientation of voids and inclusions, the presence of carbonate shaped voids, the abundance of larger limestone temper, and the composition of limestone temper. Within an individual fabric, voids evenly distributed and inclusions are unevenly distributed with the occasional larger quartz, chert, or chalcedony inclusion. The color varies on most samples due to the presence of a dark core.
- (b) ***Micromass:*** Slightly optically active to optically active. The b-fabric is variable across the sample is monostriated and granostriated. Most of the samples display firing horizons and the thickness of the core varies from thick (4.8mm) to thin (3mm). The color of the sample without a core (87) is a dark brown in PPL and a greyish golden brown in XPL (x40). The samples with a core are a dark brown with slightly lighter brown margins in PPL and a greyish golden brown in XPL with slightly lighter brown margins (x40). The difference in color between the core and margin is not abrupt; rather the color gradually grades from dark in the center to a lighter color near the vessel walls.
- (c) ***Inclusions:*** The size distribution is bimodal with an upper size class (>0.1mm) composed primarily of calcite terminal grades, sparry calcite, crystalline calcite, micrite, and dolomite. The upper size class is also composed of monocrystalline and polycrystalline quartz, chert, and chalcedony. The lower size class (<0.1mm) is composed of coarse silt to very fine sand sized crystalline calcite, micrite, monocrystalline quartz, polycrystalline quartz, chert, and zircon. The dominant terminal grade calcite in the coarse fraction and the dominant crystalline calcite in

the fine fraction contribute to this fabric groups a packed appearance (though less so than Calcite A). The largest inclusion is 2mm (finely crystalline sparry calcite) and 98% of the inclusions range in size from 0.1mm (very fine sand) to 1.5mm (coarse sand) with a mode size of medium sand. Calcite terminal grades and sparry calcite are subrounded to subangular because they break apart at the boundaries of discrete grains that comprise the sparry calcite. Crystalline calcite is generally rhombic, subrounded to angular. All other inclusions (monocrystalline and polycrystalline quartz, chert, chalcedony) are predominantly equant and rounded to subrounded. Sorting is poor across all samples.

c:f:v 10 μ = 75:20:5 to 80:10:10

c:f:v 100 μ = 65:25:10 70:20:10

Coarse Inclusions (>0.1mm)

Dominant

Terminal Grade Calcite: Subrounded to subangular, predominantly equant to irregular with very few elongated grains. They range in size from 0.1mm (very fine sand) to 0.55mm (coarse sand) with a mode size of 0.4mm (medium sand).

Few to Very Few

Sparry Calcite (finely to coarsely crystalline, predominantly medium to coarsely crystalline mosaics): Subrounded to subangular, equant to elongated. They range in size from 0.45mm (medium sand) to 2mm (granule) with a mode size of 0.6mm (coarse sand).

Monocrystalline Quartz (undulose): Rounded to angular, equant to elongated to irregular, they range in size from 0.1mm (very fine sand) to 1mm (very coarse sand) with a mode size of 0.3mm (medium sand). The quartz grains are occasionally brown in PPL suggesting that they formed within the pore space of limestone. They also occasionally have an iron oxide coating, or are infilled along fissures with iron oxide.

Very Few to Rare

Crystalline Calcite: Subangular to angular, equant to elongated, most have the typical crystalline calcite rhombic shape. They range in size from 0.3mm (medium sand) to 1.05mm (very coarse sand) with a mode size of 0.75mm (coarse sand).

Dolomite: Only present in Samples 66, 93, 25, 69, 87, 181, 212, 59. Subangular to angular, equant (rhombic) to irregular, they range in size from 0.25mm (medium sand) to 0.75mm (coarse sand) with a mode size of 0.3mm (medium sand). The dolomite is zoned with a darkened, inclusion rich core and clear rim.

Micrite: Rounded to subangular, equant to elongated to irregular grains. They range in size from 0.1mm (very fine sand) to 0.5mm (coarse sand) with a mode size of 0.2mm (fine sand). One sample (69) has a larger (0.85mm, coarse sand),

irregularly shaped micrite inclusions with sparry calcite attached. The micrite in sample 181 is bioclastic with plant matter bioclasts.

Rare to Very Rare

Polycrystalline Quartz: Rounded, equant to elongated, they range in size from 0.1mm (very fine sand) to 1.45mm (very coarse sand) with a mode size of 0.15mm (fine sand). They occasionally have an iron oxide coating, or are infilled along fissures with iron oxide.

Chalcedony (secondary): The chalcedony in this group appears to be due to the infilling marine organisms. Rounded to subrounded, equant to elongated, they range in size from 0.2mm (fine sand) to 1mm (very coarse sand) with a mode size of 0.25mm (medium sand). They occasionally have an iron oxide coating, or are infilled along fissures with iron oxide.

Chert (secondary): Rounded to subrounded, equant to elongated, they range in size from 0.2mm (fine sand) to 1mm (very coarse sand) with a mode size of 0.25mm (medium sand). They occasionally have an iron oxide coating, or are infilled along fissures with iron oxide.

Very Rare

Sparry Calcite in Micrite Matrix Limestone: Only present in Samples 81 and 87. Subrounded to subangular, equant to elongated, they range in size from 0.25mm to 1.15 mm with a mode size of 0.35mm.

Sparite + Quartz Rock Fragment: Subangular, elongated, 1.2mm (very coarse sand). This rock fragment is only present in Sample 34.

Fine Inclusions (<0.1mm)

Few to Very Few: Crystalline calcite and monocrystalline quartz (subrounded to rounded)

Few to Very Rare: Polycrystalline quartz, chert, micrite (subrounded to subangular)

Very Rare: Zircons

III. Textural Concentration Features (Tcf)

Rare to very few textural concentration features. These features have a granular structure. They are dark brown in PPL and brown to golden brown in XPL and have a medium to high optical density. They occasionally have silt to very fine sand sized quartz inclusions that are discordant with the orientation of features in the surrounding fabric and very small dark red to brown amorphous concentration features within them. In some, the red to brown concentration features occupy over 90% of the feature. They are predominantly round and equant though some irregular shapes are present. The boundaries are sharp to diffuse. They range in size from 0.2mm (fine sand) to 1.5mm (very coarse sand) with a mode size of 0.25mm (medium sand).

IV. Amorphous Concentration (depletion) Features (Acf)

Very few to few rounded to subrounded, equant to irregular, black (PPL and XPL; 40x) to dark reddish brown (PPL and XPL; 40x) nodules with moderate optical density. Boundaries are diffuse to merging. They range in size from 0.02mm (silt) to 0.6mm (coarse sand) with a mode size of 0.45mm (medium sand).

Rare to very few (0.3mm to 1.15mm), rounded, equant to irregular, black to dark reddish brown in PPL (x40) and brownish black to dark reddish brown in XPL (x40) nodules with very high optical density. They have silt to fine sand sized inclusions that are discordant with the orientation of features in the surrounding fabric. Inclusions are primarily quartz but also very rare muscovite and quartz+muscovite rock fragments. Boundaries are sharp to diffuse and are partially to completely surrounded by channel voids.

Calcite B, Subgroup 1 **Abundant Small Terminal Grade Variant**

Samples: 17, 62, 72, 90, 94, 168 (n=6)

The microstructure (voids, c/f distribution packing, and preferred orientation) and the micromass (optical activity, b-fabric, color) of this subgroup are within the range of variation of those described for Calcite B except that the inclusions in this subgroup are all equant and so show no preferred orientation. The primary differences are: the predominance of small calcite terminal grades, less obvious bimodality due to the very few to rare inclusions in the coarse fraction, and moderate sorting. All of these vessels are thin walled suggesting that potters selected finely crystalline calcite limestone for this fabric group. The limestone was then crushed more thoroughly to eliminate large fragments of limestone within the ceramic body. Dolomite is present in Samples 62, 90, 163, 168, and 208. Sparry Calcite in a micrite matrix is present in Samples 62, 72, 90, 17, 208. The micrite in Sample 72 is bioclastic with plant matter bioclasts. Feldspar is only present in Sample 168. A calcite + quartz limestone fragment is present in Sample 17.

Calcite B, Subgroup 2 **Abundant Medium Terminal Grade Variant**

Samples: 5, 12, 42, 48, 83, 163, 172, 208, 215 (n=9)

Calcite B, Subgroup 2 is the same as Calcite B in all respects except for predominant medium sized (mode size of 0.15mm to 0.2mm, fine sand) calcite terminal grades giving the fabric a very packed appearance. The c/f distribution is still closed-spaced to single-spaced, porphyric related distribution but closed-spaced predominates in this subgroup. Samples 12, 83, 172, and 215 contain dolomite. Samples 83, 172, and 215 contain sparite in a micrite matrix. Sample 215 contains micrite with bioclastic plant material.

Sample 48 contains organic inclusions and unknown volcanic rock fragments. These fragments are medium sand sized, subrounded to subangular, and clear to light brown in PPL, and black to grey in XPL. They resemble quartz but have very birefringent inclusions. They also have iron oxide coatings and iron oxide that has entered the inclusions via fissures indicating that they are part of the clay component. Samples 5 and 42 contain almost no carbonate inclusions.

Calcite B, Subgroup 3
“Dusty” Fabric Variant

Samples: 10, 30, 35, 64, 65, 73, 74, 175, 190 (n=9)

Calcite B, Subgroup 3 is the same as Calcite B in all respects except for predominant crystalline calcite in the fine inclusions (<0.1mm) that gives this subgroup a “dusty” appearance. Samples 30, 64, 65, and 73 contain dolomite. Sample 64 contain sparite in a micrite matrix. Sample 175 contains primarily finely crystalline calcite. Sample 74 has a large perthite inclusion (subrounded, equant, 1.2mm). Samples 10 and 64 contain feldspar.

Calcite B, Subgroup 4
Abundant Small Calcite Terminal Grades and Quartz

Samples: 24, 28

Calcite B, Subgroup 4 is the same as Calcite B, Subgroup 2 in all respects except for the few, large (largest is 1.5mm; very coarse sand) monocrystalline and polycrystalline quartz inclusions. Most are rounded to angular, equant to elongated to irregular. Given their size and uneven distribution, the quartz appears to have been added as temper along with the carbonate inclusions added as temper discussion as part of Calcite B. There are also smaller (fine sand) irregular and angular quartz inclusions that may have been part of the limestone crushed as temper.

COMMENTS

Paste Technology

Calcite B can be characterized as a poorly sorted, calcareous clay containing primarily calcite with smaller quantities of micrite, monocrystalline quartz, polycrystalline quartz, chert, chalcedony, feldspar, and zircon that is tempered with limestone. The micromass is dark brown in PPL and a greyish golden brown in XPL with margins that are slightly lighter in color. The golden brown appearance of the fabric aids in distinguishing Calcite B from Calcite A. The limestone rock temper occurs as large fragments composed primarily of sparry calcite with smaller quantities of different types of limestone including dolomitic limestone and sparry calcite in a micrite matrix as well as limestone with quartz inclusions. Crystalline calcite is also present as temper. The bimodal and

uneven distribution of these aplastics, in conjunction with their angularity, suggests that they were added as tempering material. Terminal grade calcite that comprises the majority of the coarse fraction in Calcite B has a similar crystal morphology to the discrete grains that comprise the finely to coarsely crystalline limestone indicating that crushed limestone is the source of the temper. The general lack of micrite in the fine fraction suggests that the micrite was processed as part of the limestone and added as temper. Although the Calcite B fabric has a packed appearance, it is less packed than Calcite A and often contains fewer larger limestone rock fragments. The larger quartz, chert, and chalcedony inclusions may have been added as part of the limestone temper though the smaller inclusions are almost certainly part of the natural clay. The quartz, chert, and chalcedony are most often brown in PPL suggesting that they formed in the pore space in the limestone. Other minerals in the fine fraction (e.g. feldspar, polycrystalline quartz) are also small and rounded indicating they were also part of the natural clay. Quartz, polycrystalline quartz, and feldspars frequently have iron oxide coatings and iron oxide infilling fissures in monocrystalline quartz, between quartz grains in polycrystalline quartz, and along cleavage planes in feldspar.

Provenance

The inclusions in Calcite B are consistent with the geology of the Belize River Valley. Sparry calcite mosaics are present in all of the samples suggesting that this was the preferred tempering material though the limestones are variable across the group indicative of different, but still local, provenance. The abundance of small, rounded crystalline calcite in the fine fraction suggests that this clay formed directly atop (or very near to) limestone bedrock. Calcite B is very similar to Calcite A; however, the lack of concentric circle soil features suggest that the clay for Calcite B was procured from a different location in the foothills to the north and south of the alluvial bottom, likely a well-drained rather than seasonally inundated location. The different type of clay gives the samples of the Calcite B fabric group a lighter brown color in PPL and more golden color in XPL than Calcite A. Calcite B also contains textural concentration features that are consistent with Vertisols (or soils with vertic properties). These textural concentration features are likely dark (abundant organic material) aggregates of material that originated at the surface and were incorporated into the clay via openings in the soils that result from the shrinking and swelling of vertic soils. In summary, this group is variable across the samples but the data indicate that the clay for the Calcite B fabric group was retrieved from the foothills, likely from more well-drained soils. Crushed limestone temper is used and sparry calcite was the preferred type of limestone temper. The variation in limestone suggests different source locations. These data, in conjunction with their abundance, suggests a provenance local to the Belize Valley though the exact location is unknown.

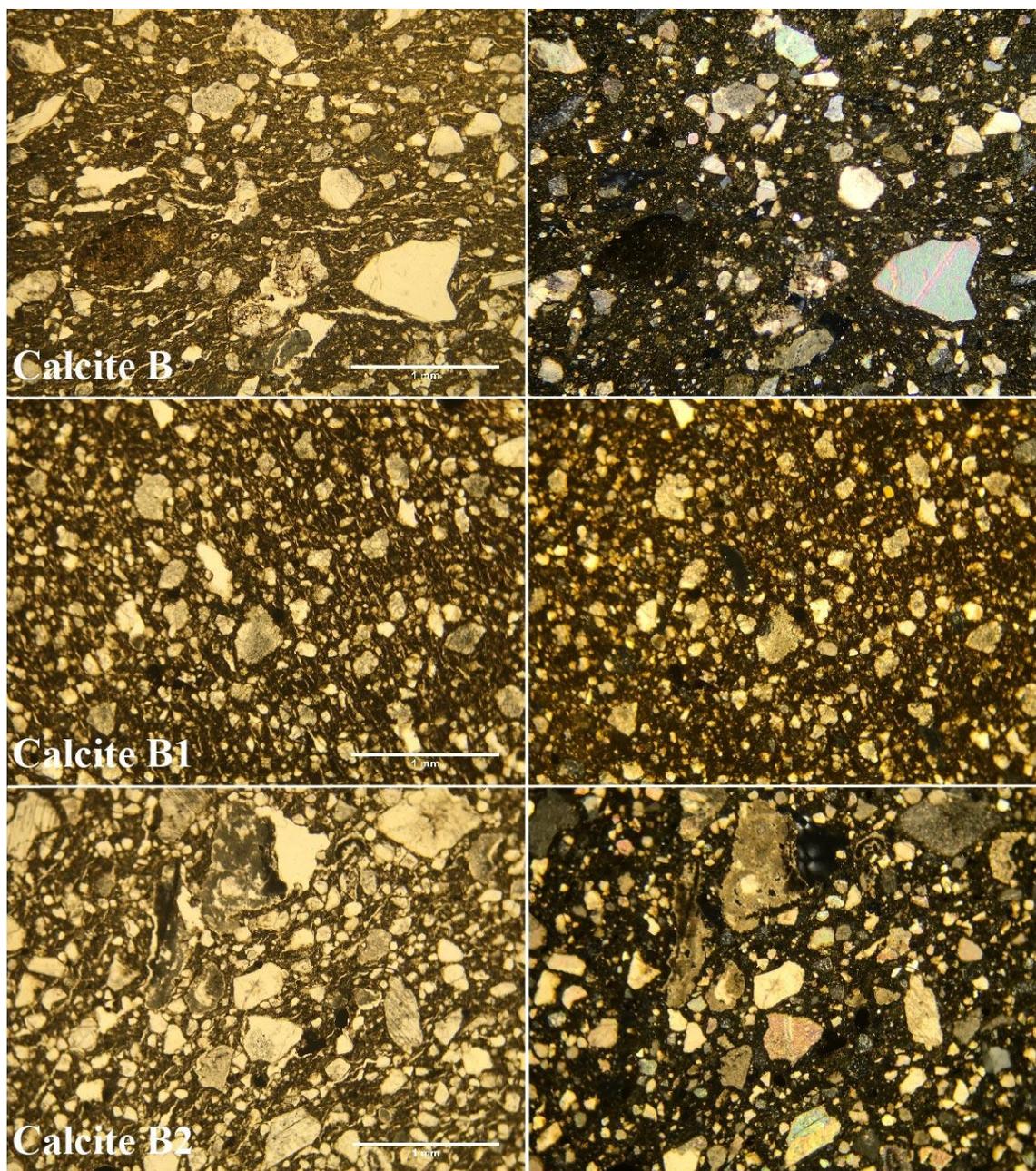


Figure D.2. Calcite B, BKP 50 (Upper Left: PPL, Upper Right: XPL); Calcite B1, BKP 72 (Middle Left: PPL, Middle Right: XPL); Calcite B2, BKP 83 (Lower Left: PPL, Lower Right: XPL).

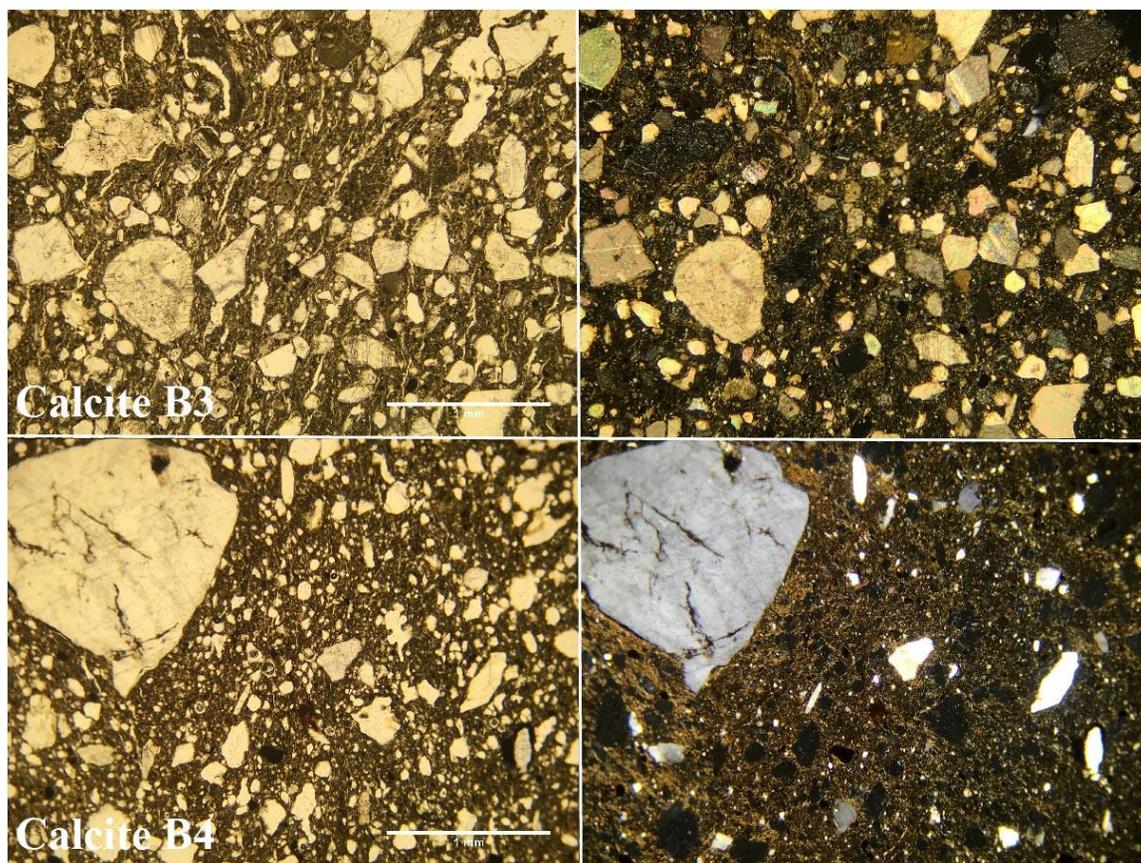


Figure D.3. Calcite B3, BKP 64 (Upper Left: PPL, Upper Right: XPL); Calcite B4, BKP 28 (Lower Left: PPL, Lower Right: XPL).

CALCITE C

Samples: 4, 19, 23, 31, 36, 39, 46, 47, 52, 81, 92, 162, 177, 185, 187,
191, 201, 202, 206, 207, 211, 213 (n=22)

I. Microstructure:

- (a) ***Voids:*** Very few to common voids, predominantly mesochannels with few to very few microchannels, few mesovughs with rare macrovughs. The amount and relative frequency of the types of voids present varies continuously across the group but channels (both micro- and meso-) are most abundant across all of the samples. Samples 19, 31, 36, 39, 52, 162, and 206 contain carbonate shaped voids. In most cases the voids are located along the exterior margin of the samples. The voids maintain the shape of the carbonate inclusions. Samples 4 and 213 do not contain any carbonate inclusions.
- (b) ***c/f related distribution:*** Single-spaced to open-spaced, porphyric related distribution
- (c) ***Preferred Orientation:*** There is variation across the group with respect to the orientation of both voids and inclusions. Voids are parallel to vessel margins, including at the lip where the voids become perpendicular to the body parallel to the vessel margins; oblique (at a 45° angle) and parallel to the vessel margins. Inclusion orientation is moderately developed parallel to vessel margins; weakly developed parallel to vessel margins; no preferred orientation. The inclusions that show no preferred orientation are predominantly equant.

II. Groundmass:

- (a) ***Homogeneity:*** There is variation across the group with respect to: the orientation of voids and inclusions, the presence of carbonate shaped voids, the abundance of larger limestone temper, the composition of limestone temper, and the presence of concentric circle concentration features. The group has the most variation in color with samples ranging from brown to red. Within an individual fabric, voids are evenly distributed and inclusions are unevenly distributed. In many samples there are large areas of poorly mixed clay that does not contain any added temper. The color varies on most samples due to the presence of a dark core.
- (b) ***Micromass:*** Slightly optically active to optically active. The b-fabric is variable across the sample and is monostriated and granostriated. Most of the samples display firing horizons and the thickness of the dark core varies. The color is variable across the group: The color of samples without a core is a dark brown in PPL, some are a dark golden brown in XPL and some are a yellow golden brown in XPL. Samples with a core fall into two groups. Dark brown with slightly lighter brown margins in PPL and golden brown with slight lighter golden brown in XPL, dark brown with reddish brown margins in PPL and golden brown with reddish golden brown margins. The difference in color between the core and margin is not abrupt; rather the color gradually grades from dark in the center to a lighter color near the vessel walls.
- (c) ***Inclusions:*** The size distribution is bimodal with an upper size class (>0.1 mm) composed primarily of calcite terminal grades, sparry calcite, crystalline calcite and micrite. The upper size class is also composed to monocrystalline and

polycrystalline quartz, chert, chalcedony, and limestone fragments (chert and sparry calcite). The lower size class (<0.1mm) is composed of coarse silt to very fine sand sized crystalline calcite, micrite, monocrystalline quartz, chert, polycrystalline quartz, muscovite, and zircons. The largest inclusion is 2mm (finely crystalline sparry calcite) and 98% of the inclusions range in size from 0.1mm (very fine sand) to 1.3mm (very coarse sand) with a mode size of medium sand. Calcite terminal grades and sparry calcite are subrounded to subangular because they break apart at the boundaries of discrete grains that comprise the sparry calcite. Crystalline calcite is generally rhombic, subrounded to angular. Some of the micrite is irregularly shaped and bioclastic but the majority is rounded and equant. All other inclusions (crystalline calcite, monocrystalline and polycrystalline quartz, chert, chalcedony, and limestone fragments) are rounded; rare quartz inclusions are subangular. Sorting is poor across all samples.

c:f:v 10 μ = 60:30:10 to 55:35:10

c:f:v 100 μ = 70:20:10 to 75:15:10

Coarse Inclusions (>0.1mm)

Common

Terminal Grade Calcite: Subrounded to subangular, predominantly equant to irregular with very few elongated grains. They range in size from 0.1mm (very fine sand) to 0.55mm (coarse sand) with a mode size of 0.25mm (medium sand).

Sparry Calcite (finely to coarsely crystalline, predominantly medium to coarsely crystalline mosaics): Subrounded to subangular, equant to elongated. They range in size from 0.35mm (medium sand) to 2mm (granule) with a mode size of 0.6mm (coarse sand).

Few to Rare

Micrite: Rounded, equant to elongated micrite is present in all samples. They range in size from 0.1mm (very fine sand) to 0.6mm (coarse sand) with a mode size of 0.4mm (medium sand). Some samples (Samples: 46, 47, 81, 93, 162, 177, 191, 201) have larger and irregularly shaped micrite with an upper size range of 1.3mm (very coarse sand). Four samples (Samples: 46, 47, 93, 191) are bioclastic micrite. Some of the larger micrite inclusions are attached to sparry calcite indicating that they are part of the same parent material.

Very Few to Rare

Crystalline Calcite: Subangular to angular, equant to elongated, most have the typical crystalline calcite rhombic shape. They range in size from 0.25mm (medium sand) to 1.2mm (very coarse sand) with a mode size of 0.75mm (coarse sand). In some cases the rhombic calcite is attached to sparry crystalline calcite indicating that these were part of the same limestone formation.

Monocrystalline Quartz (undulose): Rounded to subrounded, equant to elongated, they range in size from 0.1mm (very fine sand) to 1.25mm (very coarse sand) with a mode size of 0.3mm (medium sand).

Very Few to Very Rare

Polycrystalline Quartz: Rounded, equant to elongated to irregular, they range in size from 0.15mm (fine sand) to 0.6mm (coarse sand) with a mode size of 0.4mm (medium sand).

Rare to Very Rare

Chert (secondary): Rounded, equant, they range in size from 0.25mm (medium sand) to 1.25mm (very coarse sand) with a mode size of 0.25mm (medium sand).

Chalcedony (secondary): Rounded, equant, 4mm (medium sand) (Sample: 213) to 0.9mm (coarse sand).

Chert + Sparry Calcite Limestone: Subrounded, elongated, they range in size from 1.25mm (very coarse sand) to 1.75mm (very coarse sand) (Samples: 187, 206).

Quartz + Sparry Calcite Limestone: Subrounded, elongated, they range in size from 1.25mm (very coarse sand) to 1.75mm (very coarse sand) (Samples: 17, 177, 187).

Chalcedony + Sparry Calcite Limestone: Subrounded, elongated, they range in size from 1.25mm (very coarse sand) to 1.75mm (very coarse sand) (Samples: 19, 206).

Fine Inclusions (<0.1mm)

Common: Crystalline calcite and monocrystalline quartz

Common to Very Few: Micrite, chert

Few to Very Few: Polycrystalline quartz

Very Rare: Zircon

III. Textural Concentration Features (Tcf)

Few to very few textural concentration features. These features have a granular texture and are the same features discussed for Calcite B. They are dark brown in PPL and brown to golden brown in XPL and have a medium to high optical density. They occasionally have silt to very fine sand sized quartz inclusions that are discordant with the orientation of features in the surrounding fabric and very small dark red to brown amorphous concentration features within them. In some features, the red to brown concentration features occupy over 90% of the feature. They are predominantly round and equant though some irregular shapes are present. The boundaries are sharp to diffuse. They range in size from 0.2mm (fine sand) to 1.5mm (very coarse sand) with a mode size of 0.25mm (medium sand).

Rare to very rare depletion features. The features are similar to the clay pellets described above except that they are grey in XPL. The feature is moderately impregnated, rounded, equant, and 1.36mm (very coarse sand).

IV. Amorphous Concentration Features (Acf)

Very few to few rounded to subrounded, equant to irregular, black (PPL and XPL; 40x) to dark reddish brown (PPL and XPL; 40x) nodules with moderate optical density. Boundaries are diffuse to merging. They range in size from 0.02mm (silt) to 0.6mm (coarse sand) with a mode size of 0.45mm (medium sand).

Rare to very few (0.3mm to 1.15mm), rounded, equant to irregular, black to dark reddish brown in PPL (x40) and brownish black to dark reddish brown in XPL (x40) nodules with very high optical density. They have silt to fine sand sized inclusions that are discordant with the orientation of features in the surrounding fabric. Inclusions are composed of quartz. Boundaries are sharp to diffuse and are partially to completely surrounded by channel voids.

Calcite C, Subgroup 1 **Abundant Textural Concentration Feature Variant**

Samples: 43, 80

Calcite C, Subgroup 1 is the same as Calcite C in all respects except for the abundance of textural concentration features (common) in this fabric group. This variant likely represents clay procured from a different location but similar depositional environment as Calcite C.

COMMENTS

Paste Technology

Calcite C can be characterized as a poorly sorted, calcareous clay containing primarily calcite with smaller quantities of micrite, monocrystalline quartz, polycrystalline quartz, chert, chalcedony, feldspar, and zircon that is tempered with limestone. The limestone rock temper occurs as large fragments composed primarily of sparry calcite with smaller quantities of different types of limestone including dolomitic limestone and sparry calcite in a micrite matrix as well as limestone with chert, chalcedony, and quartz inclusions. Crystalline calcite is also present as temper. The bimodal and uneven distribution of these aplastics, in conjunction with their angularity, suggests that they were added as tempering material. Terminal grade calcite that comprises the majority of the coarse fraction in Calcite C has a similar crystal morphology to the discrete grains that comprise the finely to coarsely crystalline limestone indicating that crushed limestone is the source of the temper. The general lack of micrite in the fine fraction suggests that the micrite was

processed as part of the limestone and added as temper. Furthermore, there is no micrite in the textural concentration features suggesting that micrite was added as part of the crushed limestone temper. The larger quartz, chert, and chalcedony inclusions may have been added as part of the limestone temper though the smaller inclusions are almost certainly part of the natural clay. The quartz, chert, and chalcedony are most often brown in PPL suggesting that they formed in the pore space in the limestone. Other minerals in the fine fraction (e.g. feldspar, polycrystalline quartz) are also small and rounded indicating they were also part of the natural clay. Quartz, polycrystalline quartz, and feldspars frequently have iron oxide coatings and iron oxide infilling fissures in monocrystalline quartz, between quartz grains in polycrystalline quartz, and along cleavage planes in feldspar. Calcite C is most similar to Calcite B but is distinctive due to the poorly mixed fabric in which large swaths of clay without limestone temper is present. Calcite C also contains far fewer limestone inclusions than Calcite A or Calcite B. The sparse temper, and abundance of poorly mixed clay, is the defining characteristic of this group. These characteristics may indicate that this fabric group is the product of expedient ceramic production.

Provenance

The inclusions in Calcite C are consistent with the geology of the Belize River Valley. Sparry calcite mosaics are present in all of the samples suggesting that this was the preferred tempering material though the limestones are variable across the group indicative of different, but still local, provenance. The abundance of small, rounded crystalline calcite in the fine fraction suggests that this clay formed directly atop (or very near to) limestone bedrock. The clay for Calcite C was procured from a location in the foothills to the north and south of the alluvial bottom, likely a well-drained rather than seasonally inundated location. Calcite C also contains textural concentration features that are consistent with Vertisols (or soils with vertic properties). These textural concentration features are likely dark (abundant organic material) aggregates of material that originated at the surface and were incorporated into the clay via openings in the soils that result from the shrinking and swelling of vertic soils. In summary, this group is variable across the samples but the data indicate that the clay for the Calcite C fabric group was retrieved from the foothills, likely from more well-drained soils. Crushed limestone temper is used and sparry calcite was the preferred type of limestone temper. The variation in limestone suggests different source locations. These data, in conjunction with their abundance, suggests a provenance local to the Belize Valley though the exact location is unknown.

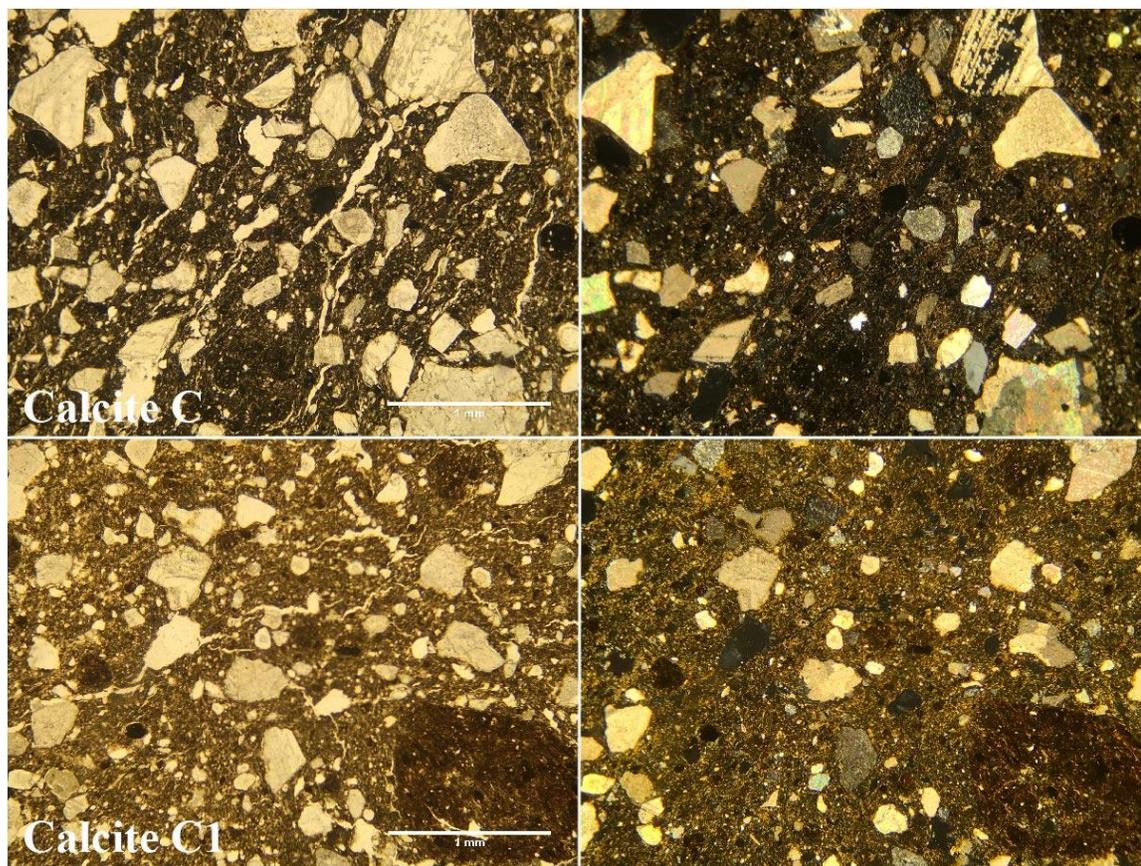


Figure D.4. Calcite C, BKP 52 (Upper Left: PPL, Upper Right: XPL); Calcite C1, BKP 80 (Lower Left: PPL, Lower Right: XPL).

CALCITE D

Samples: 11, 53, 54, 75, 76, 77, 169, 178 (N=8)

I. Microstructure

- (a) **Voids:** Very few to common voids, predominantly mesochannels with few to very few microchannels, few to very few mesovughs. The amount and relative frequency of the types of voids present varies continuously across the group but channels (both micro- and meso-) are most abundant across all of the samples.
- (b) **c/f related distribution:** Closed-spaced to open-spaced porphyric related distribution.
- (c) **Preferred orientation:** There is variation across the group with respect to the orientation of both voids and inclusions. Voids are parallel to vessel margins, including at the lip where the voids become perpendicular to the body; oblique (at a 45° angle), perpendicular, and parallel to the vessel margins; weakly oriented parallel to vessel margins. Inclusion orientation is weakly developed parallel to vessel margins to moderately developed parallel to vessel margins. Sample 76 contains carbonate shaped voids. The voids maintain the shape of the carbonate inclusions. Sample 77 shows evidence of degraded carbonate on the exterior margins.

II. Groundmass

- (a) **Homogeneity:** There is little variation across the group. Some samples contain dolomite and one sample contains sparry calcite + chalcedony limestone and sparry calcite in a micrite matrix. Most samples contain primarily coarsely crystalline calcite. Within an individual fabric, voids evenly distributed and inclusions are unevenly distributed with the occasional larger quartz, chert, or chalcedony inclusion. The color varies on most samples due to the presence of a dark core.
- (b) **Micromass:** Slightly optically active to optically active. The b-fabric is variable across the sample is monostriated and granostriated. The color in PPL is a very light brown (x40) and the color in XPL is a golden yellow brown (x40). Samples 75 and 53 have a dark core that is a slightly darker brown in the center in PPL (x40) and a slightly darker golden brown in the center in XPL (x40).
- (c) **Inclusions:** The size distribution is bimodal with an upper size class (>0.1mm) composed primarily of calcite terminal grades, sparry calcite, and dolomite. The upper size class is also composed to monocrystalline quartz, chert, chalcedony, and limestone fragments (chert and sparry calcite). The lower size class (<0.1mm) is composed of coarse silt to very fine sand sized crystalline calcite and quartz. The largest inclusion is 2mm (terminal grade of a coarsely crystalline sparry calcite) and 98% of the inclusions range in size from 0.1mm (very fine sand) to 1.3mm (very coarse sand) with a mode size of medium sand. Calcite terminal grades and sparry calcite are subrounded to subangular because they break apart at the boundaries of discrete grains that comprise the sparry calcite. This group contains an abundance of terminal grains from coarsely crystalline mosaics. Sorting is moderate to poorly across all samples.

c:f:v 10μ = 90:5:5 to 85:10:5

Coarse Inclusions (>0.1mm)

Common

Terminal Grade Calcite: Subrounded to subangular, predominantly equant to irregular with very few elongated grains. They range in size from 0.1mm (very fine sand) to 2mm (granule) with a mode size of 0.4mm (medium sand). Terminal grades from coarsely crystalline calcite are much more common in this group.

Few to Very Few

Sparry Calcite (Finely crystalline to coarsely crystalline mosaics): Subrounded to subangular, equant to elongated. They range in size from 0.45mm (medium sand) to 1.6mm (granule) with a mode size of 1.44 mm (very coarse sand). Coarsely crystalline sparry calcite is the most common.

Monocrystalline Quartz (Undulose): Subangular to angular, equant to irregular, they range in size from 0.1mm (very fine sand) to 0.8mm (coarse sand) with a mode size of 0.35mm (medium sand). The larger particles rarely have an oxide coating indicating they were part of the limestone.

Few to Rare

Dolomite: Only present in Samples 75, 77, 11, 52, and 169. Subangular to angular, equant (rhombic), they range in size from 0.25mm (medium sand) to 0.75mm (coarse sand) with a mode size of 0.3mm (medium sand). The dolomite is zoned with a darkened, inclusion rich core and clear rim.

Rare to Very Rare

Chert: Rounded to angular, equant to irregular, they range in size from 0.25mm (medium sand) to 0.8mm (coarse sand) with a mode size of 0.35mm (medium sand). The particles rarely have an oxide coating indicating they were part of the limestone.

Chalcedony Rounded to angular, equant to irregular, they range in size from 0.25mm (medium sand) to 1.44mm (very coarse sand) with a mode size of 0.35mm (medium sand).

Micrite: Rounded to angular, equant to irregular, they range in size from 0.2mm (fine sand) to 1.36mm (very coarse sand) with a mode size of 0.75mm (coarse sand). The very rare larger micrite inclusions are occasionally bioclastic.

Very Rare

Sparry Calcite in Micrite Matrix Limestone: Only in Sample 178. Rounded, equant, 0.72mm (coarse sand).

Sparry Calcite + Chalcedony Limestone: Only in Sample 178 but is few in this sample. Subangular, elongated, 0.5mm (coarse sand) to 1.5mm (very coarse sand).

Fine Inclusions (<0.1mm)

Few to Very Few: Crystalline Calcite and Monocrystalline Quartz

III. Textural Concentration Features

Very few to rare textural concentration features. They are dark brown in PPL and brown to golden brown in XPL and have a medium to high optical density. They occasionally have silt to very fine sand sized quartz inclusions that are discordant with the orientation of features in the surrounding fabric and very small dark red to brown amorphous concentration features within them. In some aggregates, the red to brown concentration features occupy over 90% of the clay pellet. The features are predominantly round and equant though some irregular shapes are present. The boundaries are sharp to diffuse. They range in size from 0.2mm (fine sand) to 1.5mm (very coarse sand) with a mode size of 0.25mm (medium sand).

Rare to very rare depletion features. The features are similar to the features described above except that they are grey in XPL. The feature is moderately impregnated, rounded, equant, and 1.36mm (very coarse sand).

IV. Amorphous Concentration Features

Very few to few rounded to subrounded, equant to irregular, black (PPL and XPL; 40x) to dark reddish brown (PPL and XPL; 40x) nodules with moderate optical density. Boundaries are diffuse to merging. They range in size from 0.02mm (silt) to 0.6mm (coarse sand) with a mode size of 0.45mm (medium sand).

Very rare to rare (0.3mm to 1.15mm), rounded, equant to irregular, black to dark reddish brown in PPL (x40) and brownish black to dark reddish brown in XPL (x40) nodules with very high optical density. They have silt to fine sand sized inclusions that are discordant with the orientation of features in the surrounding fabric. Inclusions are composed of quartz. Boundaries are sharp to diffuse and are partially to completely surrounded by channel voids.

Calcite D, Subgroup 1
Reddish Brown Micromass Variant

Samples: 9

Calcite D, Subgroup 1 is the same as Calcite D in all respects except the fabric is a reddish brown in both PPL and XPL. There is more abundant micrite and sparry calcite in a micrite matrix but is consistent with Sample 178.

Calcite D, Subgroup 2
Finely Crystalline Sparry Calcite Variant

Samples: 20

Calcite D, Subgroup 2 has a similar golden yellow brown (XPL) fabric as Calcite D but this subgroup has abundant small calcite terminal grades and the limestone temper is predominantly finely crystalline calcite.

COMMENTS

Paste Technology

Calcite D can be characterized as a moderately to poorly sorted, calcareous clay containing calcite, monocrystalline quartz, chert, and chalcedony that is tempered with limestone. The fabric is sparsely tempered with a distinctive light brown (PPL) and light yellow golden brown (XPL) fabric. The clay in this fabric group is very refined and contains few non-carbonate inclusions and variation is minimal which also distinguishes this fabric from Calcite A-C. The limestone rock temper occurs as large fragments composed primarily of sparry calcite with smaller quantities of different types of limestone including dolomitic limestone and sparry calcite with a micritic component as well as limestone with chalcedony inclusions. The bimodal and uneven distribution of these aplastics, in conjunction with their angularity, indicates that they were added as tempering material. There is much less monocrystalline quartz in Calcite D than in Calcite A-C and much of the quartz is angular and does not have an oxide coating suggesting it was part of the crushed limestone temper. The sparse temper, distinctive yellow brown fabric in XPL, and the abundance of coarsely crystalline sparry calcite limestone and terminal grades are the distinguishing characteristics of this fabric group.

Provenance

The inclusions in Calcite D are consistent with the geology of the Belize River Valley. Sparry calcite mosaics are present in all of the samples suggesting that this was the preferred tempering material though the limestones are variable across the group indicative of different, but still local, provenance. The near complete lack of inclusions in the fine fraction suggests a different provenance and a location that is not directly atop bedrock. However, the clay is inconsistent with geologic samples from riverine depositional environments in the Belize Valley suggesting that it was procured from land locations in the foothills. The abundance of coarsely crystalline sparry calcite and dolomite (compared to Calcite A-C) also suggests a different provenance for the temper. These data, in conjunction with their abundance, suggests a provenance local to the Belize Valley though the exact location is unknown.

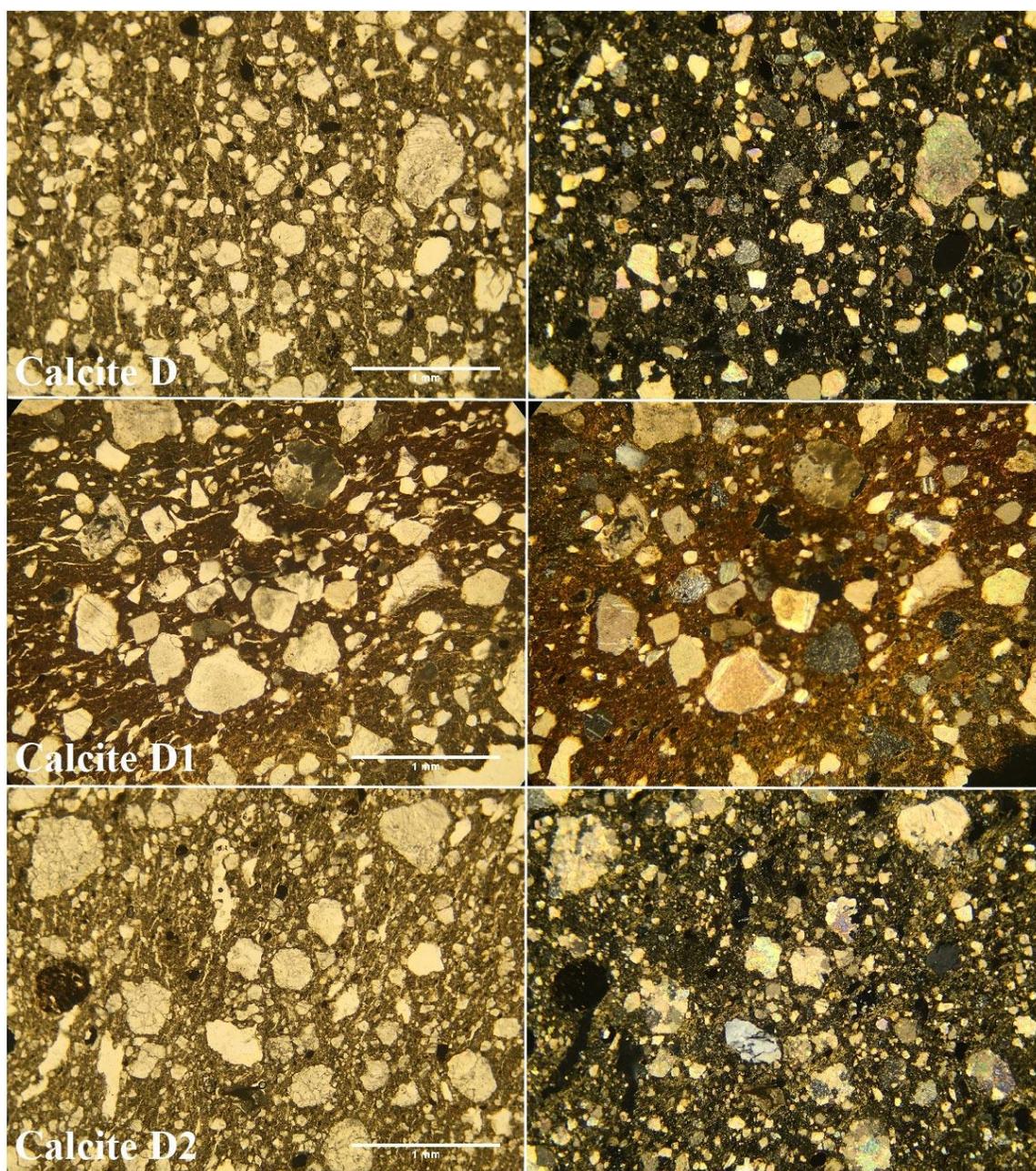


Figure D.5. Calcite D, BKP 77 (Upper Left: PPL, Upper Right: XPL); Calcite D1, BKP 9 (Middle Left: PPL, Middle Right: XPL); Calcite D2, BKP 20 (Lower Left: PPL, Lower Right: XPL).

CALCITE E

Samples: 15, 44, 79, 89, 91, 95, 173 (n=7)

I. Microstructure

(a) *Voids:* Few voids, common mesochannels and very few microchannels, very few mesovughs. Sample 15 contains carbonate shaped voids. The voids are limited to the exterior margins and maintain the shape of the carbonate inclusions.

(b) *c/f related distribution:* closed-spaced to double-spaced, porphyric related distribution

(c) *Preferred orientation:* Voids are oriented parallel to vessel margins. Inclusions are weakly developed parallel to the vessel margins

II. Groundmass

(a) *Homogeneity:* The fabric group is relatively consistent across the samples with the exception of Samples 15 and 89 which contain significantly less carbonate sand and more abundant calcite terminal grades. Within a fabric, voids are evenly distributed and inclusions are unevenly distributed.

(b) *Micromass:* Optically active. The b-fabric is monostriated. The color in PPL is a light brown (x40) and the color in XPL is a bright yellow brown (x40).

(c) *Inclusions:* The size distribution is bimodal and the upper size class (>0.0625mm) is composed of carbonate sand (frequent), terminal grade calcite (few), sparry calcite (few), sparry calcite in an isotropic matrix (few), isotropic spherules (few), micrite, chert, monocrystalline quartz, chalcedony, and polycrystalline quartz (very few to very rare). The lower size class (<0.0625mm) is composed of calcite (few to very few), quartz (very few to rare), chert (rare), chalcedony (rare), and zircon (very rare). The largest inclusion is 2.08mm (sparry calcite) and 98% of inclusions range in size from 0.0625mm to 0.5mm. The fabric is poorly sorted.

c:f:v _{62μ} : 60:30:10 to 70:20:10

Coarse Inclusions (>0.0625mm)

Frequent

Carbonate Sand: Rounded, equant, they range in size from 0.0625mm (coarse silt) to 0.4mm (medium sand) with a mode size of 0.15mm (fine sand). Carbonate sand is few in Sample 89 and rare in Sample 15.

Few

Calcite Terminal Grades: Subrounded to subangular, equant to elongated to irregular. There are two size ranges. One ranges in size from 0.1mm (fine sand) to 0.3mm (medium sand) with a mode size of 0.2mm (fine sand). The other ranges in size from 0.4mm (medium sand) to 1.5mm (very coarse sand) with a mode size of 0.55mm (coarse sand).

Sparry Calcite (finely to coarsely crystalline): Subrounded, equant to elongated, they range in size from 0.4mm (medium sand) to 2.08mm (granule) with a mode size of 0.95mm (coarse sand).

Sparry Calcite in an Isotropic Matrix: Same characteristics as the sparry calcite except the calcite grains are enclosed inside a matrix that is completely black in XPL.

Isotropic Spherules: Rounded, equant to elongated, they range in size from 0.2mm (fine sand) to 0.7mm (coarse sand) with a mode size of 0.5mm (coarse sand). Many have the appearance of micrite in PPL but are completely black in XPL. Others have the structure of the isotropic matrix of the sparry calcite. Occasionally, the isotropic spherules have no internal structure visible in PPL.

Very Few to Very Rare

Micrite: Rounded, irregular, they range in size from 0.8mm (coarse sand) to 1.6mm (very coarse sand) with a mode size of 1mm (very coarse sand). Much of the micrite is bioclastic and is often attached to sparry calcite.

Chert: Rounded, equant, they range in size from 0.2mm (fine sand) to 0.6mm (medium sand) with a mode size of 0.4mm (medium sand). All chert in this group is a light brown in PPL suggesting that the chert was precipitated out of the limestone rather than formed in a vein (i.e. bedded chert). They occasionally have an iron oxide coating, or are infilled along fissures with iron oxide. Sample 91 has a very large chert inclusion (1.35mm, very coarse sand).

Monocrystalline Quartz (undulose): Rounded, equant, they range in size from 0.1mm (very fine sand) to 0.5mm (coarse sand) with a mode size of 0.3mm (medium sand). The quartz grains are frequently brown in PPL suggesting that they formed within the pore space of limestone. They also frequently have an iron oxide coating, or are infilled along fissures with iron oxide.

Chalcedony: Rounded, equant, very fine sand sized. All chalcedony in this group is a light brown in PPL suggesting that the chert was precipitated out of the limestone rather than formed in a vein (i.e. bedded chert). They occasionally have an iron oxide coating, or are infilled along fissures with iron oxide.

Polycrystalline Quartz: Rounded, irregular, medium sand sized.

Fine Inclusions (<0.0625mm)

Few to Very Few: Calcite

Very Few to Rare: Quartz

Rare: Chert and Chalcedony

Very Rare: Zircon

III. Textural Concentration Features

Rare to very rare clay pellets, dark reddish brown (PPL and XPL), moderate optical density, clear to merging boundaries, rounded, equant to elongated, they range in size from 0.3mm to 0.55 mm. The larger clay pellets contain silt-sized quartz grains that are discordant with the surrounding matrix.

IV. Amorphous Concentration Features

Rare to very rare nodules, red to black (PPL and XPL), high optical density, merging boundaries, rounded, equant to elongated.

COMMENTS

Paste Technology

This fabric is characterized by a bright yellow fabric (XPL), abundant carbonate sand, sparry calcite in an isotropic matrix, glass spherules, and a very refined clay with very few inclusions. The finely to coarsely grained sparry calcite (including the sparry calcite with an isotropic matrix) was likely added as temper. The bimodal and uneven distribution of these aplastics, in conjunction with their angularity, indicates that they were added as tempering material. Though the isotropic spherules are rounded, they were likely added as temper as part of the crushed limestone. All of the samples except for 15 and 89 have frequent carbonate sand that is evenly distributed in the fabric indicating this component was part of the natural clay. Samples 15 and 89 may have a slightly different, though related, provenance. There are few inclusions in the fine fraction.

Provenance

This fabric is considered possibly local. The temper (with the exception of the isotropic components) is similar to that of the Belize Valley suggesting that practice was the same but provenance differed. The carbonate sand and glass spherules, however, cannot be firmly tied to the Belize Valley.

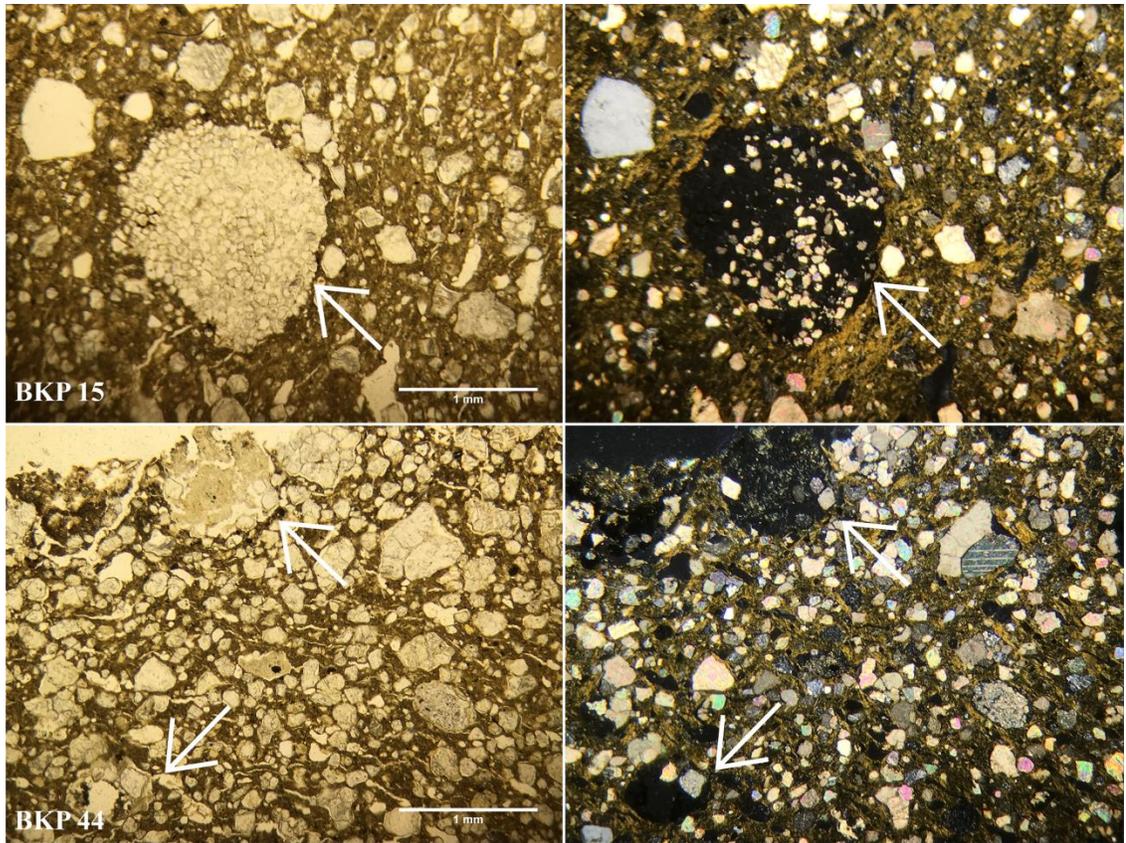


Figure D.6. Calcite E Fabric Group Micrographs, Arrows Pointing to Carbonate in an Isotropic Matrix (Upper Left: BKP15, PPL; Upper Right: BKP15, XPL; Lower Left: BKP44, PPL; Lower Right: BKP44, XPL).

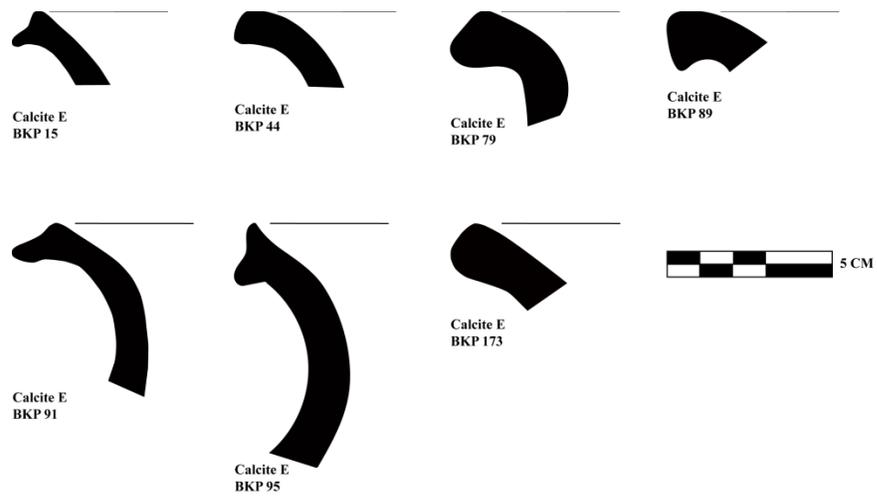


Figure D.7. Calcite E Rim Forms.

CALCITE ONE-OFF FABRIC GROUPS

CALCITE F

Samples: 174

I. Microstructure

- (a) **Voids:** Few voids, predominantly mesochannels with rare microchannels and mesovughs
- (b) **c/f related distribution:** Closed-spaced to single-spaced, porphyric related distribution
- (c) **Preferred orientation:** Voids are oriented parallel to vessel margins. Inclusions show no preferred orientation.

II. Groundmass

- (a) **Homogeneity:** Voids are evenly distributed across the fabric group. Larger terminal grade calcite, dolomite, and quartz are unevenly distributed. The color varies due to the presence of a dark core.
- (b) **Micromass:** Slightly optically active. The b-fabric is speckled. The core is brown and the margins are a dark yellow brown in PPL (x40) and the core is a dark greyish brown and the margins are a dark golden brown in XPL (x40)
- (c) **Inclusions:** The size distribution is bimodal with an upper size class (>0.1mm) composed of calcite terminal grades (dominant), dolomite (dominant), monocrystalline quartz (few), sparry calcite (rare), chert (very rare), and perthite (very rare). The lower size class (<0.1mm) is composed of calcite and monocrystalline quartz. The largest inclusion is 0.8mm (sparry calcite) and 98% of the inclusions range in size from 0.1mm to 0.6mm. The fabric is poorly sorted.

c:f:v_{100μ} : 15:80:5

Coarse Inclusions (>0.1mm)

Dominant

Calcite Terminal Grades: Subrounded to subangular, equant to irregular, they range in size from 0.1mm (very fine sand) to 0.6mm (coarse sand) with a mode size of 0.15mm (fine sand).

Dolomite Terminal Grades: Subrounded to subangular, equant to irregular, they range in size from 0.1mm (very fine sand) to 0.6mm (coarse sand) with a mode size of 0.15mm (fine sand).

Few

Monocrystalline quartz: Subrounded to subangular, equant to elongated, they range in size from 0.1mm (very fine sand) to 0.75mm (very coarse sand) with a mode size of 0.15mm (fine sand).

Rare

Sparry Calcite: Subrounded to subangular, they range in size from 0.2mm (fine sand) to 0.8mm (very coarse sand) with a mode size of 0.35mm (medium sand).

Very Rare

Chert: Rounded, equant, fine sand sized.

Perthite: Rounded, equant, fine sand sized.

Fine Inclusions (<0.1mm)

Few: Calcite and Monocrystalline quartz

III. Textural Concentration Features

Very few concentration features that appear to be the remains of organic inclusions. They are very dark brown in PPL and XPL, merging boundaries, moderate optical density, and are generally elongated. They are only present in the interior of the sample.

IV. Amorphous Concentration Features

Rare, black (PPL and XPL) nodules, high optical density, merging boundaries, equant to elongated, very fine to fine sand sized.

COMMENTS**Paste Technology**

The Calcite F fabric group is characterized by evenly distributed calcite and dolomite terminal grades as well as smaller monocrystalline quartz that were likely part of the natural clay. Large terminal grades of calcite and dolomite terminal grades, quartz, and sparry calcite are unevenly distributed and were likely added as temper. The bimodal and uneven distribution of these aplastics, in conjunction with their angularity, indicates that they were added as tempering material. This fabric was likely tempered with dolomitic limestone but the limestone was well-processed as there are very few large rock fragments present.

Provenance

Possibly local, the abundance of dolomite in this fabric and organics are unusual.

CALCITE G

Samples: 170

I. Microstructure

- (a) *Voids*: Common voids, mesochannels and meso- and macrovughs
- (b) *c/f related distribution*: Closed-spaced to double-spaced, porphyric related distribution
- (c) *Preferred orientation*: Voids and inclusions show no preferred orientation.

II. Groundmass

- (a) *Homogeneity*: Voids and inclusions are unevenly distributed
- (b) *Micromass*: Optically active. The b-fabric is monostriated. The color in PPL is a reddish brown (x40) and the color in XPL is a golden reddish brown (x40).
- (c) *Inclusions*: The size distribution is bimodal with an upper size class (>0.1mm) composed of terminal grade calcite (predominant), sparry calcite (few), crystalline calcite (few), monocrystalline quartz (rare), polycrystalline quartz (rare), and chert (rare). The lower size class (<0.1mm) is composed of calcite (frequent), quartz (few), and muscovite (rare). The largest inclusion is 1mm (sparry calcite) and 98% of the inclusions range in size from 0.1mm to 0.5mm. The fabric is poorly sorted.

c:f:v_{100μ} : 60:25:15

Coarse Inclusions (>0.1mm)

Predominant

Terminal Grade Calcite: Subrounded to angular, they range in size from 0.1mm (very fine sand) to 0.75mm (very coarse sand) with a mode size of 0.25mm (medium sand).

Few

Sparry Calcite (finely to coarsely crystalline): Subrounded to subangular, they range in size from 0.25mm (medium sand) to 1mm (very coarse sand) with a mode size of 0.35mm (medium sand)

Crystalline Calcite: Angular, elongated (rhombic), they range in size from 0.25mm (medium sand) to 0.5mm (coarse sand) with a mode size of 0.5mm (coarse sand).

Rare

Monocrystalline Quartz: Rounded, equant to elongated, very fine to fine sand sized.

Polycrystalline Quartz: Rounded, equant, very fine to fine sand sized.

Chert: Rounded, equant, very fine to fine sand sized.

Coarse Inclusions (<0.1mm)

Frequent: Calcite

Few: Quartz

Rare: Muscovite

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Very Few black to reddish brown amorphous concentration features with a high optical density. They are predominantly rounded and equant to elongated though some are irregularly shaped. Sharp to merging boundaries with rare channel voids around them. They range in size from 0.02mm (silt) to 0.6mm (coarse sand) with a mode size of 0.45mm (medium sand). Very Few larger (very coarse sand sized), rounded, equant, amorphous concentration features with silt sized inclusions that are discordant with the orientation of features in the surrounding fabric. These features have sharp to merging boundaries.

COMMENTS**Paste Technology**

The Calcite F fabric group is characterized by a very gritty, red fabric that is distinctive in the sample. The fabric is tempered with crushed medium to coarsely crystalline limestone. The bimodal and uneven distribution of these aplastics, in conjunction with their angularity, indicates that they were added as tempering material.

Provenance

The temper is consistent with limestones used to temper other thin-walled vessels in the Belize River Valley but because there is only one sample of this fabric group it is considered possibly local at this time.

CALCITE H

Samples: 164

I. Microstructure

- (a) **Voids:** Few voids, predominantly mesochannels with few meso- and macrovughs. There are carbonate shaped voids that are limited to the exterior margins.
- (b) **c/f related distribution:** Single-spaced to double-spaced, porphyric related distribution.
- (c) **Preferred orientation:** Voids are weakly oriented to vessel margins. Inclusions show now preferred orientation.

II. Groundmass

- (a) **Homogeneity:** Voids and inclusions are unevenly distributed. The color varies due to the presence of a core.
- (b) **Micromass:** Optically active. The b-fabric is granostriated. The margins are a light brown and the core is a reddish brown in PPL (x40). The margins are a golden brown and the core dark reddish brown in XPL (x40).
- (c) **Inclusions:** The size distribution is bimodal with an upper size class (>0.1mm) composed of terminal grade calcite (frequent), sparry calcite (very few), crystalline calcite (very few), micrite (very few), monocrystalline quartz (rare), chert (rare), and isotropic spherules (rare). The lower size class (<0.1mm) is composed of calcite and quartz (few). The largest inclusion is 0.9mm (sparry calcite) and 98% of inclusions range in size from 0.1mm to 0.5mm. The fabric is poorly sorted.

c:f:v_{100μ} : 35:55:10

Coarse Inclusions (>0.1mm)

Frequent

Terminal Grade Calcite: Subrounded to angular, they range in size from 0.1mm (very fine sand) to 0.75mm (very coarse sand) with a mode size of 0.25mm (medium sand).

Very Few

Sparry Calcite (finely to coarsely crystalline): Subrounded to subangular, they range in size from 0.25mm (medium sand) to 0.9mm (coarse sand) with a mode size of 0.35mm (medium sand)

Crystalline Calcite: Angular, equant to elongated (rhombic), they range in size from 0.25mm (medium sand) to 0.5mm (coarse sand) with a mode size of 0.5mm (coarse sand).

Micrite: Rounded, equant to irregular, they range in size from 0.1mm (very fine sand) to 1mm (very coarse sand) with a mode size of 0.4mm (medium sand). The larger micrite is bioclastic and is occasionally attached to sparry calcite.

Rare

Monocrystalline Quartz: Rounded, equant to elongated, very fine to fine sand sized.

Chert: Rounded, equant, very fine to fine sand sized.

Isotropic Spherules: Rounded, equant, medium sand sized.

Coarse Inclusions (>0.1mm)

Few: Calcite and Quartz

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Rare black to reddish brown amorphous concentration features with a moderate to high optical density. They are predominantly rounded and equant to elongated though some are irregularly shaped. Sharp to merging boundaries with rare channel voids around them. They range in size from 0.02mm (silt) to 0.6mm (coarse sand) with a mode size of 0.45mm (medium sand).

COMMENTS**Paste Technology**

The Calcite G fabric group is tempered with crushed limestone consisting primarily of sparry calcite and micrite. There are rare glass spherules and very rare occurrence of non-carbonate inclusions, including in the natural clay.

Provenance

The temper is consistent with limestones used to temper other thin-walled vessels in the Belize River Valley but because there is only one sample of this fabric group it is considered possibly local at this time.

CALCITE I

Samples: 33

I. Microstructure

(a) *Voids*: Few micro to mesochannels, very few micro to mesovughs

There are carbonate shaped voids that are limited to the exterior margins.

(b) *c/f related distribution*: Single-spaced to double-spaced porphyric distribution

(c) *Preferred orientation*: Channel voids oriented parallel to the vessel margins.

Inclusions show no preferred orientation

II. Groundmass

(a) *Homogeneity*: Voids are evenly distributed. Inclusions are unevenly distributed.

(b) *Micromass*: Slightly optically active. The b-fabric is granostriated. The fabric has a reddish brown core and brown margins in PPL (x40) reddish brown core and golden brown margins in XPL (x40).

(c) *Inclusions*: The size distribution is bimodal with an upper size class (>0.125mm) composed of terminal grade calcite (frequent), sparry calcite (very few), monocrystalline quartz (very few), chert (rare), and chalcedony (rare). The lower size class (<0.125mm) is composed of calcite, quartz, chert, and chalcedony (very few) and zircon (very rare). The largest inclusion is 0.6mm (terminal grade calcite, sparry calcite, and chert) and 98% of inclusions range in size from 0.125mm to 0.5mm. The fabric is moderately sorted.

c:f:v_{125μ} : 50:40:10

Coarse Inclusions (>0.125mm)

Frequent

Terminal Grade Calcite: Predominantly rounded and equant with a few elongated and irregular grains. They range in size from 0.1mm (fine sand) to 0.6mm (coarse sand) with a mode size of 0.2mm (medium sand).

Very Few

Sparry Calcite (finely to medium crystalline): Equant to elongated, rounded to subrounded. They range in size from 0.35mm (medium sand) to 0.6mm (coarse sand) with a mode size of 0.35mm (medium sand).

Monocrystalline Quartz (undulose and non-undulose): Rounded to subrounded, equant to elongated, and range in size from 0.2mm (fine sand) to 0.6mm (coarse sand) with a mode size of 0.2mm (fine sand).

Rare

Chert and Chalcedony (secondary): Rounded to subrounded, equant to elongated, and range in size from 0.2mm (fine sand) to 0.6mm (coarse sand) with a mode size of 0.2mm (fine sand).

Fine Inclusions (<0.125mm)

Very Few: Calcite, quartz, chert, chalcedony

Very Rare: Zircon

III. Textural Concentration Features

Very rare, brown reddish brown (PPL and XPL), rounded, equant clay pellets. They range in size from 0.15mm to 0.65mm with a mode size of 0.3mm. They have a moderate optical density (slightly more dense than the surrounding fabric), boundaries are clear to merging, some pellets are partially surrounded by channel voids. Pellets have quartz inclusions and red and black amorphous concentration features; inclusions are discordant with the orientation of inclusions in the surrounding matrix.

IV. Amorphous Concentration Features

Few red to reddish brown to black amorphous concentration features with a high optical density. They are predominantly rounded and equant to elongated though some are irregularly shaped. Sharp to merging boundaries with rare channel voids around them. They range in size from .02mm (silt) to .6mm (coarse sand) with a mode size of .45mm (medium sand).

COMMENTS**Paste Technology**

The Calcite I fabric is characterized by a very dense, reddish brown fabric that is sparsely tempered with crushed limestone (bimodal, angular, uneven distribution). There are very few non-carbonate inclusions in the natural clay.

Provenance

The temper is consistent with limestones used to temper other thin-walled vessels in the Belize River Valley but because there is only one sample of this fabric group it is considered possibly local at this time.

CALCITE J

Samples: BKP3

I. Microstructure

- (b) *Voids:* Few micro to mesochannels, very few micro to mesovughs
 (b) *c/f related distribution:* Single-spaced to double-spaced porphyric distribution
 (c) *Preferred orientation:* Channel voids oriented parallel to the vessel margins.
 Inclusions show no preferred orientation

II. Groundmass

- (a) *Homogeneity:* Voids are evenly distributed. Inclusions are unevenly distributed.
 (b) *Micromass:* Slightly optically active. The b-fabric is granostriated. The fabric is brown in PPL (x40) and reddish golden brown in XPL (x40).
 (c) *Inclusions:* The size distribution is bimodal with an upper size class (>0.125mm) composed of terminal grade calcite (common), sparry calcite (few), monocrystalline quartz (very few), chert (rare), chalcedony (rare), and crystalline calcite (rare). The lower size class (<0.125mm) is composed of calcite, quartz, chert, and chalcedony (very few) and zircon (very rare). The largest inclusion is 1mm (sparry calcite) and 98% of inclusions range in size from 0.125mm to 0.5mm. The fabric is moderately sorted.

c:f:v _{125μ} : 40:50:10

Coarse Inclusions (>0.125mm)

Common

Terminal Grade Calcite: Predominantly rounded and equant with a few elongated and irregular grains. They range in size from 0.1mm (fine sand) to 0.6mm (coarse sand) with a mode size of 0.2mm (medium sand).

Few

Sparry Calcite (finely to coarsely crystalline): Equant to elongated, rounded to subrounded. They range in size from 0.35mm (medium sand) to 1mm (coarse sand) with a mode size of 0.35mm (medium sand).

Very Few

Monocrystalline Quartz (undulose and non-undulose): Rounded to subrounded, equant to elongated, and range in size from 0.2mm (fine sand) to 0.6mm (coarse sand) with a mode size of 0.2mm (fine sand).

Rare

Chert and Chalcedony (secondary): Rounded to subrounded, equant to elongated, and range in size from 0.2mm (fine sand) to 0.6mm (coarse sand) with a mode size of 0.2mm (fine sand).

Crystalline Calcite: Subangular to angular, equant to elongated, most have the typical crystalline calcite rhombic shape. They range in size from 0.3mm (medium sand) to 0.85 mm (coarse sand) with a mode size of 0.5mm (coarse sand).

Fine Inclusions (<0.125mm)

Very Few: Calcite, quartz, chert, chalcedony

Very Rare: Zircon

III. Textural Concentration Features

Very rare, brown reddish brown (PPL and XPL), rounded, equant clay pellets. They range in size from 0.15mm to 0.65mm with a mode size of 0.3mm. They have a moderate optical density (slightly more dense than the surrounding fabric), boundaries are clear to merging, some pellets are partially surrounded by channel voids. Pellets have quartz inclusions and red and black amorphous concentration features; inclusions are discordant with the orientation of inclusions in the surrounding matrix.

IV. Amorphous Concentration Features

Few red to reddish brown to black amorphous concentration features with a high optical density. They are predominantly rounded and equant to elongated though some are irregularly shaped. Sharp to merging boundaries with rare channel voids around them. They range in size from 0.02mm (silt) to 0.6mm (coarse sand) with a mode size of 0.45mm (medium sand).

COMMENTS

Paste Technology

The Calcite J fabric is very similar to Calcite I (BKP33) but with fewer inclusions in general, more sparry calcite, and the presence of crystalline calcite. These could possibly be combined into a single fabric group.

Provenance

The temper is consistent with limestones used to temper other thin-walled vessels in the Belize River Valley but because there is only one sample of this fabric group it is considered possibly local at this time.

CALCITE K

Samples: 63

I. Microstructure

- (a) *Voids*: Few micro to mesochannels, very few micro to mesovughs
- (b) *c/f related distribution*: Single-spaced to double-spaced porphyric related distribution
- (c) *Preferred orientation*: Channel voids are oriented parallel to the vessels margins (including at the lip where the channel voids change direction but remain parallel to the vessel wall). Inclusions show no preferred orientation.

II. Groundmass

- (a) *Homogeneity*: Voids are evenly distributed. Inclusions are unevenly distributed. The core varies due to the presence of a dark core.
- (b) *Micromass*: Slightly optically active. The b-fabric is monostriated. The color is a pale tan core with a slightly darker margins in PPL (x40) and a mottled light greyish brown in XPL (x40).
- (c) *Inclusions*: The size distribution is bimodal with an upper size class (>0.125mm) composed of terminal grade calcite (common), micrite (common), monocrystalline quartz (few), sparry calcite (rare), polycrystalline quartz (rare), and perthite (very rare). The lower size class (<0.125mm) is composed of calcite, monocrystalline quartz, and micrite (few), polycrystalline quartz, muscovite, and feldspar (rare) and zircon (very rare). The largest inclusion is 1.7mm (micrite) and 98% of inclusions range in size from 0.125mm to 1mm. The fabric is poorly sorted.

c:f:v_{125μ} : 50:40:10

Coarse Inclusions (>0.125mm)

Common

Calcite Terminal Grades: Subrounded to subangular, predominantly equant with a few elongated and irregular grains. They range in size from 0.125mm (fine sand) to 0.75mm (coarse sand) with a mode size of 0.3mm (medium sand).

Micrite: Rounded to subrounded, equant to elongated to irregularly shaped. A few of the grains are attached to sparite fragments indicating these are from the same parent rock source. They range in size from 0.125mm (fine sand) to 1.77mm (very coarse sand) with a mode size of .4mm (medium sand). The size and shape of small, rounded micrite is similar to the terminal grade calcite described above. Irregularly shaped micrite range in size 0.75mm (coarse sand) to 1.2mm (very coarse sand) and are bioclastic.

Few

Monocrystalline Quartz (Undulose): Predominantly rounded, equant to elongated. Rare subangular, equant to elongated particles. They range in size from 0.125mm

(fine sand) to 1mm (coarse sand) with a mode size of 0.3mm (medium sand). The larger particles sizes are very rare.

Rare

Sparry Calcite (finely to coarsely crystalline): Subrounded to subangular, equant to elongated (the rock breaks along the individual calcite grains), they range in size from 0.75mm (coarse sand) to 1mm (very coarse sand) with a mode size of 0.9mm (coarse sand). The finely crystalline sparry calcite is attached to micrite and do not exist as discrete grains.

Polycrystalline Quartz: Predominantly rounded, equant to elongated to irregular. Rare subangular to equant to elongated particles. They range in size from 0.125 mm (fine sand) to 0.25mm (fine sand) with a mode size of 0.25mm (fine sand). The size and roundness of the polycrystalline quartz inclusions suggest they are natural to the clay source.

Very Rare

Perthite: There is one perthite grain in the coarse fraction. It is subrounded, equant, and measures 1.25mm (very coarse sand).

Fine Inclusions (<0.125mm)

Few: Calcite, monocrystalline quartz, and micrite

Rare: Polycrystalline quartz, muscovite, feldspar

Very Rare: Zircon

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Very rare nodules, black (PPL and XPL), rounded, equant, high optical density, merging boundaries, coarse silt to fine sand sized.

COMMENTS

Paste Technology

The Calcite K fabric group is characterized by a very pale tan (PPL) and greyish brown (XPL) fabric. The natural clay is micritic and is tempered with abundant micrite temper and sparry calcite in a micrite matrix.

Provenance

The temper is consistent with limestones used to temper other thin-walled vessels in the Belize River Valley but because there is only one sample of this fabric group it is considered possibly local at this time.

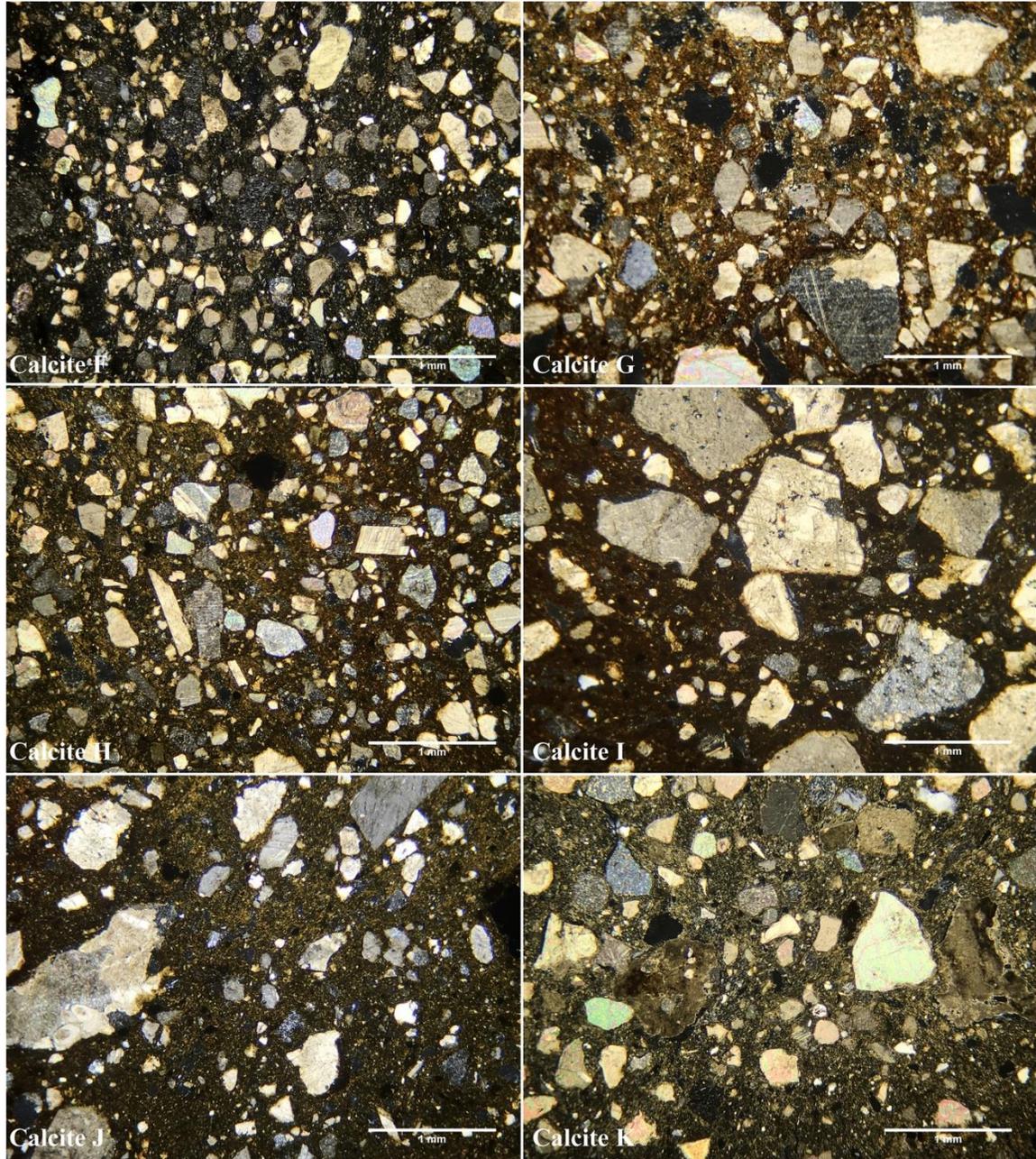


Figure D.8. Calcite F to Calcite K Micrographs (XPL).

CALCITE L

Samples: BKP70

I. Microstructure

- (a) ***Voids:*** Few voids, predominantly mesochannels, rare micro to macrovughs
- (b) ***c/f related distribution:*** Single-spaced to open-spaced, porphyric related distribution
- (c) ***Preferred orientation:*** Channel voids are oriented parallel to the vessel walls (including at the lip where the channel voids change direction but remain parallel to the vessel wall). Inclusions have a weakly developed preferred orientation to the vessel walls.

II. Groundmass

- (a) ***Homogeneity:*** Voids are evenly distributed. Inclusions are unevenly distributed.
- (b) ***Micromass:*** Optically active with a monostriated B-fabric. The fabric is medium brown in PPL and golden brown in XPL.
- (c) ***Inclusions:*** The size distribution is bimodal with an upper size class (>0.1mm) composed of terminal grade calcite (frequent), micrite (frequent), monocrystalline quartz (few), chert (few), chalcedony (few), and zircon (very rare). The lower size class (<0.1mm) is composed of crystalline calcite (common), monocrystalline quartz (few), chert (few), chalcedony (few), and zircon (very rare). The largest inclusion is 1.75mm (micrite) and 98% of inclusions range in size from 0.15 mm to 1mm. The fabric is poorly sorted.

c:f:v _{150μ}: **40:50:10**

Coarse Inclusions (>0.1mm)

Frequent

Terminal Grade Calcite: Subrounded to subangular, predominantly equant with a few elongated and irregular grains. They range in size from 0.15mm (fine sand) to 0.6mm (coarse sand) with a mode size of 0.2mm (medium sand). The terminal grades in this group are smaller than others likely due to a smaller sparite parent rock.

Micrite: Large, rounded to subrounded, rounded to elongated to irregular micrite lumps. They range in size from 0.6mm to 1.75mm (very coarse sand) with a mode size of 0.85mm (medium sand). The micrite is occasionally attached to small sparite fragments and/or crystalline calcite, is bioclastic, and has amorphous iron-rich nodules inside.

Common

Monocrystalline (undulose) quartz: Rounded to subrounded, equant to elongated, they range in size from 0.15mm (fine sand) to 0.85mm (coarse sand) with a mode size of 0.35mm (medium sand).

Few

Chert and Chalcedony (Secondary): Grains are equant to elongated, rounded, and range in size from 0.15mm (fine sand) to 0.7mm (coarse sand) with a mode size of 0.4mm to 0.5mm (medium sand).

Fine Inclusions (<0.15mm)**Common**

Crystalline Calcite: Rounded, Equant, they range in size from 0.04mm (coarse silt) to 0.1mm (fine sand) with a mode size of 0.7mm (very fine sand).

Few

Monocrystalline undulose quartz: Rounded to subrounded, equant to elongated, they range in size from 0.04mm (coarse silt) to 0.1 mm (fine sand) with a mode size of 0.7mm (very fine sand).

Chert/Chalcedony (secondary): Rounded, equant to elongated, they range in size from 0.04mm (coarse silt) to 0.1 mm (fine sand) with a mode size of 0.7mm (very fine sand).

Very Rare

Zircon: Rounded, 0.1mm (very fine sand)

III. Textural Concentration Features

Few clay pellets, reddish brown (PPL and XPL), rounded, equant, moderate optical density, merging boundaries, they range in size from fine sand to coarse sand sized. The larger pellets have silt sized quartz inclusions that are discordant with the surrounding matrix.

IV. Amorphous Concentration Features

None

COMMENTS**Paste Technology**

The Calcite L is characterized as a gritty natural clay tempered with micrite (bimodal, uneven distribution). There is abundant quartz, chert, and chalcedony in the natural clay.

Provenance

The temper is consistent with limestones used to temper other thin-walled vessels in the Belize River Valley but because there is only one sample of this fabric group it is considered possibly local at this time.

CALCITE M

Samples: BKP61

I. Microstructure

- (a) ***Voids:*** Common voids, common micro to mesochannels, very few micro to mesovughs
- (b) ***c/f related distribution:*** Single-spaced to double-spaced porphyric distribution
- (c) ***Preferred orientation:*** Channel voids are oriented parallel to vessel walls, inclusions are weakly oriented to the vessel walls

II. Groundmass

- (a) ***Homogeneity:*** Voids are evenly distributed. Inclusions are unevenly distributed.
- (b) ***Micromass:*** Minimally birefringent with a speckled B-fabric. The fabric is a reddish brown in PPL and a golden dark reddish brown in XPL (x40).
- (c) ***Inclusions:*** The size distribution is bimodal. The upper size class (>0.1mm) is composed of carbonate sand (frequent), terminal grade calcite (few), sparry calcite (very few), micrite (rare), monocrystalline quartz (rare), polycrystalline quartz (very rare), and shell (very rare). The lower size class (<0.1mm) is composed of calcite (few), monocrystalline quartz and muscovite (very few), polycrystalline quartz and chert (rare), and perthite, feldspar, and zircon (very rare). The largest inclusions measures 2.05mm (sparry calcite+micrite limestone) and 98% of the inclusions range in size from 0.1mm to 1.5mm. This fabric is poorly sorted.

c:f:v _{10μ}: 35:50:15

Coarse Inclusions (>0.1mm)

Frequent

Carbonate Sand: Rounded, predominantly equant with a few elongated grains, they range in size from 0.1mm (very fine sand) to 0.4mm (medium sand) with a mode size of 0.2mm (fine sand).

Few

Terminal Grade Calcite: Terminal grades calcite range in size from fine to coarse. The smaller terminal grades are subrounded to subangular, predominantly equant with a few elongated and irregular grains. They range in size from 0.1mm (fine sand) to 0.75mm (coarse sand) with a mode size of 0.3mm (medium sand). The larger terminal grades are. They are predominantly equant to elongated though there are some irregular shapes that may have been formed as calcite crystals were detached from coarse grained calcarenites. They range in size from 0.5mm (coarse sand) to 2.05mm (coarse sand) with a mode size of 0.9mm. Rare examples are attached to fine grained sparry calcite and micrite indicating that the parent rock was composed of both micrite and sparry calcite. They range in size from 0.5mm (coarse sand) to 2.05mm (coarse sand) with a mode size of 0.9mm. Some inclusions have bioclastic ghosts.

Very Few

Sparry Calcite (medium to coarsely crystalline mosaics): Subrounded, equant to elongated (the rock breaks along the individual calcite grains), they range in size from 0.75mm (coarse sand) to 1.75mm (very coarse sand) with a mode size of 0.9mm (coarse sand). Rare examples are calcite crystals in a micrite matrix.

Rare

Micrite: Rounded micrite inclusions are the same size and shape as the carbonate sand. Irregularly shaped micrite ranges in size from

Monocrystalline Quartz (Undulose): Rounded to subrounded, equant to elongated to irregular. They range in size from 0.1mm (very fine sand) to 0.45 mm (medium sand) with a mode size of 0.3mm (medium sand).

Very Rare

Polycrystalline Quartz: Rounded, elongated, 0.3mm (medium sand).

Shell: Half-moon shaped, 0.46mm (medium sand), modern shell associated with the clay.

Fine Inclusions (<0.1mm)

Few: Crystalline Calcite

Very Few: Monocrystalline quartz, muscovite

Rare: Polycrystalline quartz, chert

Very Rare: Perthite, feldspar, quartz+feldspar rock fragments, zircon

III. Textural Concentration Features

Few clay pellets, reddish brown (PPL and XPL), rounded, equant to irregular, moderate optical density, merging boundaries, they range in size from fine sand to coarse sand sized. The larger pellets have silt sized quartz inclusions that are discordant with the surrounding matrix.

IV. Amorphous Concentration Features

Very rare nodules, black to dark reddish brown (PPL and XPL), rounded, equant, high optical density, merging boundaries, coarse silt to fine sand sized.

COMMENTS

Paste Technology

The Calcite M fabric group is characterized by a dense, reddish brown matrix (PPL) with carbonate sand (calcite and micrite) in the natural clay. Crushed limestone was added as temper (bimodal, angular, uneven distribution).

Provenance

The temper is consistent with limestones used to temper other thin-walled vessels in the Belize River Valley but because there is only one sample of this fabric group it is considered possibly local at this time.

CALCITE N

Samples: BKP85

I. Microstructure

- (a) ***Voids:*** Very Few voids, predominantly microchannels and microvughs, rare mesochannels and meso vughs
- (b) ***c/f related distribution:*** Closed-spaced to single-spaced, porphyric related distribution.
- (c) ***Preferred orientation:*** Inclusions show no preferred orientation, channel voids are oriented parallel to vessel margins.

II. Groundmass

- (a) ***Homogeneity:*** Inclusions and voids are unevenly distributed. The margins are slightly darker in color than the core.
- (b) ***Micromass:*** Slightly optically active. The b-fabric is crystallitic. The color in PPL is a very pale brown with slightly darker margins (x40). The color in XPL is a reddish golden brown with golden grey brown margins (x40).
- (c) ***Inclusions:*** The size distribution is bimodal with an upper size class (>0.05mm) composed by predominant, finely crystalline terminal grade calcite, monocrystalline quartz (few), sparry calcite (few), and polycrystalline quartz (very rare). The lower size class (<0.05mm) is composed of calcite (predominant), monocrystalline quartz (common), and polycrystalline quartz (rare). The largest inclusion is 1.5mm (sparry calcite) and 98% of inclusions range in size from 0.05mm (coarse silt) to 0.75mm (coarse sand). All inclusions are subrounded to rounded. This fabric is moderately well-sorted.

c:f:v_{50μ} : 80:15:5

Coarse Inclusions (>0.05mm)

Predominant:

Terminal Grade Calcite: Terminal grades calcite range are predominantly finely crystalline. Subrounded, equant to elongated to irregular. They range in size from 0.05mm (coarse silt) to 0.3mm (coarse sand) with a mode size of 0.1mm (very fine sand).

Few

Monocrystalline Quartz: They range in size from 0.05mm (coarse silt) to 0.75mm (coarse sand) with a mode size of 0.15mm (fine sand). Subrounded to rounded, equant to elongated to irregular.

Sparry Calcite (finely to coarsely crystalline): Subrounded, equant to elongated, they range in size from 0.4mm (medium sand) to 1.5mm (very coarse sand) with a mode size of 0.5mm (medium sand).

Very Rare

Polycrystalline Quartz: Rounded, elongated, 0.8mm (coarse sand)

Fine Inclusions (>0.05mm)

Predominant: Calcite

Common: Monocrystalline Quartz

Rare: Polycrystalline Quartz

III. Textural Concentration Features

Few clay pellets, mottled black and reddish brown (PPL and XPL), rounded, equant, moderate optical density, merging boundaries, they range in size from coarse sand to very coarse sand sized. The larger pellets have silt sized quartz inclusions that are discordant with the surrounding matrix.

Few depletion features. Same characteristics as above but grey mottled with dark reddish brown in XPL. They are elongated to irregular and are coarse sand to granule sized.

IV. Amorphous Concentration Features

Few rare nodules, black to dark reddish brown (PPL and XPL), rounded, equant, high optical density, merging boundaries, coarse silt to fine sand sized.

COMMENTS**Paste Technology**

The Calcite N fabric is characterized by larger calcite terminal grades, sparry calcite, and monocrystalline quartz are unevenly distributed and likely added as temper (bimodal, uneven distribution). The inclusions, with the exception of the added temper, are very small. The abundance of reddish textural concentration features and grey depletion features is distinctive.

Provenance

The temper is consistent with limestones used to temper other thin-walled vessels in the Belize River Valley but because there is only one sample of this fabric group it is considered possibly local at this time.

CALCITE O**Samples: BKP60**

See Howie's (2005:607-609; 2012: 142) description of Calcite A at Lamanai. This sample appears to be an import.

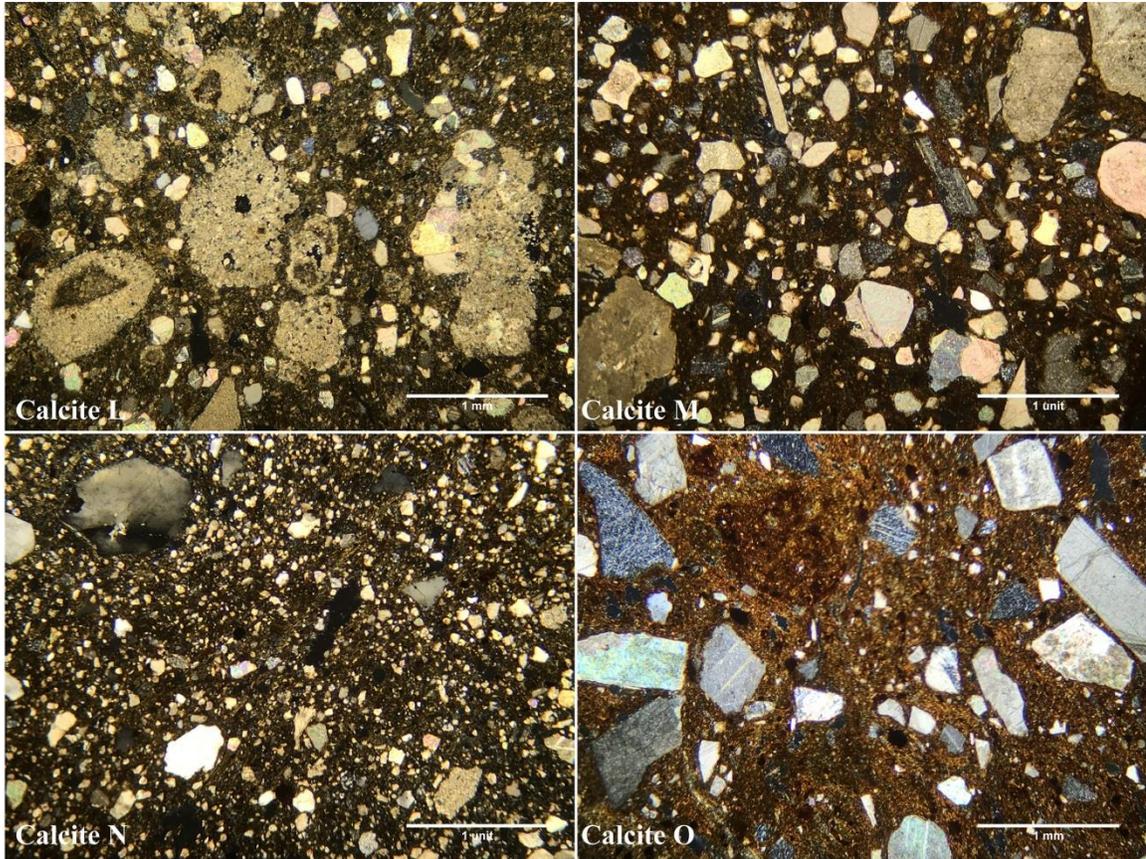


Figure D.9. Calcite I to Calcite O Micrographs (XPL).

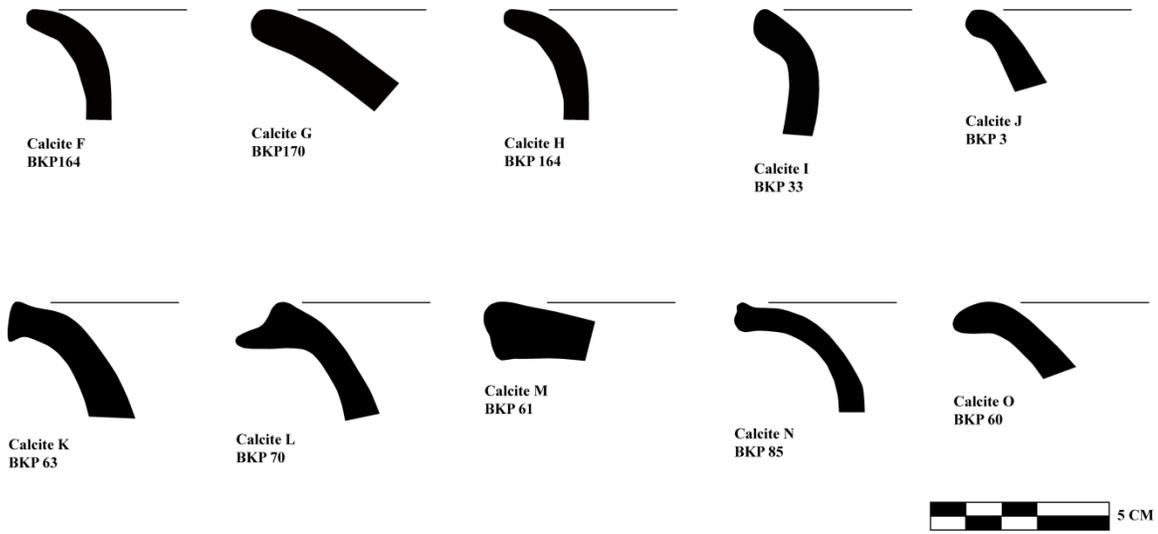


Figure D.10. Calcite F to Calcite O Rim Profiles.

CARBONATE SAND FABRIC GROUPS

None of the carbonate sand fabrics contain shell indicating that they were not produced using sands from a coastal environment. Sunahara (2005:114) reported the use of carbonate sand used by local potter David Mangaña in the village of San Jose Succotz located just across the Mopan River from Xunantunich. However, carbonate sand is not reported in the geologic literature of the region and was not sampled for this study. Another source of carbonate sand is Late Petén Itza in northern Guatemala (Mueller et al. 2010:1228). All of the carbonate sand fabrics are considered possibly local pending additional geologic sourcing or comparative petrographic information on pottery. I have indicated in the comments section of each fabric description if it is likely non-local or local based on comparison with the limestone and/or clays from the Belize River Valley addressed in this study.

CARBONATE SAND A

Samples: 49

I. Microstructure

- (a) ***Voids:*** Few voids, predominantly microchannels, rare mesochannels, rare micro- to mesovughs.
- (b) ***c/f related distribution:*** Closed-spaced porphyric related distribution
- (c) ***Preferred orientation:*** Voids are parallel and perpendicular to the vessel margins; inclusions show no preferred orientation.

II. Groundmass

- (a) ***Homogeneity:*** Voids, carbonate sand, and calcite terminal grades are evenly distributed throughout the fabric. Pelmicrite and soil features are unevenly distributed throughout the matrix. Smaller quartz grains are evenly distributed while larger quartz grains are unevenly distributed.
- (b) ***Micromass:*** Optically inactive. The color in PPL is brown (x40) and the color in XPL is dark brown (x40).
- (c) ***Inclusions:*** The size distribution is unimodal but a few fragments of pelmicrite hint at a bimodal distribution. The upper size class (>0.02mm) is composed of carbonate sand (predominant), calcite terminal grades (common), pelmicrite (few), micrite (few), sparry calcite (very few), dolomite (very few), and monocrystalline quartz (rare). The lower size class (<0.02mm) is composed of calcite (few) and quartz (rare). The largest inclusion is 1.95mm (pelmicrite) and 98% of the inclusions range in size between 0.0625mm (coarse silt) and 0.3mm (medium sand) with a mode size of 0.08mm (very fine sand). The fabric is moderately well-sorted.

c:f:v _{62μ} : 50:30:10

Coarse Inclusions (>0.0625mm)

Predominant

Carbonate Sand: Rounded, equant, they range in size from 0.0625mm (coarse silt) to 0.4mm (medium sand) with a mode size of 0.08mm (very fine sand)

Common

Terminal Grade Calcite: Subrounded to subangular, equant to elongated, they range in size from 0.0625mm (coarse silt) to 0.3mm (medium sand) with a mode size of 0.15mm (fine sand).

Few

Pelmicrite: Rounded, equant to elongated, they range in size from 0.3mm (medium sand) to 1.95mm (very coarse sand) with a mode size of 0.85mm (coarse sand). Some of the micrite is bioclastic.

Micrite: Rounded, equant to elongated, they range in size from 0.0625mm (coarse silt) to 1.25mm (coarse sand) with a mode size of 0.25mm (medium sand).

Very Few

Sparry Calcite (medium to coarsely crystalline): Subrounded, equant to irregular, they range in size from 0.15mm (fine sand) to 0.5mm (coarse sand) with a mode size of 0.4mm (medium sand).

Dolomite: Some grains show a darkened, inclusion rich core and a clear rim possibly indicative of the dolomite component. Subrounded to subangular, equant to elongated, they range in size from 0.0625mm (coarse silt) to 0.3mm (medium sand) with a mode size of 0.15mm (fine sand).

Rare

Monocrystalline Quartz (undulose): Rounded, equant to elongated, they range in size from 0.1mm (very fine sand) to 0.4mm (medium sand) with a mode size of 0.2mm (fine sand).

Fine Inclusions (>0.0625mm)

Few: Calcite

Rare: Quartz

III. Textural Concentration Features

Few clay pellets. Brown with dark reddish brown to black nodules (PPL and XPL). The pellets include silt sized calcite inclusions that are discordant with the surrounding matrix, moderate optical density, diffuse to merging boundaries, rounded, equant to elongated, they range in size from 0.06mm (coarse silt) to 1.35mm (very coarse sand). The smaller clay pellets do not have calcite inclusions. There are also greyish brown with a greenish hue clay pellets (PPL and XPL) with the same characteristics described above.

Very rare clay pellet comprised of multiple, connected, rounded and equant clay pellets, clear to merging boundaries, partially surrounded by a channel voids moderate optical density. It is greyish brown with red streaks in PPL and a darker greyish brown in XPL. There are silt sized micrite inclusions that are discordant with the surrounding matrix. There is also a micritic coating on the entire clay pellet.

IV. Amorphous Concentration Features

None

COMMENTS

Paste Technology

Carbonate Sand A is a moderately well-sorted fabric characterized by evenly distributed carbonate sand and an optically inactive micromass. The carbonate sand, composed of both crystalline calcite and micrite, was part of the natural clay that also includes monocryalline quartz. The size distribution is unimodal; however, the fabric may have been tempered with finely crystalline sparry calcite limestone with a dolomite component. The sparry calcite is unevenly distributed and does not appear to be part of the natural clay suggesting it was used as temper. The small size of the inclusions suggests that the temper was highly processed prior to adding it to the clay. The optically inactive fabric is indicative of a high firing temperature.

Provenance

Carbonate Sand A has a possibly local provenance. Much of the limestone is pelmicrite which is not identified in any of the locally produced fabric groups. Furthermore, the optically inactive fabric is inconsistent with the optical activity of locally produced pottery. These characteristics suggests a provenance non-local to the Belize River Valley but is considered tentative pending additional research.

CARBONATE SAND B

Samples: 13

I. Microstructure

- (a) *Voids*: Common voids, predominantly mesochannels, very few mesovughs
 (b) *c/f related distribution*: Single-spaced to open-spaced, porphyric related distribution.
 (c) *Preferred orientation*: Voids are oriented parallel to the vessel margins. Inclusions are weakly oriented to the vessel margins.

II. Groundmass

- (a) *Homogeneity*: Voids and carbonate sand are evenly distributed. Terminal grade calcite and limestone are unevenly distributed.
 (b) *Micromass*: Optically active. The b-fabric is monostriated. The color in PPL is a reddish brown (x40) and the color in XPL is a golden reddish brown (x40).
 (c) *Inclusions*: The size distribution is bimodal with the upper size class (>0.0625mm) composed of carbonate sand (common), calcite terminal grades (common), sparry calcite (very few), micrite (very few), monocrystalline quartz (rare). The lower size class (<0.0625mm) is composed of calcite (few), monocrystalline quartz (rare), micrite (rare), muscovite (rare), and zircon (very rare). The largest inclusion is 1.6mm (sparry calcite) and 98% of inclusions range in size from 0.0625mm (very coarse silt) to 0.7mm (very coarse sand). This fabric is moderately well-sorted.

c:f:v _{62μ} : 40:50:10

Coarse Inclusions (>0.0625mm)

Common

Carbonate Sand: Rounded, equant, they range in size from 0.0625mm (coarse silt) to 0.25mm (medium sand) with a mode size of 0.15mm (fine sand).

Terminal Grade Calcite: Subrounded to Subangular, equant to irregular, they range in size from 0.1mm (very fine sand) to 0.7mm (coarse sand) with a mode size of 0.35mm (medium sand). The larger terminal grades are attached to micrite.

Very Few

Sparry Calcite (finely to coarsely crystalline): Rounded to subrounded, equant to elongated, they range in size from 0.3mm (medium sand) to 1.6mm (very coarse sand) with a mode size of 0.5mm (coarse sand). Many of these inclusions are finely crystalline calcite in a micrite matrix.

Micrite: Rounded to subrounded, equant to irregular, they range in size from 0.0625mm (coarse silt) to 0.7mm (coarse sand) with a mode size of 0.5mm (coarse sand).

Rare

Monocrystalline Quartz (undulose): Rounded, equant, they range in size from 0.0625mm (coarse silt) to 0.08mm (very fine sand) with a mode size of 0.08mm (very fine sand).

Fine Inclusions (<0.0625mm)

Few: Calcite

Rare: Monocrystalline quartz, micrite, muscovite

Very Rare: Zircon

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Rare, rounded, equant to elongated to irregular, high optical density amorphous concentration features. They are a dark reddish brown (PPL and XPL), clear to merging boundaries, the larger nodules have silt sized quartz inclusions that are discordant with the surrounding matrix. They range in size from 0.05mm (coarse silt) to 0.35mm (medium sand).

COMMENTS

Paste Technology

Carbonate Sand B is a moderately well-sorted fabric characterized by evenly distributed carbonate sand. The carbonate sand, composed of both crystalline calcite and micrite, was part of the natural clay that also includes monocrystalline quartz, muscovite, and zircon. The fabric contains limestone temper composed of well-processed, finely to coarsely crystalline sparry calcite. The limestone temper also likely contains a micrite component. There are very few limestone rock fragments in this fabric but their bimodal and uneven distribution in conjunction with the common terminal grades (the result of crushed limestone) suggest this fabric was tempered.

Provenance

Carbonate Sand B has a possibly local provenance. The sparry calcite limestone temper is consistent with limestones used to temper other thin-walled vessels in the Belize River Valley. However, there is only one sample of this fabric group and data on carbonate sand in the region is minimal so Carbonate Sand B is considered possibly local.

CARBONATE SAND C

Samples: 58

I. Microstructure

- (a) **Voids:** Few voids, predominantly mesochannels with very few microchannels and macrovughs.
- (b) **c/f related distribution:** Closed-spaced to single-spaced, porphyric related distribution
- (c) **Preferred orientation:** Voids are oriented parallel to vessel walls. Inclusions show no preferred orientation.

II. Groundmass

- (a) **Homogeneity:** Voids and carbonate sand are distrusted evenly across the fabric. A very few larger inclusion (terminal grade calcite, quartz, and mudstone) are unevenly distributed.
- (b) **Micromass:** Optically active. The b-fabric is speckled. The color in PPL is brown with reddish brown margins (x40). The color in XPL is a golden brown with golden reddish brown margins (x40).
- (c) **Inclusions:** This fabric is unimodal. The upper size class (>0.0625mm) is composed of carbonate sand (dominant), micrite (few), calcite terminal grades (very few), monocrystalline quartz (very few), sparry calcite (rare), polycrystalline quartz (very rare), and mudstone (very rare). The lower size class (<0.0625mm) is composed of calcite and quartz (common). The largest inclusion is 0.85mm (quartz) and most of the inclusions range in size from 0.0625mm (coarse silt) to 0.4mm (medium sand). This fabric is well-sorted.

c:f:v _{62μ} : 35:60:5

Coarse Inclusions (>0.0625mm)

Dominant

Carbonate Sand: Equant, rounded, they range in size from 0.0625mm (coarse silt) to 0.2mm (fine sand) with a mode size of 0.08mm (very fine sand).

Few

Micrite: Rounded to subrounded, equant to irregular, they range in size from 0.0625mm (coarse silt) to 0.4mm (medium sand) with a mode size of 0.25mm (medium sand).

Very Few

Calcite Terminal Grades: Rounded, equant, they range in size from 0.0625mm (coarse silt) to 0.35mm (medium sand) with a mode size of 0.14mm (fine sand). These represent sand rather than crushed limestone.

Monocrystalline Quartz: The quartz is predominantly equant, rounded, they range in size from 0.0625mm (coarse silt) to 0.3mm (medium sand) with a mode size of

0.1mm (very fine sand). There are two longer, angular quartz grains (0.65mm and 0.85mm). The larger inclusion contains glass and fluid inclusions.

Rare

Sparry Calcite (finely to medium crystalline): Subrounded, equant to elongated, they range in size from 0.12mm (fine sand) to 0.5mm (medium sand) with a mode size of 0.2mm (fine sand).

Very Rare

Polycrystalline Quartz + Chalcedony: Rounded, equant, 0.6mm (coarse sand).
Mudstone: Rounded, elongated, 0.9mm (coarse sand).

Fine Inclusions (<0.0625mm)

Common: Calcite and Quartz

III. Textural Concentration Features

Very rare clay pellet, medium sand sized, brown (PPL and XPL), merging boundaries, moderate optical density.

IV. Amorphous Concentration Features

Very Few (0.01mm to 0.1mm), equant and irregular, equant, black to dark reddish brown (PPL and XPL) nodules. They have moderate to high to dense optical density and have merging to clear boundaries. Some are partially surrounded by channel voids.

COMMENTS

Paste Technology

Carbonate Sand C is a well-sorted fabric characterized by evenly distributed carbonate sand. The carbonate sand, composed of both crystalline calcite and micrite, was part of the natural clay that also includes monocrySTALLINE quartz. The fabric is similar to Carbonate Sand B but the fabric is unimodal and lacking in larger, sparry calcite limestone inclusions and terminal grades. This may indicate that the Carbonate Sand C fabric is not tempered or that is tempered with very well-processed sparry calcite limestone that was thoroughly crushed prior to adding it to the clay.

Provenance

Carbonate Sand C has a possibly local provenance. A single mudstone fragment in this fabric is inconsistent with the other fabrics produced locally within the Belize River Valley. However, there is only one sample of this fabric group and data on carbonate sand in the region is minimal so Carbonate Sand C is considered possibly local.

CARBONATE SAND D

Samples: 1, 67, 68

I. Microstructure

- (a) **Voids:** Few voids, common microchannels, few mesochannels and mesovughs
 (b) **c/f related distribution:** Closed-spaced to single-spaced, porphyric related distribution
 (c) **Preferred orientation:** Voids are oriented parallel to vessel margins. Inclusions are weakly oriented to vessel margins. All samples carbonate shaped contain voids that are located along the exterior margin of the samples.

II. Groundmass

- (a) **Homogeneity:** Voids and most inclusions evenly distributed across the fabric. Terminal grade calcite is larger and unevenly distributed. There is a color difference due to the presence of a dark core. Sample 1 has more abundant monocrystalline quartz than Samples 67 and 68.
 (b) **Micromass:** Slightly optically active. The b-fabric is granostriated. The color in PPL is a greyish brown core with brown margins (x40). The color in XPL is a greyish brown core with golden brown margins (x40).
 (c) **Inclusions:** The size distribution is bimodal with the upper size class (>0.0625mm) Composed of carbonate sand (frequent), terminal grade calcite (frequent), monocrystalline quartz (common), micritic sand (few), sparry calcite (rare), sparry calcite + micrite limestone (rare), polycrystalline quartz (very rare), isotropic spherule (very rare), chert (very rare), and chalcedony (very rare). The lower size class (<0.0625mm) is composed of calcite (frequent), quartz (common), and zircon (very rare). The largest inclusion is 0.6mm (sparry calcite) and 98% of inclusions range in size from 0.0625mm (very coarse silt) to 0.4mm (medium sand). This fabric is moderately well-sorted.

c:f:v _{60μ} : 60:30:10

Coarse Inclusions (>0.0625mm)

Frequent

Carbonate Sand: Rounded, equant, they range in size from 0.0625mm (coarse silt) to 0.2mm (fine sand) with a mode size of 0.08mm (very fine sand).

Terminal Grade Calcite: Subrounded to subangular, equant to irregular, they range in size from 0.1mm (very fine sand) to 0.18mm (fine sand) with a mode size of 0.25mm (fine sand).

Common

Monocrystalline quartz (undulose): Rounded to subangular, equant to elongated to irregular, they range in size from 0.0626mm (coarse silt) to 0.4mm (medium sand) with a mode size 0.25mm (fine sand).

Few

Micritic Sand: Rounded, equant, they range in size from 0.08mm (very fine sand) to 0.5mm (medium sand) with a mode size of 0.25mm (medium sand).

Rare

Sparry Calcite (finely to medium crystalline): Rounded, equant to elongated, they range in size from 0.12mm (very fine sand) to 0.16mm (fine sand) with a mode size of 0.16mm (fine sand). This is basically sparite limestone sand.

Sparry calcite + micrite limestone: Rounded, elongated, they range in size from 0.4mm (medium sand) to 0.6mm (coarse sand).

Very Rare

Polycrystalline Quartz: Subrounded to subangular, equant to elongated, very fine sand sized.

Isotropic Spherules: Rounded, equant, fine sand sized. These inclusions are black in XPL indicative of glass and they occasionally contain non-isotropic sparry calcite inclusions.

Chert: Rounded, equant to elongated, medium sand sized.

Chalcedony: Rounded, equant to elongated, medium sand sized.

Fine Inclusions (<0.0625mm)

Frequent: Calcite

Common: Quartz

Very Rare: Zircon

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Very Few (0.3mm to 0.5mm), rounded, equant, brown to reddish brown amorphous concentration features with silt sized quartz inclusions that are discordant with the orientation of features in the surrounding fabric. They have medium to dense optical density and have merging to sharp boundaries. Some are partially surrounded by channel voids. Smaller red amorphous concentration features (fine sand sized) do not have quartz inclusions.

COMMENTS

Paste Technology

Carbonate Sand D is a moderately well-sorted fabric characterized by evenly distributed carbonate sand. The carbonate sand, composed of both crystalline calcite and micrite, was part of the natural clay that also includes crystalline calcite, monocrystalline quartz, chert, chalcedony, and zircon. The fabric contains limestone temper composed of well-processed, finely to coarsely crystalline sparry calcite. The limestone temper also likely contains a micrite component. There are very few limestone rock fragments in this fabric but their bimodal and uneven distribution in conjunction with the common terminal grades (the result of crushed limestone) suggest this fabric was tempered. The fabric is very similar to Carbonate Sand B but also contains isotropic spherules. It is unclear if these spherules were part of the natural clay or the added limestone temper.

Provenance

Carbonate Sand D has a possibly local provenance. The limestone is consistent with fabrics produced locally in the Belize River Valley. However, there is only one sample of this fabric group and data on carbonate sand in the region is minimal so Carbonate Sand D is considered possibly local.

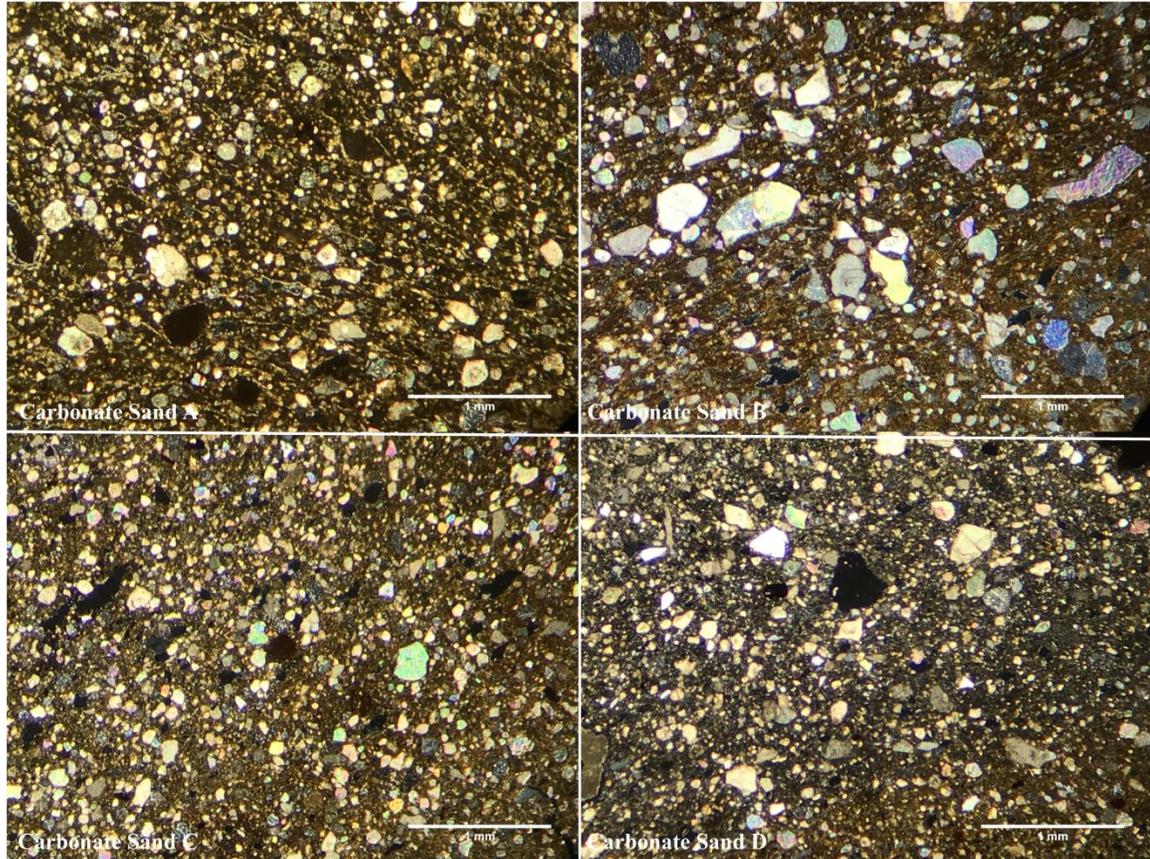


Figure D.11. Carbonate Sand A to Carbonate Sand D Micrographs.

CARBONATE SAND E

Samples: 40

I. Microstructure

- (a) **Voids:** Common voids, common mesochannels, common micro-to mesovughs, very few micro- to meso vesicles. The sample contains carbonate shaped voids that are located along the exterior margin of the samples.
- (b) **c/f related distribution:** Closed-spaced to single-spaced, porphyric related distribution.
- (c) **Preferred orientation:** Voids and inclusions show no preferred orientation.

II. Groundmass

- (a) **Homogeneity:** Voids and carbonate sand are evenly distributed across the fabric. Terminal grade calcite and quartz are unevenly distributed. There is a color difference due to the presence of a dark core.
- (b) **Micromass:** Slightly optically active. The b-fabric is monostriated. The color in PPL is brown with darker brown margins (x40). The color in XPL is a golden reddish brown with darker reddish brown margins (x40).
- (c) **Inclusions:** The size distribution is bimodal with an upper size class (>0.02mm) composed of carbonate sand (dominant), calcite terminal grades (common), monocrystalline quartz (very few), sparry calcite (rare), polycrystalline quartz (rare), chert (rare), calcite+quartz limestone (very rare) and zircon (very rare). The lower size class (<0.02mm) is composed of calcite and quartz. The largest inclusion is 1mm (monocrystalline quartz) and 98% of the inclusions range in size from 0.02mm (medium silt) to 0.5mm (medium sand). The fabric is moderately well-sorted.

c:f:v_{20μ} : 60:30:10

Coarse Inclusions (>0.02mm)

Dominant

Carbonate Sand: Rounded, equant, they range in size from 0.02mm (medium silt) to 0.08mm (very fine sand) with a mode size of 0.03mm (medium silt).

Common

Terminal Grade Calcite: Subrounded to subangular, equant to elongated, they range in size from 0.02mm (medium silt) to 0.5mm (medium sand) with a mode size of 0.1mm (very fine sand).

Very Few

Monocrystalline Quartz (undulose): Rounded to angular, equant to elongated, they range in size from 0.02mm (medium silt) to 1mm (very coarse sand) with a mode size of 0.1mm (very fine sand). The quartz grains are frequently brown in PPL suggesting that they formed within the pore space of limestone. They also frequently have an iron oxide coating, or are infilled along fissures with iron oxide.

Rare

Sparry Calcite (Finely to medium crystalline): Subrounded, equant to elongated, they range in size from 0.14mm (fine sand) to 0.6mm (medium sand).

Polycrystalline Quartz: Subrounded to subangular, equant to elongated, they range in size from 0.02mm (medium silt) to 0.5mm (medium sand) with a mode size of 0.1mm (very fine sand).

Chert: Subrounded to subangular, equant to elongated, they range in size from 0.02mm (medium silt) to 0.5mm (medium sand) with a mode size of 0.1mm (very fine sand).

Very Rare

Calcite + Quartz Limestone: Subangular, elongated, 0.7mm (coarse sand)

Zircon: 0.02mm (medium silt)

Fine Inclusions (<0.02mm)

Common: Calcite and Monocrystalline Quartz

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Very Few (0.3mm to 0.5mm), rounded, equant, red amorphous concentration features with silt sized quartz inclusions that are discordant with the orientation of features in the surrounding fabric. They have medium to dense optical density and have merging boundaries. Smaller red amorphous concentration features (fine sand sized) do not have quartz inclusions.

COMMENTS**Paste Technology**

Carbonate Sand E is a moderately well-sorted fabric characterized by evenly distributed carbonate sand. The carbonate sand, composed only of crystalline calcite, was part of the natural clay that also includes monocrystalline quartz, polycrystalline quartz, chert, and zircon. The fabric contains limestone temper composed of well-processed, finely to coarsely crystalline sparry calcite. The limestone temper also contains a quartz component. There are very few limestone rock fragments in this fabric but their bimodal and uneven distribution in conjunction with the common terminal grades (the result of crushed limestone) suggest this fabric was tempered.

Provenance

Carbonate Sand E has a possibly local provenance. The sparry calcite limestone temper is consistent with limestones used to temper other thin-walled vessels in the Belize River

Valley. However, there is only one sample of this fabric group and data on carbonate sand in the region is minimal so Carbonate Sand E is considered possibly local. This fabric contains more abundant larger, monocrystalline quartz inclusions than the other carbonate sand fabrics. The quartz may have been added as part of the limestone temper or was part of the natural clay but is indicative of a different provenance.

CARBONATE SAND F

Samples: 37

I. Microstructure

- (a) **Voids:** Few voids, common microchannels, common micro-to mesovughs. The sample contains carbonate shaped voids that are located along the exterior margin of the samples.
- (b) **c/f related distribution:** Closed to single-spaced, porphyric related distribution
- (c) **Preferred orientation:** Voids are oriented parallel to vessel margins. Inclusions show no preferred orientation.

II. Groundmass

- (a) **Homogeneity:** Voids and carbonate sand are evenly distributed across the fabric. Terminal grade calcite and quartz are unevenly distributed.
- (b) **Micromass:** Slightly optically active. The b-fabric is monostriated. The color in PPL is a dark brown (x40). The color in XPL is a golden brown (x40).
- (c) **Inclusions:** The size distribution is bimodal and the upper size class (>0.02mm) is composed of carbonate sand (frequent), terminal grade calcite (common), monocrystalline quartz (common), sparry calcite (very few), polycrystalline quartz (very few), isotropic spherules (very few), micrite (rare) and zircon (very rare). The lower size class (<0.02mm) is composed of calcite and monocrystalline quartz (common). The largest inclusion is 1mm (micrite) and 98% of inclusions are between 0.02mm and 0.5mm. The fabric is moderately well-sorted.

c:f:v_{20μ} : 60:30:10

Coarse Inclusions (>0.02mm)

Frequent

Carbonate Sand: Rounded, equant, they range in size from 0.02mm (medium silt) to 0.16mm (fine sand) with a mode size of 0.06mm (coarse silt).

Common

Terminal Grade Calcite: Subrounded to angular, equant to irregular, they range in size from 0.1mm (very fine sand) to 0.4mm (medium sand) with a mode size of 0.06mm (coarse silt).

Monocrystalline Quartz (undulose): Rounded to angular, equant to elongated to irregular, they range in size from 0.02mm (medium silt) to 0.9mm (coarse sand) with a mode size of 0.05mm (coarse silt).

Very Few

Sparry Calcite (finely to coarsely crystalline): Subrounded to subangular, equant to elongated, they range in size from 0.14mm (fine sand) to 0.5mm (medium sand) with a mode size of 0.5mm (medium sand).

Polycrystalline Quartz: Subrounded to subangular, equant to elongated, they range in size from 0.02mm (medium silt) to 0.5mm (medium sand) with a mode size of 0.1mm (very fine sand).

Isotropic Spherules: Rounded, equant, medium sand sized. These inclusions are black in XPL indicative of glass and they occasionally contain non-isotropic sparry calcite inclusions.

Rare

Micrite: Rounded, equant to elongated, they range in size from 0.35mm (medium sand) to 1mm (coarse sand) with mode size of 0.35mm (medium sand). The micrite is bioclastic and occasionally attached to sparry calcite.

Very Rare

Zircon: 0.02mm (medium silt)

Fine Inclusions (<0.02mm)

Common: Calcite and Monocrystalline Quartz

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Rare, rounded, equant to elongated, red, silt to fine sand sized amorphous concentration features. They have medium to high optical density and merging boundaries.

COMMENTS

Paste Technology

Carbonate Sand F is a moderately well-sorted fabric characterized by evenly distributed carbonate sand. The carbonate sand, composed of both crystalline calcite and micrite, was part of the natural clay that also includes monocrystalline quartz, polycrystalline quartz, and zircon. The fabric contains limestone temper composed of well-processed, finely to coarsely crystalline sparry calcite. The limestone temper also likely contains a micrite component. There are very few limestone rock fragments in this fabric but their bimodal and uneven distribution in conjunction with the common terminal grades (the result of crushed limestone) suggest this fabric was tempered. This fabric is similar to Carbonate Sand B but with large, micrite lumps (likely added as part of the limestone temper) and isotropic spherules that may have been part of the natural clay or the limestone temper.

Provenance

Carbonate Sand F has a possibly local provenance. The limestone is consistent with fabrics produced locally in the Belize Valley. The isotropic spherules have an unknown provenance. However, there is only one sample of this fabric group and data on carbonate sand in the region is minimal so Carbonate Sand F is considered possibly local.

CARBONATE SAND G

Samples: 214

I. Microstructure

- (a) **Voids:** Very few voids, common microchannels, rare micro- to mesovughs.
- (b) **c/f related distribution:** Closed-spaced to double-spaced, porphyric related distribution.
- (c) **Preferred orientation:** Voids are oriented parallel to the vessel margins. Inclusions show no preferred orientation.

II. Groundmass

- (a) **Homogeneity:** Voids and carbonate sand are evenly distributed across the fabric. Terminal grade calcite and quartz are unevenly distributed.
- (b) **Micromass:** Slightly optically active. The b-fabric is speckled. The color in PPL is brown (x40) and the color in XPL is a dark golden greyish brown (x40)
- (c) **Inclusions:** The size distribution is bimodal and the upper size class (>0.0625mm) is composed of carbonate sand (common), calcite terminal grades (common), sparry calcite (few), dolomite (few), monocrystalline quartz (very few), micrite (rare), crystalline calcite (very rare), and chert (very rare). The lower size class (<0.0625mm) is composed of calcite (common) and monocrystalline quartz (very few). The largest inclusion is 0.85mm (quartz) and 98% of the inclusions range in size from 0.0625mm to 0.3mm. The fabric is well-sorted.

c:f:v_{62μ} : 60:30:10

Coarse Inclusions (>0.0625mm)

Common

Carbonate Sand: Rounded, equant, they range in size from 0.0625mm (coarse silt) to 0.2mm (fine sand) with a mode size of 0.08mm (very fine sand).

Calcite Terminal Grades: Subrounded to subangular, equant to irregular, they range in size from 0.08mm (very fine sand) to 0.2mm (fine sand) with a mode size of 0.2mm (fine sand).

Few

Sparry Calcite (finely to medium crystalline): Rounded to subrounded, equant to elongated, they range in size from 0.2mm (fine sand) to 0.55mm (coarse sand) with a mode size of 0.35mm (medium sand).

Dolomite: Subangular to angular, equant (rhombic) to irregular, they range in size from 0.25mm (medium sand) to 0.75mm (coarse sand) with a mode size of 0.3mm (medium sand). The dolomite is zoned with a darkened, inclusion rich core and clear rim.

Very Few

Monocrystalline Quartz (undulose): Rounded, equant to irregular, they range in size from 0.15mm (fine sand) to 0.85mm (coarse sand) with a mode size of 0.15mm (fine sand).

Rare

Micrite: Rounded, equant to elongated to irregular, they range in size from 0.1mm (very fine sand) to 0.5mm (medium sand) with a mode size of 0.25mm (medium sand). The micrite is often attached to sparry calcite.

Very Rare

Crystalline Calcite: Subangular, equant (rhombic), coarse sand sized
Chert: Rounded, elongated, medium sand sized.

Chert: Rounded, elongated, medium sand sized.

Fine Inclusions (<0.0625mm)

Common: Calcite

Very Few: Monocrystalline quartz

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Very rare, rounded, equant to elongated, black, silt to fine sand sized amorphous concentration features. They have moderate to high optical density and merging boundaries.

COMMENTS**Paste Technology**

This fabric is characterized by evenly distributed carbonate sand suggesting that it was part of the natural clay. It was likely tempered with well-crushed, finely crystalline sparry calcite limestone. The limestone was likely dolomitic and also contained a micritic component. There are very few limestone rock fragments but the common terminal grades suggest this fabric was tempered. The bimodal and uneven distribution of these aplastics, in conjunction with their angularity, indicate that they were added as tempering material. This fabric is well-sorted indicating that the clay and temper were very well mixed. The terminal grade calcite inclusions are unevenly distributed compared to the sand but much more evenly distributed than other carbonate sand fabrics.

Provenance

The temper is consistent with limestones used to temper other thin-walled vessels in the Belize River Valley but because there is only one sample of this fabric group and the reporting of carbonate sand in the region is minimal.

CARBONATE SAND H

Samples: 203

I. Microstructure

- (a) **Voids:** Rare voids, microchannels and micro- to mesovughs
 (b) **c/f related distribution:** Closed-spaced, porphyric related distribution
 (c) **Preferred orientation:** Voids are oriented parallel to the vessel walls. Inclusions show no preferred orientation.

II. Groundmass

- (a) **Homogeneity:** Voids and carbonate sand are evenly distributed across the fabric. Terminal grade calcite and quartz are unevenly distributed
 (b) **Micromass:** Slightly optically active. The b-fabric is monostriated. The color in PPL is reddish brown (x40). The color in XPL is a dark reddish brown (x40).
 (c) **Inclusions:** The size distribution is bimodal and the upper size class (>0.04mm) is composed of carbonate sand (dominant), calcite terminal grades (frequent), sparry calcite (few), micrite (few), dolomite (few), monocrystalline quartz (few). The lower size class (<0.04mm) is composed of calcite (common) and monocrystalline quartz (very few). The largest inclusion is 0.75mm (calcite terminal grade, dolomite) and 98% of the inclusions range in size from 0.04mm to 0.5mm. The fabric is moderately well-sorted.

c:f:v_{10μ} : 85:10:5

Coarse Inclusions (>0.04mm)

Dominant

Carbonate Sand: Rounded, equant, they range in size from 0.04mm (coarse silt) to 0.2mm (fine sand) with a mode size of 0.08mm (very fine sand).

Frequent

Calcite Terminal Grades: Subrounded, equant to irregular, they range in size from 0.1mm (very fine sand) to 0.75mm (coarse sand) with a mode size of 0.2mm (fine sand)

Few

Sparry Calcite (finely to coarsely crystalline): Rounded, equant to elongated, they range in size from 0.1mm (very fine sand) to 0.5mm (medium sand) with a mode size of 0.4mm (medium sand).

Micrite: Rounded, equant to elongated, they range in size from 0.7mm (medium sand) to 0.8mm (coarse sand) with a mode size of 0.7mm (medium sand).

Dolomite: Subangular to angular, equant (rhombic) to irregular, they range in size from 0.25mm (medium sand) to 0.75mm (coarse sand) with a mode size of

0.3mm (medium sand). The dolomite is zoned with a darkened, inclusion rich core and clear rim.

Monocrystalline Quartz (undulose): Rounded, equant to irregular, they range in size from 0.15mm (fine sand) to 0.7mm (coarse sand) with a mode size of 0.15mm (fine sand).

Fine Inclusions (<0.04mm)

Common: Calcite

Very Few: Monocrystalline quartz

III. Textural Concentration Features

Rare clay pellets, medium to coarse sand sized, moderate optical activity, sharp to merging boundaries partially surrounded by channel voids. The larger pellets have silt sized inclusions that are discordant with the surrounding matrix.

IV. Amorphous Concentration Features

Very rare, rounded, equant to elongated, reddish brown, silt to fine sand sized amorphous concentration features. They have moderate to high optical density and merging boundaries.

COMMENTS

Paste Technology

This fabric is characterized by evenly distributed carbonate sand suggesting that it was part of the natural clay. It was likely tempered with well-crushed, finely crystalline sparry calcite limestone. The limestone was likely dolomitic and also contained a micritic component. There are very few limestone rock fragments but the common terminal grades suggest this fabric was tempered. The bimodal and uneven distribution of these aplastics, in conjunction with their angularity, indicate that they were added as tempering material. This fabric is moderately well-sorted indicating that the clay and temper were very well mixed. Monocrystalline quartz is the only non-carbonate inclusion in this fabric.

Provenance

The fabric does not look like any others in this sample and I suspect that it was not locally produced but is it considered possibly local pending more geologic sourcing in the Belize River Valley.

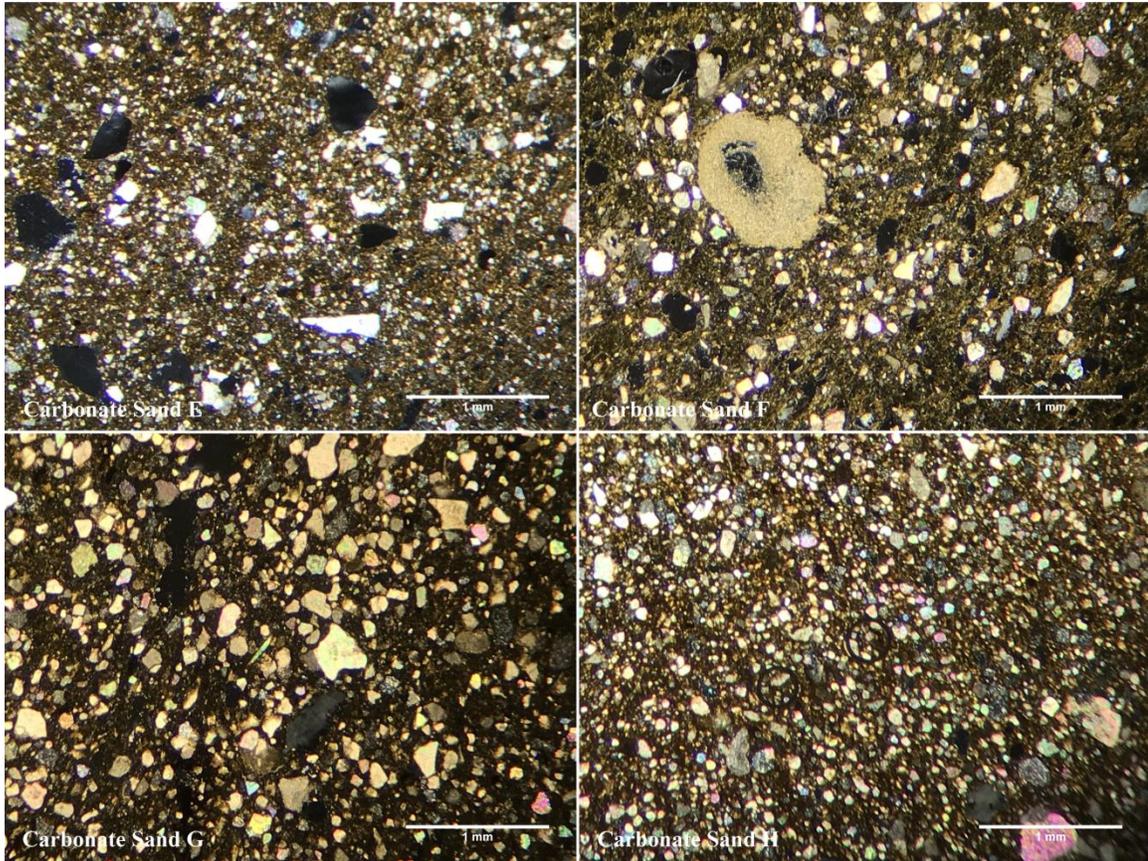


Figure D.12. Carbonate Sand E to Carbonate Sand H Micrographs.

CARBONATE SAND I

Samples: 200

I. Microstructure

- (a) **Voids:** Very few voids, micro-to mesovughs.
 (b) **c/f related distribution:** Closed-spaced to single-spaced, porphyric related distribution
 (c) **Preferred orientation:** Voids and inclusions show no preferred orientation.

II. Groundmass

- (a) **Homogeneity:** Voids and carbonate sand are evenly distributed across the fabric. Terminal grade calcite and quartz are unevenly distributed. The color varies due to the presence of a dark core
 (b) **Micromass:** Optically active. The b-fabric is speckled. The core is red and the margins are light brown in PPL (x40). The core is dark red and the margin is golden brown in XPL (x40).
 (c) **Inclusions:** The size distribution is bimodal and the upper size class (>0.02mm) is composed of calcite terminal grades (dominant), carbonate sand (common), monocrystalline quartz (few), sparry calcite (rare), polycrystalline quartz (rare), perthite (very rare), and zircon (very rare). The lower size class (<0.02mm) is composed of calcite and monocrystalline quartz (few). The largest inclusions is 0.75mm (terminal grade calcite) and 98% of inclusions range in size from 0.02mm to 0.3mm. The fabric is moderately well-sorted.

c:f:v_{20μ} : 50:40:10

Coarse Inclusions (>0.02mm)

Dominant

Calcite Terminal Grades: Subrounded, equant to irregular, they range in size from 0.1mm (very fine sand) to 0.75mm (coarse sand) with a mode size of 0.2mm (fine sand)

Common

Carbonate Sand: Rounded, equant, they range in size from 0.02mm (medium silt) to 0.12mm (very fine sand) with a mode size of 0.04mm (medium silt).

Few

Monocrystalline Quartz (undulose): Rounded to angular, they range in size from 0.02mm (medium silt) to 0.5mm (coarse) sand) with a mode size of 0.3mm (medium sand)

Rare

Sparry Calcite (finely to medium crystalline): Rounded, equant, medium to coarse sand sized.

Polycrystalline Quartz: Rounded, equant, fine to medium sand sized.

Very Rare

Perthite: Subrounded, irregular, coarse sand sized.

Zircon: 0.02mm (medium silt)

Fine Inclusions (<0.02mm)

Few: Calcite and monocrystalline quartz

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Very rare, rounded, equant to elongated, reddish brown to black, silt to fine sand sized amorphous concentration features. They have moderate to high optical density and merging boundaries.

COMMENTS**Paste Technology**

This fabric is characterized by evenly distributed carbonate sand suggesting that it was part of the natural clay. It was likely tempered with well-crushed, finely crystalline sparry calcite limestone. There are very few limestone rock fragments but the common terminal grades suggest this fabric was tempered. The bimodal and uneven distribution of these aplastics, in conjunction with their angularity, indicate that they were added as tempering material. This fabric is moderately well-sorted indicating that the clay and temper were well mixed.

Provenance

The temper is consistent with limestones used to temper other thin-walled vessels in the Belize River Valley but because there is only one sample of this fabric group and the reporting of carbonate sand in the region is minimal it is considered possibly local at this time.

CARBONATE SAND J

Samples: 198

I. Microstructure

- (a) **Voids:** Few voids, micro- and mesochannels, mesovughs
 (b) **c/f related distribution:** Single-spaced to double-spaced, porphyric related distribution
 (c) **Preferred orientation:** Voids are parallel to the vessel margins, inclusions show no preferred orientation

II. Groundmass

- (a) **Homogeneity:** Voids and carbonate sand are evenly distributed across the fabric. Terminal grade calcite, quartz, and sparry calcite are unevenly distributed.
 (b) **Micromass:** Optically active. The b-fabric is monostriated. The color in PPL is a light reddish brown (x40). The color in XPL is a golden reddish brown (x40).
 (c) **Inclusions:** The size distribution is bimodal with an upper size class (>0.02mm) composed of carbonate sand (dominant), terminal grade calcite (common), monocrystalline quartz (few), micrite (very few), polycrystalline quartz (very few), sparry calcite + quartz limestone (very rare). The lower size class (<0.02mm) is composed of calcite and quartz (few). The largest inclusion is 0.85mm (terminal grade calcite) and 98% of inclusions range in size from 0.02mm to 0.3mm. The fabric is moderately well-sorted.

c:f:v _{20μ} : 20:75:5

Coarse Inclusions (>0.02mm)

Dominant

Carbonate Sand: Rounded, equant, they range in size from 0.02mm (medium silt) to 0.16mm (fine sand) with a mode size of 0.06mm (coarse silt).

Common

Terminal Grade Calcite: Subrounded to subangular, equant to elongated to irregular, they range in size from 0.04mm (coarse silt) to 0.85mm (coarse sand) with a mode size of 0.2mm (fine sand).

Few

Monocrystalline quartz: Subrounded to subangular, equant to elongated to irregular, they range in size from 0.04mm (coarse silt) to 0.45mm (medium sand) with a mode size of 0.2mm (fine sand).

Very Few

Micrite: Rounded, equant to elongated, they range in size from 0.1mm (fine sand) to 0.8mm (coarse sand) with a mode size of 0.3mm (medium sand). They are often attached to sparry calcite.

Polycrystalline quartz: Subrounded to angular, equant to elongated to irregular, they range in size from 0.04mm (coarse silt) to 0.65mm (coarse sand) with a mode size of 0.2mm (fine sand).

Very Rare

Sparry Calcite + Quartz Limestone: Subangular, elongated, medium sand sized.

Coarse Inclusions (<0.02mm)

Few: Calcite and Quartz

III. Textural Concentration Features

Very rare clay pellet, rounded, equant, moderate optical density, merging to sharp boundaries and partially surrounded by a channel void. Light brown (PPL) to golden brown (XPL) with silt sized quartz inclusions that are discordant with the surrounding matrix.

IV. Amorphous Concentration Features

Very rare, rounded, equant to elongated, reddish brown to black, silt to fine sand sized amorphous concentration features. They have moderate to high optical density and merging boundaries.

COMMENTS

Paste Technology

This fabric is characterized by evenly distributed carbonate sand suggesting that it was part of the natural clay. It was likely tempered with well-crushed, finely to coarsely crystalline sparry calcite limestone. The limestone likely also contained micrite and quartz. There are very few limestone rock fragments but the common terminal grades suggest this fabric was tempered. The bimodal and uneven distribution of these aplastics, in conjunction with their angularity, indicate that they were added as tempering material. This fabric is moderately well-sorted indicating that the clay and temper were well mixed.

Provenance

The temper is consistent with limestones used in the Belize River Valley but because there is only one sample of this fabric group and the reporting of carbonate sand in the region is minimal it is considered possibly local at this time.

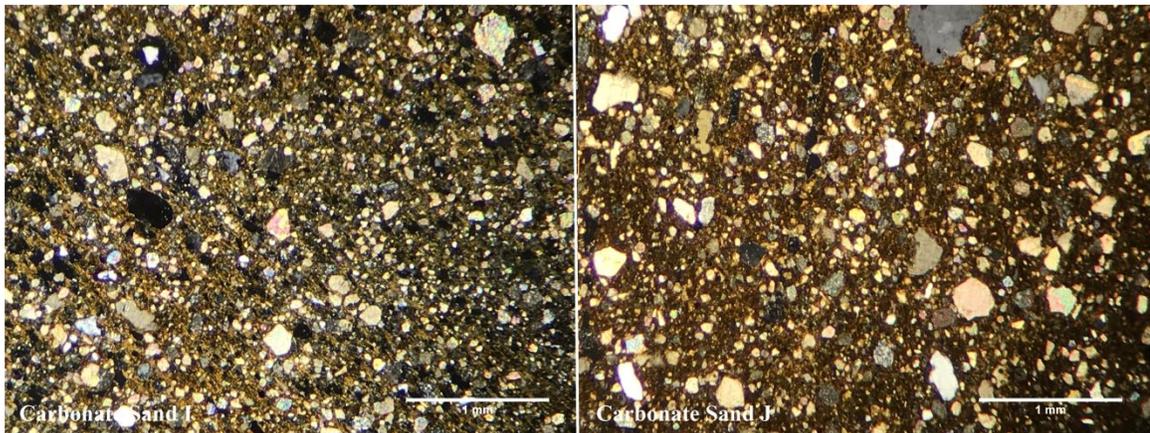


Figure D.13. Carbonate Sand I to J Micrographs.

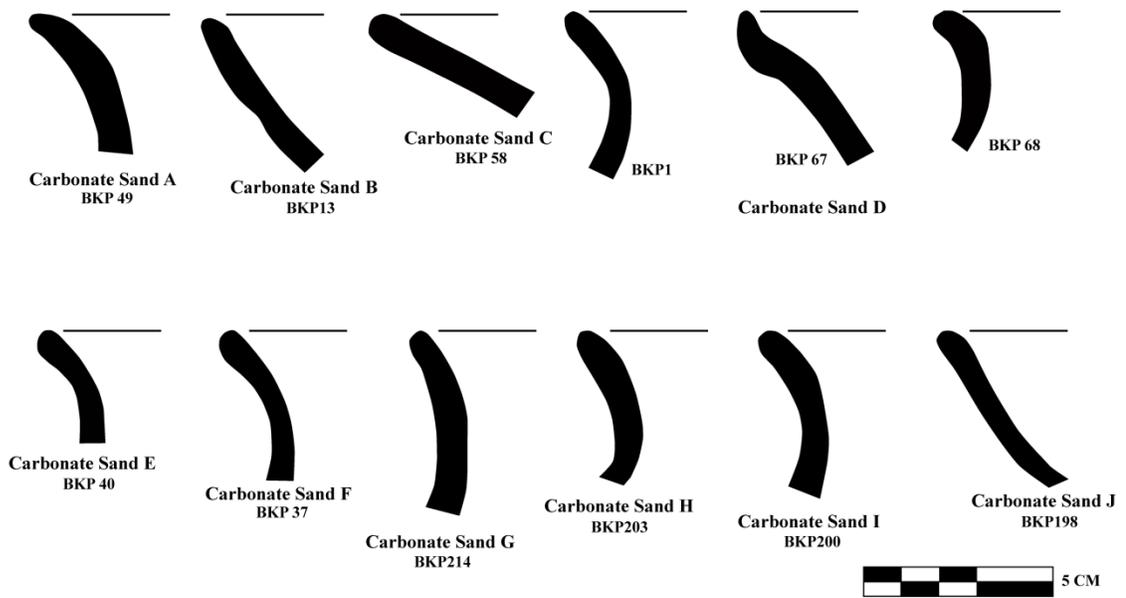


Figure D.14. Carbonate Sand Rim Profiles.

THE QUARTZ FABRIC GROUPS

The quartz fabric groups represent both locally produced vessels and imports. As with the carbonate sand fabrics, I have noted in the comments section for each fabric groups if they were likely locally produced or not. For the imported vessels in this section, a possibly provenance is indicated based on comparison with other petrographic studies and/or the geologic literature.

QUARTZ A

Samples: 55, 56

I. Microstructure

- (a) *Voids:* Few voids, predominantly mesochannels and mesovughs
- (b) *c/f related distribution:* Closed-spaced to double-spaced, porphyric related distribution
- (c) *Preferred orientation:* Voids are oriented parallel to the vessel margins. Inclusions show no preferred orientation.

II. Groundmass

- (a) *Homogeneity:* Voids and smaller inclusions are evenly distributed across the fabric. Most of the inclusions are evenly distributed with the exception of the sparry calcite limestone and calcite terminal grades.
- (b) *Micromass:* Slightly optically active. The b-fabric is monostriated. The margins are a light brown and the core is a reddish brown in PPL (x40). The margins are a golden brown and the core is a golden reddish brown in XPL (x40).
- (c) *Inclusions:* The size distribution is bimodal with an upper size class (>0.0625mm) composed primarily of monocrystalline quartz, sparry calcite and calcite terminal grades. The upper size class is also composed of muscovite, polycrystalline quartz, plagioclase feldspar, chert, and chalcedony. The lower size class (<0.0625mm) is composed of monocrystalline quartz, muscovite and plagioclase feldspar. The largest inclusion is 0.85mm (coarsely crystalline sparry calcite) and 98% of the inclusions range in size from 0.0625mm (coarse silt) to 1mm (coarse sand) with a mode size of medium sand. The clay is very micaceous and is dominated by muscovite. Sorting is poor.

c:f:v _{62.5μ} : 80:15:5

Coarse Inclusions (>0.0625mm)

Frequent

Monocrystalline quartz (undulose): Subrounded to subangular, equant to elongated to irregular, they range in size from 0.0625mm (coarse silt) to 0.8mm (coarse sand) with a mode size of 0.3mm (medium sand).

Muscovite: Elongated, they range in size from 0.0625mm (coarse silt) to 0.1mm (very fine sand) with a mode size of 0.0625mm (very coarse silt).

Common

Polycrystalline Quartz: Subrounded to subangular, equant to elongated to irregular, they range in size from 0.0625mm (coarse silt) to 0.45mm (medium sand) with a mode size of 0.2mm (fine sand).

Terminal Grade Calcite: Subrounded to subangular, predominantly equant to irregular with very few elongated grains. They range in size from 0.1mm (very fine sand) to 0.55mm (coarse sand) with a mode size of 0.4mm (medium sand).

Feldspar (Plagioclase): Subrounded to subangular, equant to elongated to irregular, they range in size from 0.0625mm (coarse silt) to 0.45mm (medium sand) with a mode size of 0.2mm (fine sand).

Few

Sparry Calcite (finely to coarsely crystalline, predominantly medium to coarsely crystalline mosaics). Subrounded to subangular, they range in size from 0.35mm (medium sand) to 0.85mm (very coarse sand) with a mode size of 0.35mm (medium sand).

Rare

Biotite: Elongated, they range in size from 0.0625mm (coarse silt) to 0.1mm (very fine sand) with a mode size of 0.0625mm (very coarse silt).

Micrite: Rounded to subrounded, equant to elongated, they range in size from 0.25mm (medium sand) to 1.25mm (very coarse sand). The micrite has monocrystalline quartz inclusions.

Very Rare

Chert: Rounded, equant, fine sand sized

Chalcedony: Rounded, equant, fine sand sized

Fine Inclusions (<0.0625mm)

Frequent: Monocrystalline Quartz, Muscovite

Few: Plagioclase Feldspar

III. Textural Concentration Features

Very rare clay pellets. They are dark brown in PPL and XPL. The clay pellets have silt to very fine sand sized quartz inclusions that are discordant with the orientation of features in the surrounding fabric. The pellets are rounded to equant to irregular. The boundaries are sharp to diffuse and most have a complete to partial channel void surrounding them. They range in size from fine sand to very coarse sand with a mode size of medium sand.

IV. Amorphous Concentration Features

Few black to reddish brown amorphous concentration features with a high optical density. They are predominantly rounded and equant to elongated though some are irregularly shaped. Sharp to merging boundaries with rare channel voids around them. They range in size from 0.02mm (silt) to 0.2mm (fine sand) with a mode size of 0.1mm (very fine sand).

COMMENTS

Paste Technology

The Quartz A fabric group can be characterized as a poorly sorted, sandy, micaceous clay containing monocrystalline quartz, muscovite, polycrystalline quartz, plagioclase feldspar, biotite, chert, chalcedony, and micrite tempered with crushed sparry calcite limestone. The micaceous clay is dominated by muscovite but biotite is also present in lesser quantities. The limestone rock temper occurs as large fragments composed of sparry calcite. The bimodal and uneven distribution of these aplastics, in conjunction with their angularity, indicates that they were added as tempering material. The terminal grade calcite that comprises has a similar crystal morphology to the discrete grains that comprise the finely to coarsely crystalline, sparry calcite limestone. These terminal grades are likely the result of processing the limestone, perhaps by crushing, for temper. Terminal grades are present in a much greater abundance than the limestone fragments likely due to the more thorough crushing of them temper due to the fact that both samples are thin-walled vessels.

Provenance

The provenance of Quartz A fabric is local to the Belize River Valley. The mineralogy, size, and sorting of the sand is consistent with riverine and floodplain clays of the region. The mineralogy of the sand is consistent with drainages originating in the Mountain Pine Ridge. Furthermore, the use of sparry calcite limestone, and the processing of the limestone for thin walled vessels, is consistent with locally produced carbonate fabrics. This fabric likely represented a different pottery practice in which riverine (as opposed to foothills) clays are used in pottery production but the tempering practice remains the same.

QUARTZ B

Samples: 195

I. Microstructure

- (a) **Voids:** Common voids, predominantly meso- to macro- channels and vughs.
- (b) **c/f related distribution:** Single-spaced to open-spaced, porphyric related distribution,
- (c) **Preferred orientation:** Voids are oriented parallel to vessel margins. Inclusions are weakly oriented to vessel margins.

II. Groundmass

- (a) **Homogeneity:** Voids and inclusions are unevenly distributed across the fabric. The color is different due to the presence of a dark core
- (b) **Micromass:** Optically active. The b-fabric is granostriated. The margin is brown and the core is reddish brown in PPL (x40). The margin is a golden brown and the core is a golden red in XPL (x40).
- (c) **Inclusions:** The size distribution is bimodal with an upper size class (>0.0625mm) composed primarily of monocrystalline quartz, sparry calcite and calcite terminal grades. The upper size class is also composed of muscovite, polycrystalline quartz, quartzite, plagioclase feldspar, perthite, mudstone, muscovite, biotite, chert, and chalcedony. The lower size class (<0.0625mm) is composed of monocrystalline quartz, muscovite, plagioclase feldspar, and zircon. The largest inclusion is 0.85mm (coarsely crystalline sparry calcite) and 98% of the inclusions range in size from 0.0625mm (coarse silt) to 1mm (coarse sand) with a mode size of medium sand. Sorting is poor.

c:f:v _{62.5μ} : 30:50:20

Coarse Inclusions (>0.0625mm)

Common

Monocrystalline quartz (undulose): Subrounded to subangular, equant to elongated to irregular, they range in size from 0.0625mm (coarse silt) to 0.8mm (coarse sand) with a mode size of 0.3mm (medium sand).

Sparry Calcite (medium to coarsely crystalline). Subrounded to subangular, they range in size from 0.35mm (medium sand) to 0.85mm (very coarse sand) with a mode size of 0.35mm (medium sand).

Terminal Grade Calcite: Subrounded to subangular, predominantly equant to irregular with very few elongated grains. They range in size from 0.1mm (very fine sand) to 0.55mm (coarse sand) with a mode size of 0.4mm (medium sand).

Few

Polycrystalline Quartz: Subrounded to subangular, equant to elongated to irregular, they range in size from 0.0625mm (coarse silt) to 0.45mm (medium sand) with a mode size of 0.2mm (fine sand).

Quartzite: Subrounded to subangular, equant to elongated to irregular, they range in size from 0.0625mm (coarse silt) to 0.45mm (medium sand) with a mode size of 0.2mm (fine sand).

Feldspar (Plagioclase): Subrounded to subangular, equant to elongated to irregular, they range in size from 0.0625mm (coarse silt) to 0.45mm (medium sand) with a mode size of 0.2mm (fine sand).

Perthite: Subangular to angular, equant, 0.25mm (medium sand) to 0.35mm (medium sand) with a mode size of 0.25mm (medium sand)

Mudstone: Subrounded, elongated, 0.5mm (coarse sand).

Muscovite: Elongated, they range in size from 0.0625mm (coarse silt) to 0.1mm (very fine sand) with a mode size of 0.0625mm (very coarse silt).

Rare

Biotite: Elongated, they range in size from 0.0625mm (coarse silt) to 0.1mm (very fine sand) with a mode size of 0.0625mm (very coarse silt).

Chert: Rounded to subrounded, equant to elongated to irregular, fine to medium sand sized

Chalcedony: Rounded to subrounded, equant to elongated to irregular, fine to medium sand sized

Fine Inclusions (<0.0625mm)

Frequent: Monocrystalline Quartz, Muscovite

Few: Plagioclase Feldspar

Very Rare: Zircon

III. Textural Concentration Features

Very rare clay pellets. They are dark brown in PPL and XPL. The clay pellets have silt to very fine sand sized quartz inclusions that are discordant with the orientation of features in the surrounding fabric. The pellets are rounded to equant to irregular. The boundaries are sharp to diffuse and most have a complete to partial channel void surrounding them. They range in size from fine sand to very coarse sand with a mode size of medium sand.

IV. Amorphous Concentration Features

Few black to reddish brown amorphous concentration features with a high optical density. They are predominantly rounded and equant to elongated though some are

irregularly shaped. Sharp to merging boundaries with rare channel voids around them. They range in size from 0.02mm (silt) to 0.2mm (fine sand) with a mode size of 0.1mm (very fine sand).

COMMENTS

Paste Technology

The Quartz B fabric group can be characterized as a poorly sorted, sandy, clay containing monocrystalline quartz, polycrystalline quartz, quartzite, plagioclase feldspar, perthite, sandstone, muscovite, biotite, chert and zircon with crushed sparry calcite limestone. The Quartz B clay contains less mica (both muscovite and biotite) than Quartz A. The limestone rock temper occurs as large fragments composed of sparry calcite. The bimodal and uneven distribution of these aplastics, in conjunction with their angularity, indicates that they were added as tempering material. The terminal grade calcite that comprises has a similar crystal morphology to the discrete grains that comprise the finely to coarsely crystalline, sparry calcite limestone. These terminal grades are likely the result of processing the limestone, perhaps by crushing, for temper. Terminal grades are present in a much greater abundance than the limestone fragments likely due to the more thorough crushing of them temper due to the fact that both samples are thin-walled vessels.

Provenance

The provenance of Quartz B fabric is local to the Belize River Valley. The mineralogy, size, and sorting of the sand is consistent with riverine and floodplain clays of the region. The mineralogy of the sand is consistent with drainages originating in the Mountain Pine Ridge. However, the mineralogy suggests that the clay was procured from a different location than Quartz A. The use of sparry calcite limestone, and the processing of the limestone for thin walled vessels, is consistent with locally produced carbonate fabrics. This fabric likely represented a different pottery practice in which riverine (as opposed to foothills) clays are used in pottery production but the tempering practice remains the same.

QUARTZ C

Sample: 196

I. Microstructure

- (a) **Voids:** Few voids, predominantly mesochannels with few microchannels and Mesovughs. Carbonate shaped voids are located at the margins.
- (b) **c/f related distribution:** Closed-spaced to single-spaced, porphyric related distribution
- (c) **Preferred orientation:** Voids are oriented parallel to the vessel margins. Inclusions show no preferred orientation.

II. Groundmass

- (a) **Homogeneity:** Voids are evenly distributed across the fabric. Most of the inclusions are evenly distributed with the exception of the sparry calcite limestone and calcite terminal grades.
- (b) **Micromass:** Slightly optically active. The b-fabric is granostriated. The color in PPL is a light brown (x40). The color in XPL is a golden brown (x40).
- (c) **Inclusions:** The size distribution is bimodal with an upper size class (>0.0625mm) composed primarily of carbonate sand, monocrystalline quartz, sparry calcite and calcite terminal grades. The upper size class is also composed of polycrystalline quartz, quartzite, plagioclase feldspar, perthite, micrite, chert, biotite and sandstone. The lower size class (<0.0625mm) is composed of calcite, monocrystalline quartz, plagioclase feldspar, and zircon. The largest inclusion is 2.4mm (coarsely crystalline sparry calcite) and 98% of the inclusions range in size from 0.0625mm (coarse silt) to 1mm (coarse sand) with a mode size of medium sand. Sorting is poor.

c:f:v _{62.5μ} : 75:20:5

Coarse Inclusions (>0.0625mm)

Dominant

Carbonate Sand: Rounded, equant, they range in size from 0.0625mm (course silt) to 0.24mm (fine sand) with a mode size of 0.1mm (very fine sand)

Common

Terminal Grade Calcite: Subrounded to subangular, predominantly equant to irregular with very few elongated grains. They range in size from 0.1mm (very fine sand) to 0.55mm (coarse sand) with a mode size of 0.4mm (medium sand).

Monocrystalline quartz sand: Rounded, equant, they range in size from 0.0625mm (course silt) to 0.5mm (coarse sand) with a mode size of 0.25mm (medium sand).

Monocrystalline Quartz (undulose): Subrounded to subangular, equant to elongated to irregular, they range in size from 0.0625mm (coarse silt) to 0.9mm (coarse sand) with a mode size of 0.3mm (medium sand).

Few

Sparry Calcite (finely to coarsely crystalline mosaics): Subangular to angular, equant to irregular, they range in size from 0.56mm (coarse sand) to 2.4mm (granule) with a mode size of 1mm (very coarse sand).

Polycrystalline Quartz: Subrounded to subangular, equant to elongated to irregular, they range in size from 0.0625mm (coarse silt) to 0.45mm (medium sand) with a mode size of 0.2mm (fine sand).

Quartzite: Rounded to subrounded, equant to elongated to irregular, they range in size from 0.0625mm (coarse silt) to 0.45mm (medium sand) with a mode size of 0.2mm (fine sand).

Feldspar (Plagioclase): Subrounded to subangular, equant to elongated to irregular, they range in size from 0.0625mm (coarse silt) to 0.45mm (medium sand) with a mode size of 0.2mm (fine sand).

Perthite: Subrounded to subangular, equant, 0.25mm (medium sand) to 0.35mm (medium sand) with a mode size of 0.25mm (medium sand)

Very Few

Micrite: Rounded, equant, 0.25mm (medium sand) to 0.8mm (coarse sand).

Chert: Rounded to subrounded, equant to elongated to irregular, fine to medium sand sized

Biotite: Elongated, they range in size from 0.0625mm (coarse silt) to 0.1mm (very fine sand) with a mode size of 0.0625mm (very coarse silt).

Very Rare

Sandstone: Rounded, elongated, 0.8mm (medium sand)

Fine Inclusions (<0.0625mm)

Frequent: Crystalline Calcite, Monocrystalline Quartz

Few: Plagioclase Feldspar

Very Rare: Zircon

III. Textural Concentration Features

Very rare clay pellets. They are dark brown in PPL and XPL. The clay pellets have silt to very fine sand sized quartz inclusions that are discordant with the orientation of features in the surrounding fabric. The pellets are rounded to equant to irregular. The boundaries are sharp to diffuse and most have a complete to partial channel void surrounding them. They range in size from fine sand to very coarse sand with a mode size of medium sand.

IV. Amorphous Concentration Features

Very few black to reddish brown amorphous concentration features with a high optical density. They are predominantly rounded and equant to elongated though some are irregularly shaped. Sharp to merging boundaries with rare channel voids around them. They range in size from 0.02mm (silt) to 0.2mm (fine sand) with a mode size of 0.1mm (very fine sand).

COMMENTS

Paste Technology

The Quartz C fabric group can be characterized as a poorly sorted, sandy clay containing carbonate (calcite) and non-carbonate (monocrystalline quartz, polycrystalline quartz, quartzite, plagioclase feldspar, perthite, sandstone, and zircon) with crushed sparry calcite limestone. The quartz sand is consistently larger than the carbonate sand. The non-carbonate sand component is also composed of polycrystalline quartz, quartzite, plagioclase feldspar, perthite, and sandstone. The limestone rock temper occurs as large fragments composed of sparry calcite. The bimodal and uneven distribution of these aplastics, in conjunction with their angularity, indicates that they were added as tempering material. The terminal grade calcite that comprises has a similar crystal morphology to the discrete grains that comprise the finely to coarsely crystalline, sparry calcite limestone. These terminal grades are likely the result of processing the limestone, perhaps by crushing, for temper. Terminal grades are present in a much greater abundance than the limestone fragments likely due to the more thorough crushing of them temper due to the fact that both samples are thin-walled vessels.

Provenance

The Quartz C fabric is possibly local. The mineralogy, size, and sorting of the sand is consistent with riverine and floodplain clays of the region. The mineralogy of the sand is consistent with drainages originating in the Mountain Pine Ridge and is the same as the Quartz B fabric group. However, Quartz C also contains carbonate sand which distinguishes it from Quartz B. There is no known carbonate sand deposit mentioned in the geologic literature of the Belize River Valley.

QUARTZ D

Samples: 2

I. Microstructure

- (a) **Voids:** Very Few voids, predominantly micro- to meso channels, few meso- to macrovughs
- (b) **c/f related distribution:** Double-spaced to open-spaced, porphyric related distribution
- (c) **Preferred orientation:** Voids are weakly developed parallel to vessel margins; inclusions show no preferred orientation.

II. Groundmass

- (a) **Homogeneity:** Voids are evenly distributed across the fabric. Large inclusions (>0.15mm) are unevenly distributed while smaller inclusions (<0.15mm) are evenly distributed
- (b) **Micromass:** Optically active. The b-fabric is granostriated. The color in PPL is a light brown (x40) and the color in XPL is a yellowish grey (x40).
- (c) **Inclusions:** The size distribution is bimodal with an upper size class (>0.15mm) composed of sandstone sand (common), monocrystalline quartz (few), and feldspar (very few). The lower size class (<0.15mm) is composed of sandstone and quartz (frequent), feldspar and biotite (rare), and zircon (very rare). The largest inclusions is 1.84mm (sandstone sand) and 98% of the inclusions range in size from 0.15mm to 1mm. The fabric is poorly sorted.

c:f:v_{150μ} : 10:75:75:5

Coarse Inclusions (>0.15mm)

Common

Sandstone Sand: Rounded, equant to elongated, they range in size from 0.25mm (medium sand) to 1.84mm (very coarse sand) with a mode size of 0.64mm (coarse sand). The sandstone is primarily composed of quartz with occasional feldspar, biotite, and what is either a very altered feldspar or epidote. One of the larger grains has a zircon inclusion. Many of the quartz grains show fluid inclusion trails and slight evidence of metamorphism. Most of the sand grains are composed a large quartz grain surrounded by polycrystalline quartz. They also frequently have an iron oxide coating, or are infilled along fissures with iron oxide.

Few

Quartz: Rounded to subangular, equant to elongated to irregular, they range in size from 0.15mm (very fine sand) to 1.6mm (very coarse sand) with a mode size of 0.4mm (medium sand). They also frequently have an iron oxide coating, or are infilled along fissures with iron oxide.

Very Few

Feldspar: Rounded, equant to elongated, they range in size from 0.15mm (very fine sand) to 0.5mm (coarse sand) with a mode size of 0.25mm (fine sand). The feldspars are most likely plagioclase but they are very altered, some have a perthitic texture. They also frequently have an iron oxide coating, or are infilled along fissures with iron oxide. It likely that the feldspar sand was originally part of the sandstone.

Fine Inclusions (<0.15mm)

Frequent

Sandstone: The sandstone inclusions in the fine fraction are often composed only of polycrystalline quartz with the occasional larger quartz, feldspar, or mica. They are rounded, equant to elongated, and range in size from 0.04mm (course silt) to 0.15mm (very fine sand) with a mode size of 0.1mm (very fine sand).

Quartz: Rounded, equant to elongated, and range in size from 0.04mm (course silt) to 0.15mm (very fine sand) with a mode size of 0.1mm (very fine sand).

Rare

Feldspar: Rounded, equant to elongated, and range in size from 0.04mm (course silt) to 0.15mm (very fine sand) with a mode size of 0.1mm (very fine sand).

Biotite: Rounded, elongated, and range in size from 0.04mm (course silt) to 0.15mm (very fine sand) with a mode size of 0.1mm (very fine sand).

Very Rare

Zircon: Angular, equant, 0.1mm (very fine sand)

III. Textural Concentration Features

Very few clay segregations. They are equant to elongated to irregular, iron rich segregation, with moderate optical density.

IV. Amorphous Concentration Features

Rare, black (PPL and XPL) nodules, high optical density, merging boundaries, coarse silt to fine sand sized.

COMMENTS

Paste Technology

Quartz D can be characterized as a poorly sorted, sandy clay containing sandstone, monocrystalline quartz, feldspar (likely perthitic plagioclase), biotite, and zircon and is tempered with sandstone sand. The sandstone is primarily composed of quartz with occasional feldspar, biotite, and what is either very altered feldspar or epidote. The bimodal distribution of the sand, and their uneven distribution across the fabric, indicates that the sand was added as temper. The sand grains are surrounded by an iron oxide coating indicative of sedimentary deposition of the grain after it was detached from the parent material. The similarity in the composition of the sand temper and the clay indicate that they are of a similar depositional environment.

Provenance

The Quartz D fabric group is not local to the Belize River Valley. The quartz grains with fluid inclusions, in combination with evidence of metamorphism, suggest that this sandstone is derived from the Baldy Beacon area of the Maya Mountains. Because the Baldy Beacon derived material is sand, and not crushed rock, the provenance for this pottery could be near the outcrop or downstream from the region.

QUARTZ E

Samples: 57

I. Microstructure

- (a) **Voids:** Common voids, predominantly micro- to meso channels, with few micro- to macrovughs.
- (b) **c/f related distribution:** Closed-spaced to double-spaced, porphyric related distribution.
- (c) **Preferred orientation:** Voids are oriented parallel to the vessel margins, inclusions are weakly oriented to vessel margins.

II. Groundmass

- (a) **Homogeneity:** Voids are evenly distributed across the fabric. Large (>0.15mm) are unevenly distributed across the fabric and small inclusions (<0.15mm) are evenly distributed across the fabric.
- (b) **Micromass:** Optically active. The b-fabric is granostriated. The color in PPL is a light brown (x40) and the color in XPL is a golden grey brown (x40).
- (c) **Inclusions:** The size distribution is bimodal with an upper size class (>0.15mm) composed of perthite, quartz, quartzite, muscovite and biotite (common), feldspar and granite rock fragments (very few). The lower size class (<0.15mm) is composed of muscovite and biotite (frequent), monocrystalline quartz and quartzite (common), and perthite, microcline, and plagioclase (few). The largest inclusion is 2.4mm (granite rock fragment) and 98% of the inclusions range in size from 0.15mm to 0.8mm. The fabric is poorly sorted.

c:f:v_{150μ} : 60:30:10

Coarse Inclusions (>0.15mm)

Common

Perthite: Subrounded to angular, equant to elongated, they range in size from 0.15mm (very fine sand) to 1.6mm (very coarse sand) with a mode size of 0.72mm (coarse sand). The perthite is likely perthitic microcline.

Quartz: Subrounded to angular, equant to elongated, they range in size from 0.15mm (very fine sand) to 1.92mm (very coarse sand) with a mode size of 0.72mm (coarse sand).

Quartzite: Subrounded to angular, equant to elongated, they range in size from 0.15mm (very fine sand) to 1.6mm (very coarse sand) with a mode size of 0.72mm (coarse sand).

Muscovite: Subrounded, elongated, they range in size from 0.15mm (very fine sand) to 0.88mm (coarse sand) with a mode size of 0.15mm (very fine sand).

Biotite: Most of the biotite is chloritized indicative of hydrothermal alteration. Subrounded, elongated, they range in size from 0.15mm (very fine sand) to 0.5mm (coarse sand) with a mode size of 0.2mm (fine sand).

Very Few

Feldspar: Both plagioclase and microcline are present as discrete grains. Rounded to angular, equant to elongated, they range in size from 0.15mm (very fine sand) to 0.5mm (coarse sand) with a mode size of 0.2mm (fine sand).

Granite Rock Fragment: The granite is composed of quartz, muscovite, predominantly perthitic microcline, microcline, and plagioclase. Angular, equant to elongated, they range in size from 0.4mm (medium sand) to 2.4mm (granule) with a mode size of 1mm (coarse sand).

Fine Inclusions (<0.15mm)

Frequent: Muscovite and chloritized biotite

Common: Quartz, Quartzite

Few: Perthite, Microcline, and Plagioclase

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Very rare, black (PPL and XPL), high optical density, merging boundaries, coarse silt to very fine sand sized.

COMMENTS

Paste Technology

The Quartz E fabric group can be characterized as a poorly sorted, micaceous clay composed of muscovite, chloritized biotite, quartz, quartzite, perthite, microcline, and plagioclase tempered with crushed granite rock. The bimodal and uneven distribution of the granite fragments, in conjunction with their angularity, indicates that it was added as temper. The complete lack of soil features and abundance inclusions in the fine fraction suggest that this clay was derived from a riverine source. The clay and temper have identical mineralogical compositions indicative of the same source locale for both.

Provenance

The Quartz E fabric is not local to the Belize River Valley. The mineralogy of the granite suggests a provenance in the vicinity of the Mountain Pine Ridge Batholith.

QUARTZ F

Samples: 71

I. Microstructure

- (a) **Voids:** Few voids, predominantly micro- to mesochannels, very few mesovughs
 (b) **c/f related distribution:** Single-spaced to open-spaced, porphyric related distribution
 (c) **Preferred orientation:** Voids are oriented parallel to vessel margins. Inclusions show no preferred orientation.

II. Groundmass

- (a) **Homogeneity:** Voids are evenly distributed. Inclusions are unevenly distributed. The color is variable due to the presence of a dark core.
 (b) **Micromass:** Slightly optically active. The b-fabric is granostriated. The color in PPL is a light brown core with reddish brown margins (x40). The color in XPL is a yellowish grey with reddish yellow margins (x40).
 (c) **Inclusions:** The size distribution is bimodal with an upper size class (>0.1mm) composed of common monocrystalline quartz, polycrystalline quartz, microcline, perthite, plagioclase, quartzite, and isotropic features (possibly altered rhyolite). The lower size class (<0.1mm) is composed of monocrystalline quartz (dominant) and muscovite and feldspar (common). The largest inclusion measure 1.2mm (quartzite) and 98% of the inclusions range in size from 0.1mm to 0.4mm. The fabric is moderately well-sorted.

c:f:v_{100μ} : 30:60:10

Coarse Inclusions (>0.1mm)

Common

Monocrystalline Quartz: Rounded to angular, equant to irregular, they range in size from 0.1mm to 0.8mm (coarse sand) with a mode size of 0.4mm (medium sand).

Polycrystalline Quartz: Rounded to angular, equant to irregular, they range in size from 0.1mm to 0.4mm (coarse sand) with a mode size of 0.4mm (medium sand).

Microcline: Rounded to angular, equant to irregular, they range in size from 0.1mm to 0.4mm (coarse sand) with a mode size of 0.4mm (medium sand).

Perthite: Rounded to angular, equant to irregular, they range in size from 0.1mm to 0.4mm (coarse sand) with a mode size of 0.4mm (medium sand).

Plagioclase: Rounded to angular, equant to irregular, they range in size from 0.1mm to 0.4mm (coarse sand) with a mode size of 0.4mm (medium sand).

Quartzite: Rounded to angular, equant to irregular, they range in size from 0.1mm to 1.2mm (very coarse sand) with a mode size of 0.4mm (medium sand).

Isotropic Features: Rounded, medium sand sized. These may be very altered rhyolite. They are completely surrounded by iron oxides and appear reddish brown in PPL.

Coarse Inclusions (<0.1mm)

Dominant: Monocrystalline quartz

Common: Muscovite, Feldspar

III. Textural Concentration Features

Very few clay pellets. They are a dark reddish brown (PPL and XPL) and have moderate to high optical density. Boundaries are merging to clear and the pellets are often partially to completely surrounded by channel voids. They are rounded, equant, and range in size from fine sand to coarse sand sized. The pellets have silt sized quartz inclusions that are discordant with the surrounding matrix.

IV. Amorphous Concentration Features

Few black to dark reddish brown (PPL and XPL) nodules. They are rounded, equant to elongated, have a high optical density and merging boundaries, and range in size from coarse silt to fine sand.

COMMENTS

Paste Technology

The Quartz F fabric group can be characterized as a poorly sorted, very coarse sandy clay composed of monocrystalline quartz, muscovite, polycrystalline quartz, microcline, perthite, plagioclase, quartzite, and isotropic features that may be rhyolite and is tempered with quartz sand. The quartz sand is larger and its bimodal distribution suggests it was added as temper.

Provenance

The Quartz F fabric was not produced locally in the Belize River Valley. There are no granite fragments in the fabric but the mineral package has a granite signature similar to the Mountain Pine Ridge. The presence of quartzite and possibly rhyolite suggests a location near Baldy Beacon, perhaps somewhere in the Roaring Creek drainage.

QUARTZ G

Samples: 192

I. Microstructure

- (a) **Voids:** Few voids, common micro- to mesochannels, few micro- to mesovughs
- (b) **c/f related distribution:** Single-spaced to double-spaced, porphyric related distribution
- (c) **Preferred orientation:** Voids orientation is variable. Voids are perpendicular to the lip and parallel to oblique (45°angle) to the vessel margins. Inclusions show no preferred orientation.

II. Groundmass

- (a) **Homogeneity:** Voids and inclusions are unevenly distributed across the fabric.
- (b) **Micromass:** Optically active. The b-fabric is monostriated. The color in PPL is a reddish brown (x40) and the color in XPL is a golden reddish brown (x40).
- (c) **Inclusions:** The size distribution is bimodal with an upper size class (>0.15mm) composed of monocrystalline quartz and biotite (common), seritized feldspar and granite (few). The lower size class (<0.15mm) is composed of monocrystalline quartz and biotite (common), feldspar and muscovite (few), and zircon (very rare). The largest inclusion measure 3.2mm (granite rock fragment) and 98% of the inclusions range in size between 0.15mm and 1.2mm. The fabric is very poorly sorted.

c:f:v_{150μ} : 50:40:10

Coarse Inclusions (>0.15mm)

Common

Monocrystalline Quartz: Rounded to angular, they range in size from 0.15mm (fine sand) to 0.96mm (coarse sand) with a mode size of 0.3mm (medium sand).

Biotite: Rounded to angular, they range in size from 0.15mm (fine sand) to 1.2mm (coarse sand) with a mode size of 0.24mm (fine sand)

Few

Seritized Feldspar: Subrounded to angular, equant to elongated, they range in size from 0.4mm (medium sand) to 1.2mm (very coarse sand) with a mode size of 0.8mm (coarse sand).

Granite: Subrounded to angular, equant to elongated, they range in size from 0.4mm (medium sand) to 3.2mm (granule) with a mode size of 1.2mm (very coarse sand). The granite is composed of quartz, plagioclase, microcline, very seritized feldspar, epidote, biotite, and muscovite.

Fine Inclusions (<0.15mm)

Common: Monocrystalline quartz and biotite

Few: Feldspar and Muscovite

Very Rare: Zircon

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Rare black (PPL and XPL) nodules, rounded, equant to elongated, coarse silt to fine sand sized, merging boundaries, high optical density

COMMENTS

Paste Technology

The Quartz G can be characterized as a very poorly sorted, sandy, clay containing monocrystalline quartz, biotite, muscovite, sericitized feldspar, and zircon tempered with crushed granite rock. The micaceous clay is composed predominantly of biotite with lesser quantities of muscovite. The very large frayed biotite indicates that some inclusions were part of the natural clay. The bimodal and uneven distribution of the granite fragments, in conjunction with their angularity, indicates that it was added as temper. The very large, frayed biotite inclusions are a defining characteristic of this fabric group.

Provenance

The Quartz G fabric is not local to the Belize River Valley. The composition of the granite is consistent with the Cockscomb Batholith in the Stann Creek District. The fabric description is similar to ceramics from the Alabama site (Howie 2018; Peuramaki-Brown et al. 2017).

QUARTZ H

Samples: BKP166

I. Microstructure

- (a) ***Voids:*** Very few voids, few micro- to mesochannels, very few micro- to mesovugs
 (b) ***c/f related distribution:*** Single-spaced to double-spaced, porphyric related distribution
 (c) ***Preferred orientation:*** Voids are oriented parallel to vessel margins. Inclusions are weakly oriented to vessel walls.

II. Groundmass

- (a) ***Homogeneity:*** Voids are evenly distributed. Inclusions are unevenly distributed.
 (b) ***Micromass:*** Optically active. The b-fabric is granostriated. The color in PPL is a yellow brown (x40) and the color in XPL is a golden greyish brown (x40).
 (c) ***Inclusions:*** The size distribution is bimodal with an upper size class (>0.1mm) composed of monocrystalline quartz (dominant), polycrystalline quartz, chert, and chalcedony (few), perthite (rare), and biotite (very rare). The lower size class (<0.1mm) is composed of quartz (dominant), polycrystalline quartz, chalcedony and quartz (few), biotite, muscovite, and plagioclase (rare), and zircon (very rare). The largest inclusion is 0.9mm (quartzite) and 98% of the inclusions range in size from 0.1mm to 0.5mm. The fabric is moderately well-sorted.

c:f:v_{100μ} : 50:45:5

Coarse Inclusions (>0.1mm)

Dominant

Quartz: Rounded to subrounded, equant to elongated, they range in size from 0.1mm (medium sand) to 1.3mm (very coarse sand) with a mode size of 0.55mm (coarse sand). Occasionally with undulose extinction.

Few

Polycrystalline Quartz: Rounded, equant, they range in size from 0.1mm (medium sand) to 0.9mm (coarse sand) with a mode size of 0.35mm (medium sand).

Chalcedony: Rounded, equant to elongated, they range in size from 0.1mm to 0.6mm with a mode size of 0.45mm (medium sand).

Chert: Rounded, equant to elongated, they range in size from 0.1mm (medium sand) to 0.9mm (coarse sand) with a mode size of 0.4mm (medium sand)

Rare

Perthite: Rounded to subrounded, equant to elongated, they range in size from 0.3mm (medium sand) to 0.5mm (medium sand) with a mode side of 0.35mm (medium sand)

Very Rare

Quartz+Birefringent (muscovite?) mineral rock fragment:

Biotite: Rounded, elongated, 0.45mm (medium sand). The biotite is frayed indicative of sedimentary origin.

Fine Inclusions (<0.1mm)

Dominant: Quartz

Few: Polycrystalline quartz, chalcedony, chert

Rare: Biotite, muscovite, plagioclase feldspar

Very Rare: Zircon

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Rare, black (PPL and XPL) nodules, high optical density, equant to irregular, coarse silt to medium sand sized.

COMMENTS**Paste Technology**

The Quartz H fabric can be characterized as a moderately well-sorted, sandy clay containing monocrystalline quartz, polycrystalline quartz, perthite, chalcedony, chert, biotite, muscovite, plagioclase feldspar, and zircon tempered with crushed granite rock and sand. The bimodal and uneven distribution of the granite fragments, in conjunction with their angularity, indicates that it was added as temper. The larger sand fragments, primarily composed of monocrystalline quartz, are also unevenly distributing suggesting that a sand was also used as temper. The chert and chalcedony are brown in PPL suggesting that they were formed in the pore space of limestone; however, there is not carbonate present in this fabric. The complete lack of soil features and abundance inclusions in the fine fraction suggest that this clay was derived from a riverine source.

Provenance

The Quartz H fabric is not produced locally in the Belize River Valley. The presence of chert and chalcedony that formed in pore space suggests that the clay was procured from near limestone but not in the direct vicinity. The granite is consistent with the Mountain Pine Ridge Batholith.

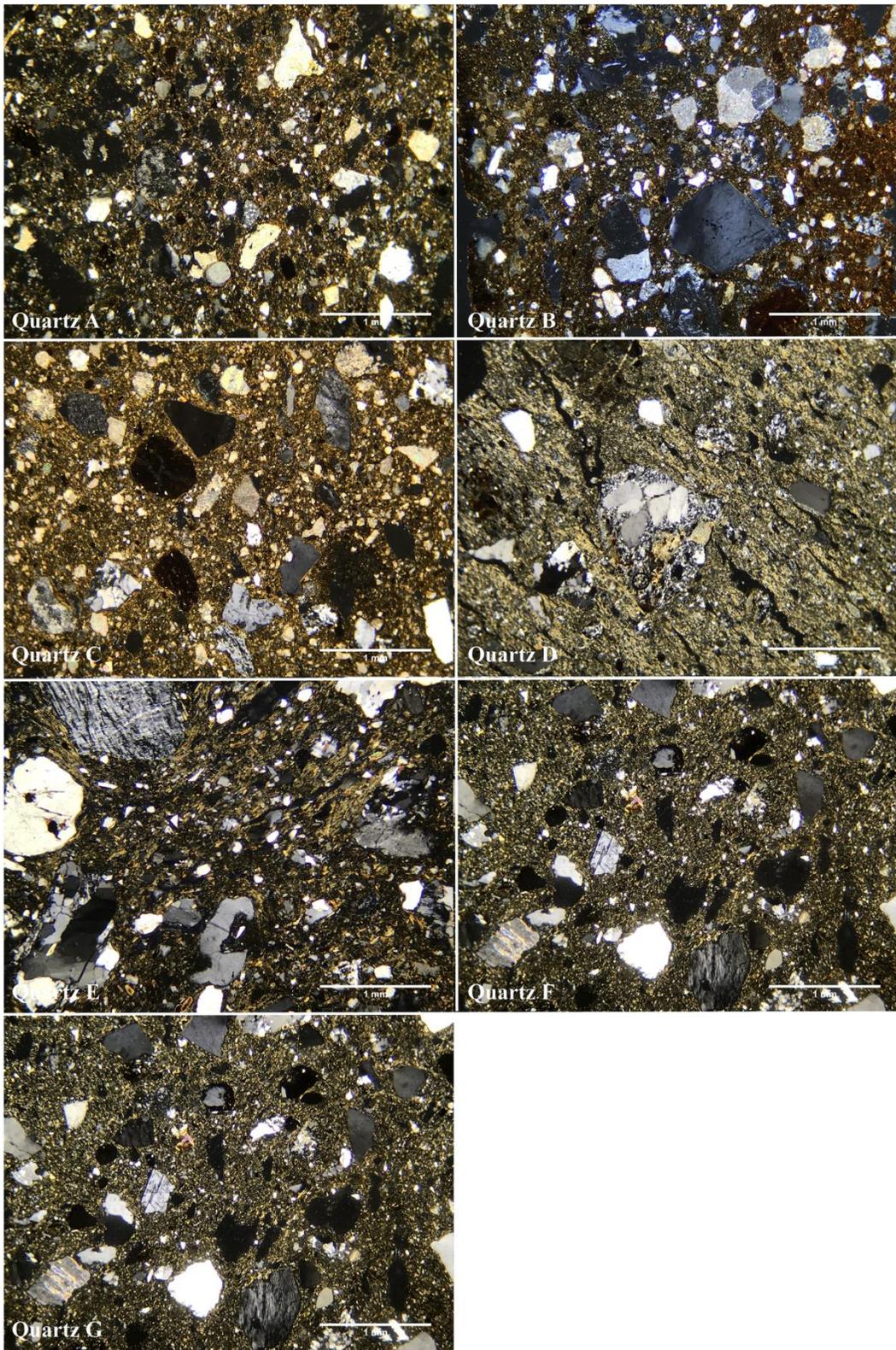


Figure D.13. Quartz A to Quartz G Micrographs (XPL).

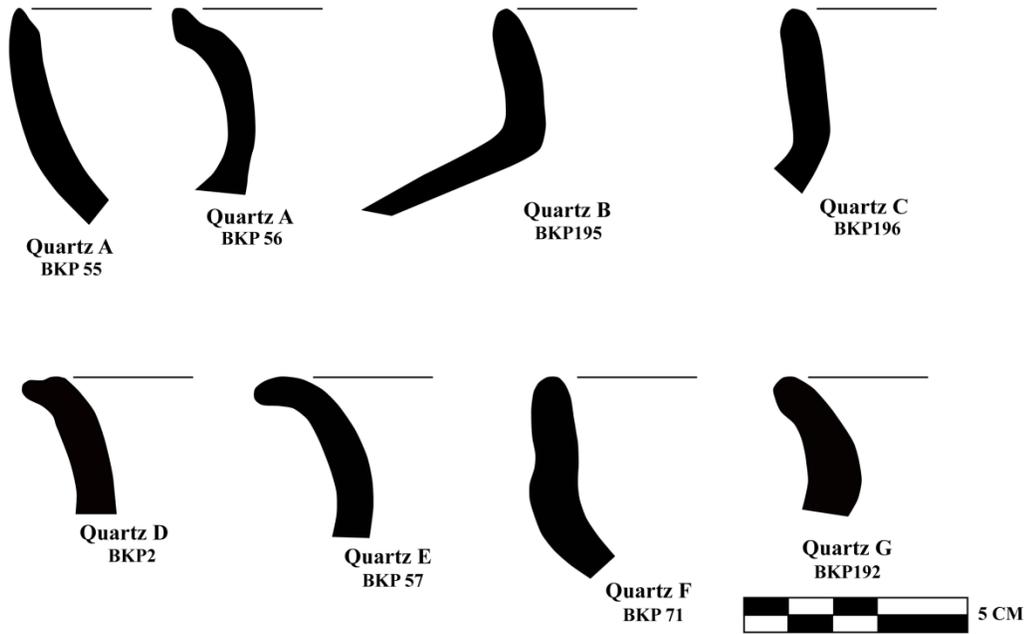


Figure D.14 Quartz Fabric Groups Rim Profiles.

APPENDIX E

UXBENKÁ FABRIC DESCRIPTIONS

Sandstone A

Samples: 3, 12, 14

I. Microstructure

(a) *Voids*: Very few voids, predominantly mesochannels, few mesovughs, very rare macrovughs

(b) *c/f related distribution*: Closed-spaced to single-spaced, porphyric related distribution

(c) *Preferred orientation*: Channel voids oriented parallel to vessel margins. Inclusion weakly oriented parallel to vessel walls.

II. Groundmass

(a) *Homogeneity*: Larger, calcareous sandstone inclusions are unevenly distributed. All other inclusions and voids are evenly distributed throughout the fabric. The color and optical activity of the micromass is homogeneous.

(b) *Micromass*: Optically active. The b-fabric is monostriated. The color is a light reddish brown in PPL (x40) and a golden reddish brown in XPL (x40).

(c) *Inclusions*: The size distribution is bimodal with an upper size class (>.25mm) composed primarily rounded to subangular naturally occurring monocrystalline quartz. Few to very few calcareous sandstone and mudstone fragments are rounded to subangular and irregularly distributed across the fabric contributing to the bimodal appearance. Other inclusions in the fine fraction include very few plagioclase feldspar, and rare quartzite, chert, chalcedony, polycrystalline quartz, and igneous rock fragments. The lower size class (<.25mm) is composed of monocrystalline quartz, muscovite, calcareous mudstone, plagioclase feldspar, biotite/chloritized biotite, quartzite, chert, chalcedony, polycrystalline quartz, igneous rock fragments, and zircon. All inclusions other than the calcareous sandstone are likely associated with the natural clay. The largest inclusion is 1mm (calcareous sandstone; coarse sand sized) and 98% of the inclusions range from .04mm (coarse silt) to .75mm (coarse sand) with a mode size of .3mm (medium sand). The sorting is moderate.

c:f:v_{10μ} : 55:40:5

c:f:v_{250μ} : 15:60:5

Coarse Inclusions (>.25mm)

Frequent

Monocrystalline Quartz: Rounded to subangular, equant to elongated, they range in size from .25mm (medium sand) to .75mm (coarse sand) with a mode size of .25mm (medium sand). The grains are predominantly undulose and rarely zoned. Few grains have iron oxide coatings.

Few

Calcareous Sandstone: Rounded to subangular, equant to elongated, they range in size from .25mm (medium sand) to 1mm (very coarse sand) with a mode size of .75mm (coarse sand). The sandstone is composed of quartz, plagioclase, biotite, muscovite, chert, and igneous rock fragments and is consistent with calcareous sandstone samples analyzed from the Uxbenká area.

Very Few

Plagioclase Feldspar: Rounded to subangular, equant to elongated, they range in size from .25mm (medium sand) to .4mm (medium sand) with a mode size of .25mm (medium sand). Few grains have iron oxide coatings.

Calcareous Mudstone: Rounded, equant to elongated, they range in size from .25mm (medium sand) to 1.15mm (very coarse sand) with a mode size of .65mm (coarse sand). Sample 3 has more abundant medium sand sized, round mudstone inclusions. The mudstone is likely part of the calcareous sandstone bedrock.

Rare

Quartzite: Rounded, equant to elongated, they range in size from .25mm (medium sand) to .55mm (coarse sand) with a mode size of .3mm (medium sand). Few grains have iron oxide coatings.

Chert: Rounded, equant to elongated, they range in size from .25mm (medium sand) to .55mm (coarse sand) with a mode size of .3mm (medium sand). Few grains have iron oxide coatings. Sample 12 has more abundant chert.

Chalcedony: Rounded, equant to elongated, they range in size from .25mm (medium sand) to .55mm (coarse sand) with a mode size of .3mm (medium sand). Few grains have iron oxide coatings.

Polycrystalline Quartz: Rounded, equant to elongated, they range in size from .25mm (medium sand) to .55mm (coarse sand) with a mode size of .3mm (medium sand). Few grains have iron oxide coatings.

Igneous Rock Fragments: Rounded, equant to elongated, they range in size from .25mm (medium sand) to .55mm (coarse sand) with a mode size of .3mm (medium sand). Few grains have iron oxide coatings.

Fine Inclusions (<.25mm)**Common**

Monocrystalline Quartz: Rounded to subangular, equant to elongated, they range in size from .02mm (medium silt) to .25mm (medium sand) with a mode size of .14mm (fine sand). Few grains have iron oxide coatings.

Muscovite: Elongated, subangular laths and laths with frayed ends, they range in size from .02mm (medium silt) to .2mm (fine sand) with a mode size of .1mm (very fine sand).

Few to Very Few

Calcareous Mudstone: Rounded, equant to elongated, they range in size from .06mm (coarse silt) to .25mm (medium sand) with a mode size of .25mm (medium sand).

Plagioclase Feldspar: Rounded to subangular, equant to elongated, they range in size from .06mm (coarse silt) to .25mm (medium sand) with a mode size of .25mm (medium sand).

Very Few to Rare

Biotite/Chloritized Biotite: Elongated, subangular laths and frayed ends, they range in size from .02mm (medium silt) to .2mm (fine sand) with a mode size of .1mm (very fine sand).

Quartzite: Equant to elongated, rounded to subangular, mode size of .2mm (fine sand)

Chert: Equant to elongated, rounded to subangular, mode size of .2mm (fine sand)

Chalcedony: Equant to elongated, rounded to subangular, mode size of .2mm (fine sand)

Polycrystalline Quartz: Equant to elongated, rounded to subangular, mode size of .2mm (fine sand)

Igneous Rock Fragments: Equant to elongated, rounded to subangular, mode size of .2mm (fine sand)

Very Rare

Zircon: Equant, rounded, fine sand sized

III. Textural Concentration Features

Rare clay pellets: Rounded, equant to irregular, moderate optical density, diffuse boundaries, they range in size from .15mm (very fine sand) to .5mm (medium sand) with a mode size of .25mm (fine sand). The color is reddish brown in PPL and XPL (x40). The pellets are Fe rich and some contain silt sized quartz grains. The

IV. Amorphous Concentration Features

Very few to few Fe/Mn Nodules (Small): Rounded, equant to irregular and rarely elongated, high to moderate optical density, merging to diffuse boundaries, they range in size from fine silt to medium sand with a mode size of .04mm to .06mm (coarse silt). The color is black to dark red in both PPL and XPL (x40). The larger particles (fine to

medium sand size) occasionally have monocrystalline quartz in inclusions that are discordant with the surrounding matrix.

Rare Fe/Mn Nodules (Large): These have the same characteristics as those described above but the larger sized particles always have a high optical density and are rare across the samples. They range in size from .5mm (medium sand) to 2.2mm (granule) and contain monocrystalline quartz, plagioclase, and chert inclusions that are discordant with the surrounding matrix.

Local Sandstone A, Subgroup 1

Samples: 1, 2

Subgroup 1 is the same as Calcareous Sandstone A in all respects except that nearly all inclusions are smaller than .25mm (medium sand). The calcareous sandstone in this subgroup is larger than other inclusions (e.g. quartz and plagioclase) and bimodally distributed suggesting it was added as temper but the inclusions are smaller (mode size of .35mm). This subgroup is moderately well-sorted.

Local Sandstone A, Subgroup 2

Samples: 9, 18, 98

Subgroup 2 is the same as Calcareous Sandstone A in all respects except that rhombic, crystalline calcite (very few) is also present. These inclusions are subangular to angular, elongated, range in size from .25mm (medium sand) to 1.2mm (very coarse sand) with a mode size of .35mm (medium sand). The calcite is large, angular, and exhibits bimodal distribution suggesting that it was added as temper alongside the calcareous sandstone. Some of the equant, rhombic inclusions may be dolomite. These inclusions do not exhibit a darkened core and need to be stained with Alizarin Red to determine if some of them are indeed dolomite. This subgroup is very poorly sorted.

COMMENTS

Paste Technology

This fabric is a moderately sorted, sandy clay containing monocrystalline quartz, calcareous sandstone, plagioclase feldspar, calcareous mudstone, quartzite, chert, chalcedony, polycrystalline quartz, igneous (mostly extrusive) rock fragments, muscovite, and zircon. The fabric is likely tempered with calcareous sandstone. The calcareous sandstone/mudstone is unevenly distributed throughout the fabric giving it a bimodal appearance. The likely temper is not angular; however, the rounded habit would be expected if collecting soft, calcareous bedrock (*nib*).

Provenance

The size, sorting, and composition of the other mineral and rock inclusions is consistent with locally derived clays. The calcareous sandstone temper is consistent with UAP11 and UAP12 samples. The smaller grain size is most similar to UAP11. The clay is a land-based clay similar to all of the clay samples collected for this study suggesting potters were using the yellow to red sandy clays (*chik lu'um*) located to the south of the polity.

Sandstone B

Samples: 15, 28, 31, 32, 34, 40, 41, 42, 44, 50, 53, 55, 60, 66, 67, 73, 75, 76, 77, 79, 80, 81, 82, 83, 88, 90, 96 (n=27)

I. Microstructure

(a) Voids: Few to very few voids, predominantly mesochannels, rare macrovugs and microchannels

(b) c/f related distribution: Closed-spaced to double-spaced, porphyric related distribution

(c) Preferred orientation: Channel voids oriented parallel to vessel margins; inclusions weakly oriented parallel to vessel margins

II. Groundmass

(a) Homogeneity: There is variation across the group with respect to: the color of the micromass, the size and quantity of carbonate inclusions, and slight differences in the size and abundance of quartz and other non-carbonate rocks and minerals (e.g. plagioclase and chert) in the coarse and fine fraction. Within an individual fabric, most non-carbonate inclusions and voids are evenly distributed and sandstone/mudstone as well as carbonate inclusions are unevenly distributed. Some fabrics (n=3) have differences in color between the core and margins.

(b) Micromass: Optically active. One sample (75) has a slightly optically active groundmass. The b-fabric is monostriated. The color in PPL is a light to medium brown in PPL (x40) and a golden reddish brown in XPL (x40). Four samples (53, 60, 66, 79) have a reddish brown exterior margin and medium brown interior margin in PPL (x40) and a golden reddish brown exterior margin and dark golden reddish brown exterior margin in XPL (x40).

(c) Inclusions: The size distribution is bimodal with an upper size class (>.5mm) composed of monocrystalline quartz (frequent to few), crystalline calcite and sandstone (few to very few), chert (very few to rare), mudstone and quartzite (rare), and bioclastic chert (very rare). The lower size class (<.5mm) is composed of monocrystalline quartz and muscovite (frequent), chert (common), quartzite (common to very few), plagioclase, chalcedony, polycrystalline quartz (few to very few), biotite/chloritized biotite, igneous rock fragments, mudstone (very few to rare), and zircon (very rare). The largest inclusion is 2.4mm (crystalline calcite) and 98% of the inclusions range in size from .04mm (silt) to 1.5mm (coarse sand). Nearly all inclusions are subangular to subrounded with the exception of the very angular crystalline calcite temper. The sorting is moderate to poor.

c:f:v _{10μ} : 40:50:10 to 45:45:10

c:f:v _{500μ} : 10:80:10 to 15:75:10

Coarse Inclusions (>.5mm)

Frequent to Few

Monocrystalline Quartz: Rounded to subangular, equant to elongated, they range in size from .5mm (medium sand) to 1mm (very coarse sand) with a mode size of .6mm (medium sand). The quartz is predominantly undulose and some grains are zoned. Many have iron oxide and clay coatings.

Few to Very Few

Crystalline Calcite: Angular, equant to elongated (rhombic), they range in size from .5mm (medium sand) to 2.4mm (granule) with a mode size of .65mm (coarse sand).

Sandstone: Rounded to subrounded, predominantly equant with very few elongated grains, they range in size from .5mm (medium sand) to 1.5mm (very coarse sand) with a mode side of .65mm (medium sand). This sandstone is composed primarily of quartz, plagioclases, and muscovite in a non-calcareous clay matrix. The color is brown in PPL an black in XPL. Many have iron oxide and clay coatings.

Very Few to Rare

Chert: Rounded, equant to elongated, they range in size from .5mm (medium sand) to 1mm (very coarse sand) with a mode size of .6mm (medium sand). Many have iron oxide and clay coatings.

Rare

Mudstone: Rounded to subrounded, predominantly equant with very few elongated grains, they range in size from .5mm (medium sand) to 1mm (very coarse sand) with a mode side of .65mm (medium sand). Many have iron oxide and clay coatings.

Quartzite: Rounded, equant to elongated, they range in size from .5mm (medium sand) to .7mm (medium sand) with a mode size of .6mm (medium sand). Many have iron oxide and clay coatings.

Very Rare

Bioclast (chert): Only in Sample 34. Rounded, elongated, 1.1mm (very coarse sand).

Fine Inclusions (<.5mm)

Frequent

Monocrystalline Quartz: Rounded to subangular, predominantly equant with few elongated grains, they range in size from .02mm (medium silt) to .5mm (medium sand) with a mode size of .2mm (fine sand). Quartz is predominantly undulose

and some grains are zoned. Many grains have iron oxide coatings, or infilled along fissures with iron oxide, and clay coatings.

Muscovite: Elongated, subangular laths and laths with frayed ends, they range in size from .02mm (medium silt) to .2mm (fine sand) with a mode size of .1mm (very fine sand).

Common

Chert: Rounded to subrounded, equant to elongated, they range in size from .04mm (coarse silt) to .5mm (medium sand) with a mode size of .3mm (medium sand). Many grains are coated with iron oxide and/or are infilled along fissures with iron oxide.

Common to Very Few

Quartzite: Rounded to subrounded, equant to elongated, they range in size from .04mm (coarse silt) to .5mm (medium sand) with a mode size of .3mm (medium sand). Many grains are coated with iron oxide and/or are infilled along fissures with iron oxide.

Few to Very Few

Plagioclase: Rounded to subrounded, equant to elongated, .04mm (coarse silt) to .5mm (medium sand) with a mode size of .3mm (medium sand). Many grains are coated with iron oxide and/or are infilled along cleavage planes with iron oxide.

Chalcedony: Rounded to subrounded, equant to elongated, they range in size from .04mm (coarse silt) to .5mm (medium sand) with a mode size of .3mm (medium sand). Many grains are coated with iron oxide and/or are infilled along fissures with iron oxide.

Polycrystalline Quartz: Rounded to subrounded, equant to elongated, they range in size from .04mm (coarse silt) to .5mm (medium sand) with a mode size of .3mm (medium sand). Many grains are coated with iron oxide and/or are infilled along fissures with iron oxide.

Very Few to Rare

Biotite/Chloritized Biotite: Elongated, subangular laths and frayed ends, they range in size from .02mm (medium silt) to .2mm (fine sand) with a mode size of .1mm (very fine sand).

Igneous Rock Fragment: Rounded, equant to elongated, they range in size from .1mm (fine sand) to .5mm (medium sand) with a mode size of .4mm (medium sand). The igneous rock fragments are to be aphanitic, extrusive rocks (e.g. basalt) consistent with lithic inclusions reported for the Toledo Formation.

Mudstone: Rounded, equant to elongated, they range in size from .1mm (fine sand) to .5mm (medium sand) with a mode size of .4mm (medium sand).

Very Rare

Zircon: Rounded to angular, equant, they range in size from .02mm (medium silt) to .06mm (coarse silt) with a mode size of .06mm (coarse sand). They occur in the micromass and also as part of the sandstone.

III. Textural Concentration Features

Rare clay pellets: Rounded, equant to elongated, moderate optical density, merging to diffuse boundaries, they range in size from .15mm (very fine sand) to .5mm (medium sand) with a mode size of .25mm (fine sand). The color is yellow brown to orange brown in PPL (x40) and golden yellow brown to golden orange brown in XPL (x40). The micromass of the clay pellets is very optically active compared to the surrounding micromass.

IV. Amorphous Concentration Features

Very few to few Fe/Mn Nodules (Small): Rounded, equant to irregular and rarely elongated, high to moderate optical density, merging to diffuse boundaries, they range in size from fine silt to medium sand with a mode size of .04mm to .06mm (coarse silt). The color is black to dark red in both PPL and XPL (x40). The larger particles (fine to medium sand size) occasionally have monocrySTALLINE quartz in inclusions that are discordant with the surrounding matrix.

Rare Fe/Mn Nodules (Large): These have the same characteristics as those described above but the larger sized particles always have a high optical density and are rare across the samples. They range in size from .5mm (medium sand) to 2.2mm (granule) and contain monocrySTALLINE quartz, plagioclase, and chert inclusions that are discordant with the surrounding matrix.

Very few black coatings around irregularly shaped voids where organics have burned out.

Local Sandstone B, Subgroup 1

Samples: 35, 38, 39, 43, 46, 52, 58, 89 (n=8)

Subgroup 1 is the same as Local Sandstone B in all respects except that the micromass in XPL is a very dark golden brown. The exterior margin on Sample 43 is the same color in PPL and XPL as the samples described as part of the main group. This subgroup likely represents a firing difference because the fabric is only slightly optically active. It is less likely that this subgroup represents clay procured from a slightly different location. The color in XPL is not similar to any of the natural clay samples collected for this study.

Local Sandstone B, Subgroup 2

Samples: 49, 59, 61, 62, 64, 65, 70, 71, 72 (n=9)

Subgroup 2 is the same as Local Sandstone B in all respects except that the micromass in PPL is reddish brown in PPL (x40) and a golden reddish brown in XPL (x40). There are also more abundant red Fe nodules (few to common) than the main group and fewer Mn nodules. The non-sandstone stone grains are generally smaller than in the main group (mode = .25mm). This subgroup likely represents clay procured from a slightly different location than the main group.

Local Sandstone B, Subgroup 3

Samples: 29, 33, 36, 37, 45, 47, 48, 51, 54, 56, 57, 68, 69, 74, 78, 87, 91, 95, 97 (n=19)

Subgroup 3 is the same as Local Sandstone B in all respect except that the fine fraction (<.5mm) is more sparse (primarily the abundance of monocrystalline quartz) and the spacing is single-spaced to open-spaced, porphyric related distribution. This group include both golden brown (Main) and golden reddish brown (Subgroup 2) in XPL fabrics. This subgroup either represents a clay procured from a slightly different location or a different vertical location in which the mineralogical abundance (but not composition) differs.

c:f:v _{10μ} : 20:70:10 to 30:60:10

c:f:v _{500μ} : 10:80:10 to 15:75:10

Local Sandstone B, Subgroup 4

Samples: 63

Sample 63 is similar to Local Sandstone B and its subgroups but also slightly different. This sample has a reddish brown fabric similar to Subgroup 2, has sparse inclusions similar to Subgroup 3, and contains numerous large rock fragments and is poorly sorted. This sample may be a censor fragment so the difference in fabric group characteristics may represent a functional difference.

COMMENTS

Paste Technology

This fabric is a moderately to poorly sorted, sandy clay containing sandstone, mudstone, monocrystalline quartz, polycrystalline quartz, quartzite, plagioclase, muscovite, biotite (some chloritized biotite), chert, chalcedony, igneous (mostly extrusive) rock fragments, and zircon. The fabric is tempered with angular, rhombic (equant to elongated) carbonate. The presence of crystalline calcite temper is evident in most samples based on the shape of void because the carbonate is no longer present. Sample 15, however, still contains calcite providing additional evidence for carbonate temper beyond void habit. It is likely that carbonate was removed due to post depositional leaching. The angularity and uneven distribution indicates that the calcite was added as temper. The presence of calcite temper gives this fabric a bimodal appearance. The sandstone and mudstone are unevenly distributed but are rounded and consistent with the distribution of these inclusions in sampled clays suggesting these inclusions are naturally occurring.

Provenance

The composition and angularity of the non-carbonate inclusions are consistent with the local geology, both geologic descriptions of the Toledo Formation and the clays collected for this study. The sandstone in this fabric group is different from that of Local Sandstone A. The mineralogical composition is largely similar but the matrix is isotropic in XPL. It is consistent with the sandstone naturally occurring in clays collected for this study. The sandstone is similar to that of Sandstone A and the calcareous sandstone samples; however, the isotropic matrix suggests that either this fabric group was fired differently than Sandstone A or that different taphonomic processes affected the pottery in the households differently than the site core. At this time, I cannot further separate this very large main group due to the nature of the parent material and soils that form atop them. The range of variation is consistent with all clay samples, regardless of location. However, the similarity to all of the clay samples suggests that potters were using the yellow to red sandy clays (*chik lu'um*) located to the south of the polity. There are two possible sources for the calcite temper: limestones interbedded with clastic deposits as part of the Toledo Formation or the Cretaceous limestone "rock patch" located to the south of the Uxbenká polity. All of the subgroups either represent differences in firing or slight differences in local provenance. The color variation that sets these groups apart is also present on a single sherd (e.g. golden and reddish fabric in PPL) suggesting that the difference may be due to firing. However, they have been split into subgroups for this study just to note the color variation. The mineralogical variability in the subgroups is the same as the main group. Local Sandstone B contains much more chert and quartzite than Local Sandstone A, perhaps indicative of a completely different, yet local, clay source.

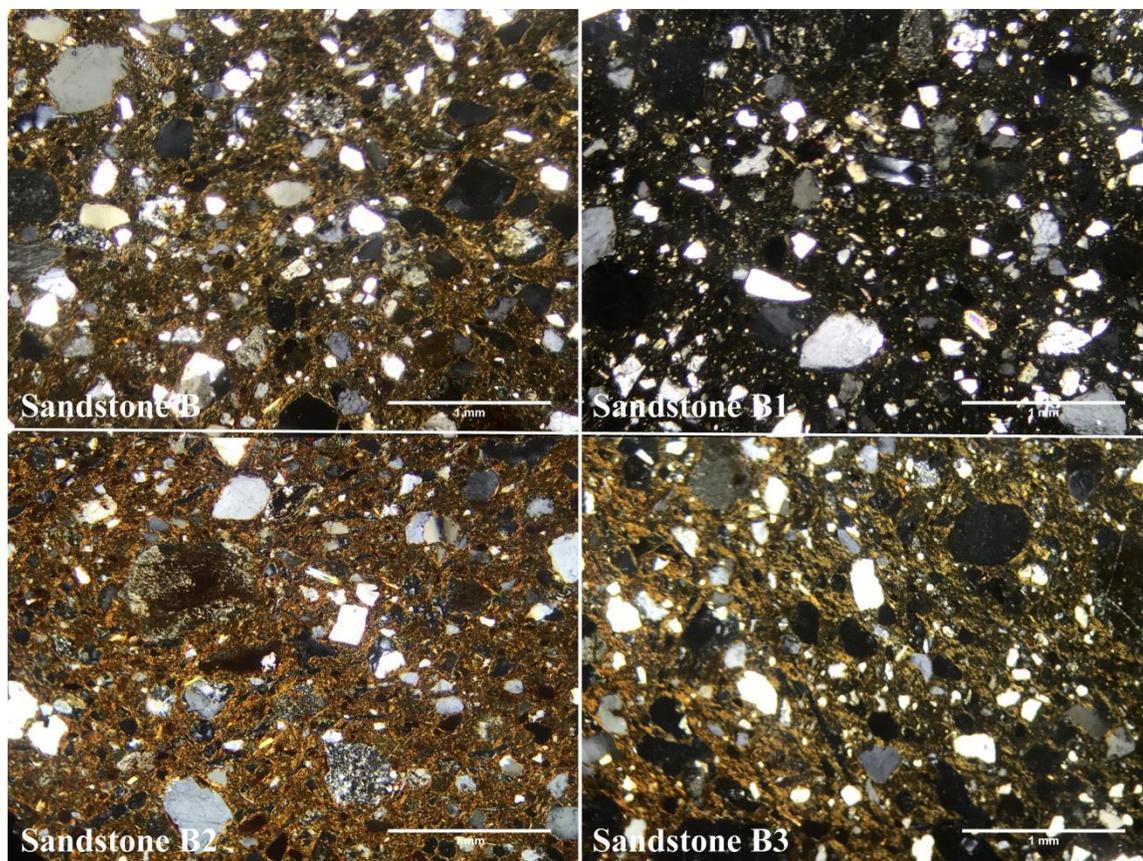


Figure E.1. Sandstone B (Sample 90); Sandstone B1 (Sample 39); Sandstone B2 (Sample 62); Sandstone B3 (Sample 97) (All XPL).

Quartz A

Samples: 4, 5, 8, 10, 11, 13, 16, 17, 25, 85, 86, 92 (n=12)

I. Microstructure

(a) **Voids:** Few voids, predominantly meso channels, few mesovughs, rare microchannels

(b) **c/f related distribution:** Closed-spaced to double-spaced, porphyric related distribution

(c) **Preferred orientation:** Channel voids oriented parallel to vessel walls. Inclusions show no preferred orientation.

II. Groundmass

(a) **Homogeneity:** There is variation across the group with respect to the color of the micromass and slight differences in the size and abundance of quartz and other minerals (e.g. plagioclase and chert). Within an individual fabric, inclusions and voids are evenly distributed.

(b) **Micromass:** Optically active. The b-fabric is monostriated. Most samples are a light to medium brown in PPL (x40) and a golden reddish brown in XPL (x40). Three samples (13, 17, and 25 are light brown in PPL (x40) and golden brown in XPL (x40).

(c) **Inclusions:** The size distribution is unimodal with an upper size class (>.0625mm) composed of monocrystalline quartz (predominant), polycrystalline quartz, quartzite, chert, chalcedony, plagioclase feldspar, muscovite, biotite/chloritized biotite (common), igneous rock fragments, and mudstone (very few to rare). The lower size class (<.0625mm) is composed of monocrystalline quartz (dominant), polycrystalline quartz, chert, plagioclase feldspar, muscovite, biotite (few to very few), and zircon (rare). The largest inclusion is .6mm (monocrystalline quartz) and 98% of the inclusions range in size from .0625mm (silt) to .35mm (medium sand). Nearly all of the inclusions are rounded to subrounded with a few subangular grains. The sorting is moderate.

c:f:v_{62μ} : 80: 15: 5

Coarse Inclusions (>.0625mm)

Predominant

Monocrystalline Quartz: Rounded to subangular, predominantly equant to elongated with a few irregular grains, they range in size from .0625mm (coarse silt) to .6mm (coarse sand) with a mode size of .35mm (medium sand). Many grains are coated with iron oxide and/or are infilled along fissures with iron oxide.

Few to Very Few

Polycrystalline Quartz: Rounded to subrounded, equant to elongated, they range in size from .0625mm (coarse silt) to .5mm (medium sand) with a mode size of .3mm (medium sand). Many grains are coated with iron oxide and/or are infilled along fissures with iron oxide.

Quartzite: Rounded to subrounded, equant to elongated, they range in size from .0625mm (coarse silt) to .5mm (medium sand) with a mode size of .3mm (medium sand). Many grains are coated with iron oxide and/or are infilled along fissures with iron oxide.

Chert: Rounded to subrounded, equant to elongated, they range in size from .0625mm (coarse silt) to .5mm (medium sand) with a mode size of .3mm (medium sand). Many grains are coated with iron oxide and/or are infilled along fissures with iron oxide.

Chalcedony: Rounded to subrounded, equant to elongated, they range in size from .0625mm (coarse silt) to .5mm (medium sand) with a mode size of .3mm (medium sand). Many grains are coated with iron oxide and/or are infilled along fissures with iron oxide.

Plagioclase Feldspar: Rounded to subrounded, equant to elongated, they range in size from .0625mm (coarse silt) to .5mm (medium sand) with a mode size of .3mm (medium sand). Many grains are coated with iron oxide and/or are infilled along fissures with iron oxide.

Muscovite: Elongated, subangular laths and frayed ends, they range in size from .0625mm (coarse silt) to .2mm (fine sand) with a mode size of .1mm (very fine sand).

Biotite/Chloritized Biotite: Elongated, subangular laths and frayed ends, they range in size from .0625mm (coarse silt) to .2mm (fine sand) with a mode size of .1mm (very fine sand).

Very Few to Rare

Igneous Rock Fragment: Rounded to subrounded, equant to elongated, they range in size from .0625mm (coarse silt) to .5mm (medium sand) with a mode size of .3mm (medium sand). Many grains are coated with iron oxide and/or are infilled along fissures with iron oxide.

Sandstone/Mudstone: Rounded to subrounded, equant to elongated, they range in size from .0625mm (coarse silt) to .5mm (medium sand) with a mode size of .3mm (medium sand). Many grains are coated with iron oxide and/or are infilled along fissures with iron oxide. Sample 10 has a 2mm (granule) mudstone inclusion.

Fine Inclusions (<.0625mm)

Dominant: Monocrystalline Quartz

Few to Very Few: Polycrystalline Quartz, Chert, Plagioclase Feldspar, Muscovite, Biotite

Very Rare: Zircon

III. Textural Concentration Features

Same as Sandstone B

IV. Amorphous Concentration Features

Same as Sandstone B

COMMENTS

Paste Technology

This fabric can be characterized as a very poorly sorted, sandy clay generally devoid of rock content and a unimodal size distribution. This fabric group is identical to the Sandstone B fabric except for the lack of rock content and limestone temper. The unimodal size distribution indicates that no temper of any kind was added. The lack of large rocks suggests that potters either removed the rock content as part of raw materials processing or purposefully selected clays devoid of rock content (i.e. clay not located just above bedrock).

Provenance

The mineralogy, sorting, and size of the sand inclusions is consistent with geology descriptions of the Toledo formation and comparable to natural clay samples indicative of a local provenance.

Mica A

Samples: 92, 93

The *Mica A* Fabric Group is identical to the Sandstone B Fabric Group except that the clay is very micaceous (primarily muscovite) and the rock and mineral inclusions are much smaller (mode size: .15mm; very fine sand-sized). The Mica A group is also tempered with rhombic crystalline calcite or dolomite.

Mixed Local Sandstone and Carbonate A

Samples: 19, 20, 26

This group is nearly identical to Sandstone B but with a more crystalline calcite temper (common).

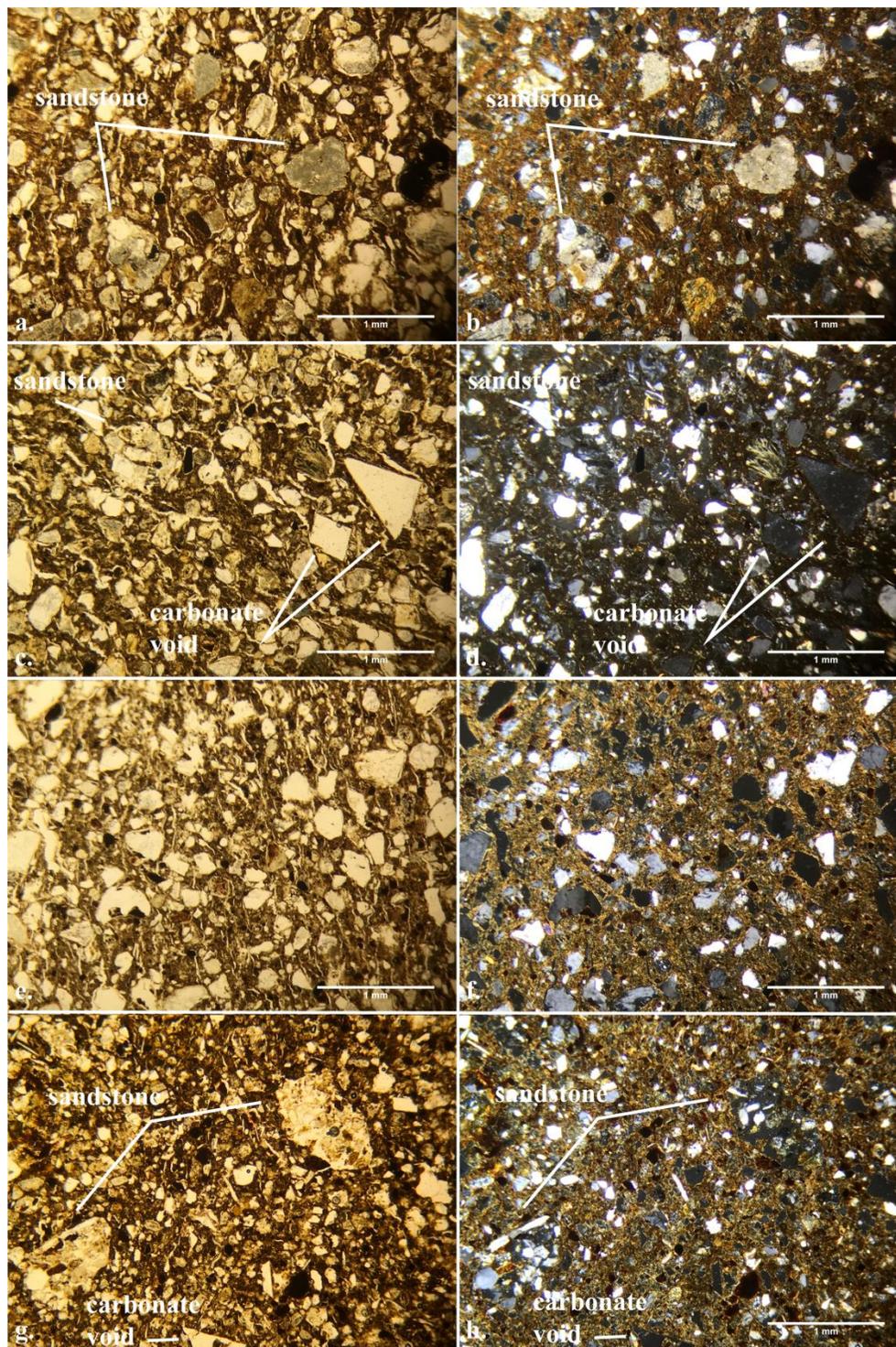


Figure E.2. Locally Produced Ceramic Groups Micrographs: a. Sandstone A, PPL (Sample 14); b. Sandstone B, XPL (Sample 14); c. Sandstone B, PPL (Sample 75); d. Sandstone B, XPL (Sample 75); e. Quartz A, PPL (Sample 10); f. Quartz A, XPL (Sample 10); g. Mica A, PPL (Sample 94); h. Mica A, XPL (Sample 94).

Carbonate Sand A

Samples: 21

I. Microstructure

(a) *Voids:* Few voids, micro- and mesochannels, mesovughs

(b) *c/f related distribution:* Closed-spaced, porphyric related distribution

(c) *Preferred orientation:* Voids are oriented parallel to the vessel margins. Inclusions show no preferred orientation.

II. Groundmass

(a) *Homogeneity:* Inclusions and voids are distributed evenly across the fabric.

(b) *Micromass:* The core is optically inactive; the margins are slightly optically active. The b-fabric is crystallitic. The core is a very dark brown with reddish brown margins in PPL (x40) and a very dark brown with golden, reddish margins in XPL (x40).

(c) *Inclusions:* The size distribution is unimodal with an upper size class (>.04mm) composed predominantly of carbonate sand with few calcite terminal grades, few micrite sand and micrite lumps, and possibly dolomite, very few monocrystalline quartz, and rare sparry calcite. The lower size class (<.04mm) is composed of common calcite and very few monocrystalline quartz. The largest inclusion is .55mm (micrite and sparry calcite) and 98% of inclusions range in size from .04mm (coarse silt) to .25mm (medium sand) with a mode size of .06mm (coarse silt). Most inclusions are rounded and equant to elongated. The fabric is well-sorted.

c:f:v _{10 μ} : **85:10:5**

c:f:v _{40 μ} : **90:5:5**

Coarse Inclusions (>.04mm)

Predominant

Carbonate Sand: Rounded, equant, they range in size from .04mm (coarse silt) to .2mm (fine sand) with a mode size of .06mm (coarse sand).

Few

Calcite Terminal Grades: Subrounded, equant to irregular, they range in size from .04mm (coarse silt) to .5mm (medium sand) with a mode size of .2mm (fine sand).

Micrite: Rounded, equant sand and rounded, equant to elongated non-sand inclusions. The micrite sand ranges in size from .06mm (coarse silt) to .45mm (medium sand) with a mode size of .08mm (very fine sand). Non-sand micrite inclusions range in size from .2mm (fine sand) to .6mm (medium sand) with a mode size of .3mm (medium sand). The larger micrite inclusions have small, isolated inclusion of crystalline calcite.

Dolomite: These inclusions are rhombs and some have inclusion rich cores. It is difficult to determine if this is dolomite without staining with Alizarin Red; however, their habit and darkened core suggest that these inclusions are dolomite. They are rounded, equant (rhombic), and range in size from .2mm (fine sand) to .3mm (medium sand) with a mode size of .25mm (medium sand).

Very Few

Monocrystalline Quartz: Rounded to subangular, equant, they range in size from .04mm (coarse silt) to .1mm (very fine sand) with a mode size of .1mm (very fine sand).

Rare

Sparry Calcite (finely crystalline): Rounded, equant to elongated, they range in size from .1mm (very fine sand) to .6mm (medium sand) with a mode size of .2mm (fine sand).

Fine Inclusions (<.04mm)

Common: Calcite

Very Few: Monocrystalline Quartz

III. Textural Concentration Features

Very rare clay pellets, moderate optical density, merging boundaries, rounded, equant to elongated, medium sand sized, reddish brown (PPL and XPL).

IV. Amorphous Concentration Features

Very few black and dark reddish brown (PPL and XPL) nodules, high optical density, merging boundaries, rounded, equant, they range in size from .05mm to 1mm with a mode size of .15mm (very fine sand).

COMMENTS

Paste Technology

This group is characterized by the predominance of discrete, rounded grains of carbonate sand composed of both crystalline calcite and micrite. The unimodal size distribution along with the abundance of carbonate sand and its even distribution suggest that this fabric group represented an untempered, clay composed predominantly of carbonate sand. The defining characteristics of this group are the predominance of very fine carbonate sand and an optically inactive matrix. This fabric is very similar to the Carbonate Sand A fabric described in the Baking Pot sample (Sample 49).

Provenance

This fabric group is non-local to the Uxbenká area; however, the provenance is unknown due to a lack of comparative petrographic studies in the area.

Carbonate Sand B

Samples: 84

I. Microstructure

(a) *Voids*: Few voids, predominantly mesovughs and mesochannels, very rare macrovugh
 (b) *c/f related distribution*: Closed-spaced to single-spaced, porphyric related distribution
 (c) *Preferred orientation*: Voids are weakly oriented parallel to vessel margins.
 Inclusions show no preferred orientation.

II. Groundmass

(a) *Homogeneity*: Inclusions and voids are evenly distributed across the fabric. There is a color difference, the margins are redder in color than the core.
 (b) *Micromass*: Slightly optically active. The b-fabric is crystallitic. The core is brown and the margins are reddish brown in PPL (x40). The core is a golden reddish brown and the margins are dark golden reddish brown in XPL (x40).
 (c) *Inclusions*: The size distribution is unimodal with an upper size class (>.04mm) composed predominantly of carbonate sand with very few monocrystalline quartz and quartzite inclusions. The lower size class (<.04mm) is composed of common calcite and very few monocrystalline quartz, quartzite, and muscovite. The largest inclusion is .75mm (quartzite) and 98% of inclusions range in size from .04mm (coarse silt) to .25mm (medium sand) with a mode size of .06mm (coarse silt). All inclusions are rounded to subrounded and most are equant with rare elongated grains. The fabric is well-sorted.

c:f:v_{10μ} : 85:10:5

c:f:v_{40μ} : 90:5:5

Coarse Inclusions (>.04mm)

Predominant

Carbonate Sand: Rounded, equant, they range in size from .04mm (coarse silt) to .2mm (fine sand) with a mode size of .06mm (coarse sand).

Very Few

Monocrystalline quartz: Rounded, equant, they range in size from .04mm (coarse silt) to .2mm (fine sand) with a mode size of .2mm (fine sand).

Quartzite: Rounded to subrounded, equant to elongated, they range in size from .1mm (very fine sand) to .75mm (coarse sand) with a mode size of .25mm (medium sand).

Fine Inclusions (<.04mm)

Common: Calcite

Very Few: Monocrystalline quartz, quartzite, muscovite

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Very few Fe/Mn impregnations (areas of impregnated groundmass), moderate optical density, merging boundaries, irregular, reddish brown (PPL and XPL), fine (.25mm) to coarse sand (.75mm) sized, some of have silt sized quartz inclusions

Few Fe/Mn nodules, high optical density, merging boundaries, dark reddish brown to black (PPL and XPL), silt (.25mm) to very fine sand (.15mm) sized.

COMMENTS

Paste Technology

This group is characterized by the predominance of discrete, rounded grains of carbonate sand. Sample 84 does not contain any carbonate inclusions, likely due to post depositional processes. The habit of the voids was used to determine the type of carbonate inclusions; however, it is unknown if the carbonate sand is composed of more than just calcite (e.g. micrite) or if other types of carbonate (e.g. dolomite) are also present. The unimodal size distribution along with the abundance of carbonate sand and its even distribution suggest that this fabric group represented an untempered clay composed predominantly of carbonate sand. The nearly complete lack of other inclusions suggests that the clay may have been highly processed. The defining characteristics of this group are the predominance of very fine carbonate sand, near absence of other types of inclusions, and a red matrix.

Provenance

This fabric group is non-local to the Uxbenká area; however, the provenance is unknown due to a lack of comparative petrographic studies in the area.

Calcite A

Samples: 23

I. Microstructure

(a) **Voids:** Few voids, predominantly mesochannels, very few mesovughs

(b) **c/f related distribution:** Closed-spaced to double-spaced, porphyric related distribution

(c) **Preferred orientation:** Voids are strongly oriented parallel to vessel margins. Inclusions show no preferred orientation.

II. Groundmass

(a) **Homogeneity:** Larger carbonate inclusions (calcite terminal grades, dolomite, sparry calcite) are unevenly distributed. Other inclusions and voids are evenly distributed. There is a color difference between the core and margins.

(b) **Micromass:** The core is optically inactive. The margins are slightly optically active. The b-fabric is monostriated. The core is a very dark brown and the margins are a reddish brown in PPL (x40). The core is a very dark brown and the margins are a golden reddish brown in XPL (x40).

(c) **Inclusions:** The size distribution is bimodal with an upper size class (>.08mm) composed of dominant calcite terminal grades, very few dolomite, micrite, sparry calcite, and monocrystalline quartz, and rare polycrystalline quartz and chert. The lower size class (<.08mm) is composed of common calcite and very few monocrystalline quartz. The largest inclusion is .7mm (sparry calcite) and 98% of inclusions range in size from .08mm (silt) to .5mm (medium sand). All inclusions are rounded to subrounded. The sorting is moderate.

c:f:v_{10μ} : 40:50:10

c:f:v_{80μ} : 30:40:10

Coarse Inclusions (>.08mm)

Dominant

Calcite Terminal Grades: Subrounded, equant to irregular, they range in size from .08mm (very fine sand) to .35mm (medium sand) with a mode size of .25mm (medium sand).

Very Few

Dolomite: Rounded, equant (rhombic), they range in size from .25mm (medium sand) to .5mm (coarse sand) with a mode size of .3mm (medium sand). The habit and darkened, inclusion rich core suggests that these inclusions are dolomite. It is difficult to determine if this is dolomite without staining with Alizarin Red.

Micrite: Rounded, equant to elongated, they range in size from .15mm (fine sand) to .5mm (coarse sand) with a mode size of .2mm (fine sand). Much of the micrite is stained red (Fe).

Sparry Calcite (finely to medium crystalline): Rounded, equant to elongated, they range in size from .25mm (medium sand) to .75mm (coarse sand) with a mode size of .3mm (medium sand).

Monocrystalline Quartz: Rounded to subrounded, equant to elongated, they range in size from .08mm (very fine sand) to .6mm (coarse sand) with a mode size of .15mm (fine sand).

Rare

Polycrystalline Quartz: Subrounded, equant to elongated, they are all silt sized inclusions

Chert: Rounded, elongated, they are all silt sized inclusions

Fine Inclusions (<.08mm)

Common: Calcite

Very Few: Monocrystalline Quartz

III. Textural Concentration Features

Very few clay pellets, rounded, equant to elongated, moderate optical density, dark brown with black nodules (PPL and XPL), clear to merging boundaries, they range in size from .25mm (medium sand) to .6mm (coarse sand). Some of the pellets contain silt sized monocrystalline quartz inclusions.

IV. Amorphous Concentration Features

Very few Fe/Mn nodules, equant, rounded, high optical density, dark red to black (PPL and XPL), clear to merging boundaries, they range in size from .1mm (very fine sand) to .45mm (medium sand).

COMMENTS

Paste Technology

This fabric group is characterized by an abundance of fine to medium calcite terminal grades that were likely added as temper. They are unevenly distributed and are slightly larger than inclusions that were part of the natural clay. Other large carbonate inclusions were also likely also temper added as part of crushed limestone (micrite, sparry calcite, and dolomite). The presence of dolomite indicates the temper was part of a dolomitic limestone or dolomitized calcite. The defining characteristic of this group is the abundance of fine to medium sized terminal grade calcite. This inclusion is likely the result of well processed (i.e. crushed) limestone temper.

Provenance

This fabric group is not local to Uxbenká. The fabric is very similar to those described for Baking Pot, particularly Calcite B, Subgroup 2 (medium terminal grade variant); however, it is not exactly identical because the groundmass is much darker and the core is optically inactive of a higher firing temperature. The Calcite A fabric group at Uxbenká likely has a Belize River Valley provenance.

Calcite B

Samples: 6, 27

I. Microstructure

(a) Voids: Few voids, predominantly mesochannels, few mesovughs

(b) c/f related distribution: Closed-spaced to single-spaced, porphyric related distribution

(c) Preferred orientation: Voids are oriented parallel to vessel margins. Inclusions are weakly oriented parallel to vessel margins.

II. Groundmass

(a) Homogeneity: Larger carbonate inclusions (calcite terminal grades, micrite, dolomite, sparry calcite) are unevenly distributed. Other inclusions and voids are evenly distributed. There is a color difference between the core and margins.

(b) Micromass: Optically active. The b-fabric is crystallitic. The core is a dark brown with reddish brown margins in PPL (x40). The core is a dark golden brown with golden reddish margins in XPL (x40).

(c) Inclusions: The size distribution is unimodal. The upper size class (>.1mm) is composed of calcite terminal grades (frequent), sparry calcite, micrite, monocrystalline quartz (few), dolomite and chalcedony (very few), polycrystalline quartz (rare), chert and sparry calcite + chalcedony rock fragment (very rare). The lower size class (<.1mm) is composed of dominant calcite, few monocrystalline quartz, and very few chert, chalcedony, and micrite. The largest inclusion is 2.8mm (micrite) and 98% of inclusions range in size from .1mm (very fine sand) to .55mm (coarse sand). Larger inclusions (e.g. terminal grade calcite and sparry calcite) are subangular and were likely added as temper. All other inclusions are rounded and equant to elongated. Sample 6 is very poorly sorted. Sample 27 is moderately sorted.

c:f:v_{10μ} : 40:50:10

c:f_{100μ} : 30:40:10

Coarse Inclusions (>.1mm)

Frequent

Calcite Terminal Grades: Subrounded to subangular, equant to irregular, they range in size from .1mm (very fine sand) to .55mm (coarse sand) with a mode size of .4mm (medium sand).

Few

Sparry Calcite (finely to coarsely crystalline): Subrounded, equant to elongated, they range in size from .15mm (fine sand) to .55mm (coarse sand) with a mode size of .3mm (medium sand).

Micrite: Rounded, equant to elongated, they range in size from .1mm (very fine sand) to 2.8mm (granule) with a mode size of .35mm (medium sand). Much of the micrite is stained red (Fe) and some inclusions are attached to sparry calcite.

Monocrystalline Quartz: Rounded to subrounded, equant to elongated, they range in size from .1mm (very fine sand) to .5mm (coarse sand) with a mode size of .15mm (fine sand).

Very Few

Dolomite: Subrounded, equant (rhombic), they range in size from .2mm (fine sand) to .55mm (coarse sand) with a mode size of .3mm (medium sand). The habit and darkened, inclusion rich core suggests that these inclusions are dolomite. It is difficult to determine if this is dolomite without staining with Alizarin Red.

Chalcedony: Rounded, equant to irregular, they range in size from .1mm (very fine sand) to .8mm (coarse sand) with a mode size of .3mm (medium sand). They frequently have an iron oxide coating, or are infilled along fissures with iron oxide..

Rare

Polycrystalline Quartz: Rounded, equant, .15mm (fine sand)

Very Rare

Chert: Rounded, equant, .15mm (fine sand)

Sparry Calcite + Chalcedony Rock Fragment: Subrounded, irregular, 1mm (very coarse sand)

Fine Inclusions (<.1mm)

Dominant: Calcite

Few: Monocrystalline Quartz

Very Few: Micrite, Chert, Chalcedony

III. Textural Concentration Features

Rare clay pellets with a granular structure, moderate optical density, clear to merging boundaries, light brown to medium brown (PPL and XPL), rounded, elongated, they are medium to coarse sand sized. These are the same types of textural concentration features described in the primary Calcite fabric groups at Baking Pot (Appendix D).

IV. Amorphous Concentration Features

Very few Fe/Mn nodules, moderate to high optical density, dark red to black (PPL and XPL), rounded, equant to elongated, they range in size from .02mm (silt) to .85mm (coarse sand) with a mode size of .2mm (fine sand).

COMMENTS

Paste Technology

This fabric group is characterized by an abundance of fine to medium calcite terminal grades that were likely added as temper. They are unevenly distributed and are slightly larger than inclusions that were part of the natural clay. Other large carbonate inclusions were also likely also temper added as part of crushed limestone (micrite, sparry calcite, and dolomite). The presence of dolomite indicates the temper was part of a dolomitic limestone or dolomitized calcite. The defining characteristic of this group is the abundance of fine to medium sized terminal grade calcite, the dusty appearance of the fabric due to the abundance of calcite in the fine fraction, and the golden brown color of the micromass. The calcite terminal grade inclusions are likely the result of well processed (i.e. crushed) limestone temper.

Provenance

This fabric group is not local to Uxbenká. The fabric is very similar to those described for Baking Pot, particularly Calcite B, Subgroup 1 (small terminal grade variant); however, it is not exactly identical. The Calcite A fabric group at Uxbenká likely has a Belize River Valley provenance.

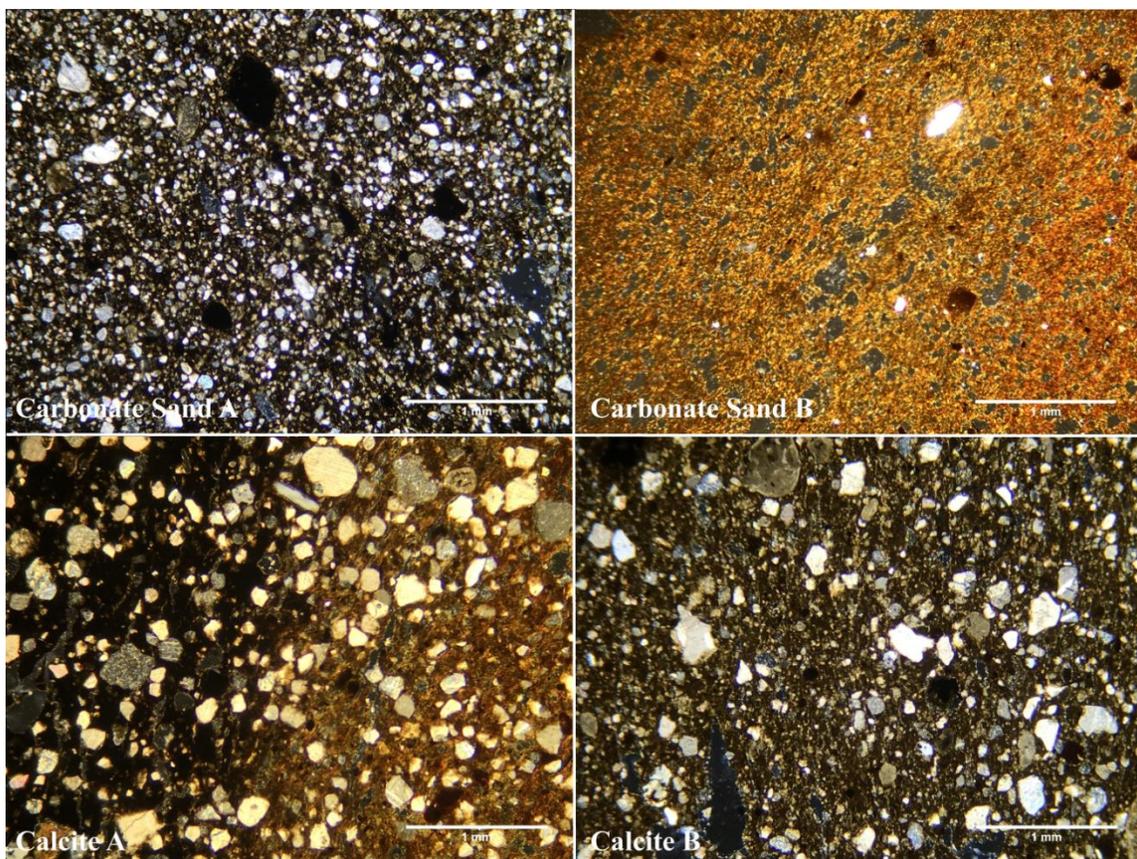


Figure E.3. Carbonate Sand A, Carbonate Sand B, Calcite A, and Calcite B Micrographs (XPL).

Dolomite A

Samples: 22

I. Microstructure

(a) *Voids*: Very few voids, mesochannels and mesovugs

(b) *c/f related distribution*: Closed-spaced to single-spaced, porphyric related distribution

(c) *Preferred orientation*: Voids are parallel and oblique (45°) to the vessel margins.

Inclusions show no preferred orientation.

II. Groundmass

(a) *Homogeneity*: Dolomite is evenly distributed across the sample. Micrite and large iron features are unevenly distributed and the core is slightly darker than the margins.

(b) *Micromass*: Slightly optically active. The b-fabric is monostriated. The core is a medium golden brown and the margins are a reddish brown in PPL (x40). The core is a golden reddish brown in PPL and a golden red in XPL (x40).

(c) *Inclusions*: The size distribution is unimodal and the upper size class (>.4mm) consists of very rare micrite, chalcedony and chert. The lower size class (<.4mm) consists of predominant dolomite, very few muscovite and monocrystalline quartz, and rare chert. The largest inclusion is 1.35mm (micrite) and 98% of the inclusions range in size from .04mm (coarse silt) to .4mm (very fine sand) with a mode size of .12mm (very fine sand). Most of the inclusions are rounded and equant dolomite; all other inclusions are rounded and equant to elongated. This fabric is well sorted with the exception of the one, large micrite inclusion.

c:f:v_{10μ} : 75:15:5

c:f_{400μ} : 5:90:5

Coarse Inclusions (>.4mm)

Very Rare

Micrite: Rounded, elongated, 1.35mm (very coarse sand)

Chalcedony: Rounded, elongated, .56mm (coarse sand). The chalcedony is brown in PPL and coated with iron oxide.

Chert: Rounded, elongated, .5mm (coarse sand). The chert is brown in PPL and coated with iron oxide.

Fine Inclusions (<.4mm)

Predominant

Dolomite: Equant (rhombic), rounded to subrounded, they range in size from .04mm (coarse silt) to .4mm (medium sand) with a mode size of .12mm (very fine sand).

Very Few

Muscovite: Elongated, they range in size from .06mm (coarse silt) to .2mm (fine sand) with a mode size of .1mm (very fine sand).

Monocrystalline Quartz: Rounded, equant to elongated, they range in size from .04mm (coarse silt) to .2mm (fine sand) with a mode size of .08mm (very fine sand)

Rare

Chert: Rounded, equant to elongated, they range in size from .04mm (coarse silt) to .2mm (fine sand) with a mode size of .1mm (very fine sand).

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Common, Fe rich (red) nodules. They are dark, reddish brown (PPL and XPL), have moderate to high optical density, rounded, equant with occasional elongated nodules, merging to diffuse boundaries. They range in size from .02mm (medium silt) to 1.6mm (very coarse sand) with a mode size of .05mm to .1mm. The larger nodules rarely have silt sized quartz inclusions that are discordant with the surrounding matrix.

COMMENTS**Paste Technology**

This group is characterized by the predominance of discrete, rhombic grains of dolomite. The unimodal size distribution along with the abundance of dolomite and its even distribution suggest that this fabric group represented an untempered, dolomitic clay. The nearly complete lack of other inclusions suggests that the clay may have been highly processed. The distinguishing characteristics of this fabric group are the predominance of discrete, rhombic dolomite grains and the near absence of other types of inclusions. Dolomitic limestone is not local the Uxbenká area.

Provenance

Dolomite is part of the Coban Formation that outcrops in southern Belize near the Caribbean Coast. A non-local provenance, possibly coastal Belize, is inferred.

Micrite A

Samples: 24

I. Microstructure

- (a) *Voids*: Rare voids, predominantly mesovughs with rare mesochannels
 (b) *c/f related distribution*: Single-spaced to open-spaced, porphyric related distribution
 (c) *Preferred orientation*: Voids and inclusions show no preferred orientation.

II. Groundmass

- (a) *Homogeneity*: Inclusions and voids are evenly distributed. The margins are slightly darker than the core.
 (b) *Micromass*: Slightly optically active. The b-fabric is crystallitic. The color in PPL is a very light greyish brown and the color in XPL is a light golden grey brown (x40). The margins are slightly darker.
 (c) *Inclusions*: The size distribution is unimodal with an upper size class (>.0625mm) is composed of monocrystalline quartz (common), micrite, polycrystalline quartz, quartzite, igneous rock fragments, and muscovite (few), chert, plagioclase, and zircon and possibly amphibole (rare). The lower size class (<.0625mm) is composed of micrite, monocrystalline quartz and muscovite (common). The largest inclusion is .75mm (micrite) and 98% of the inclusions range in size from .0626mm (silt) to .5mm (medium sand). The fabric is moderately well-sorted.

c:f:v_{10μ} : 80:15:5

c:f:v_{62.5μ} : 90:10:5

Coarse Inclusions (>.0625mm)

Common

Monocrystalline Quartz: Rounded to angular, equant to elongated, they range in size from .0625 (silt) to .6mm (coarse sand) with a mode size of .1mm (very fine sand). The larger quartz fragments have zircon inclusions.

Few

Micrite: Rounded, equant to elongated, they range in size from .0625 (silt) to .75mm (coarse sand) with a mode size of .3mm (medium sand). Some of the micrite has faintly observable crystal structure suggesting it is bordering on very finely crystalline calcite.

Polycrystalline Quartz: Rounded to subangular, equant to elongated, they range in size from .0625 (silt) to .4mm (medium sand) with a mode size of .1mm (very fine sand).

Quartzite: Rounded to subangular, equant to elongated, they range in size from .0625 (silt) to .4mm (medium sand) with a mode size of .1mm (very fine sand).

Igneous Rock Fragments: Rounded, equant to elongated, they range in size from .0625 (silt) to .6mm (medium sand) with a mode size of .1mm (very fine sand). The igneous rock fragments are likely extrusive (e.g. basalt).

Muscovite: Elongated, silt to fine sand sized

Rare

Chert: Rounded, equant, silt to very fine sand sized

Plagioclase Feldspar: Rounded, equant, silt to very fine sand sized

Zircon: Rounded, equant, silt to very fine sand sized

Amphibole (?): Rounded, equant, silt to very fine sand sized

Fine Inclusions (<.0625mm)

Micrite, monocrystalline quartz, muscovite (common)

III. Textural Concentration Features

None

IV. Amorphous Concentration Features

Fe/Mn Nodules, moderate to high optical density, dark red to black (PPL and XPL), merging boundaries, they range in size from .0625mm to .2mm (fine sand) with a mode size of .04mm (silt).

COMMENTS

Paste Technology

This fabric group can be characterized as a micritic clay with a unimodal distribution. The angular, uneven monocrystalline quartz grains may have been added as temper but it is difficult to tell as they are the same size as all of the other inclusions but are angular. The defining characteristics of this fabric group are the fine, micritic clay with small, angular quartz inclusions and rounded igneous rock fragments.

Provenance

The fabric is not local to Uxbenká. Sample 24 comes from an Saxche-Orange Palmar polychrome vessel that is stylistically similar to the Petén of Guatemala and the Belize River Valle the petrographic data are not similar to that of the Belize Valley in this study and the fabric group has been tentatively assigned a Petén provenance.

Volcanic Glass A

Samples: 7

This sample is very similar to the Volcanic Glass A fabric described by Howie at Lamanai. According to Howie (2005: 649), the Volcanic Glass A fabric group at Lamanai is “characterized by dominant fragments of volcanic glass and tuff, occurring together with common inclusions of quartz and a small amount of biotite and feldspar, in a micritic clay matrix containing lumps of micrite. The uneven distribution of the volcanic glass and tuff fragments in some samples provides some evidence that the ash and tuff represent added constituents. The distinguishing characteristic of this fabrics group, apart from the presence of the volcanic glass and tuff fragments, is the common micrite inclusions. The presence of micrite suggests a connection to a limestone geology.” The Volcanic Glass A fabric from Uxbenká, represented by only one sample, is identical to the fabric described by Howie except that there is a greater abundance of biotite (common rather than few). There is one very large micrite inclusion in this fabric (1.7mm, granule). There is no crystalline calcite in the Uxbenká sample. The defining characteristic of this fabric group that distinguishes it from Volcanic Glass A at Lamanai is the abundance of biotite and lack of crystalline calcite. This fabric is not local to Uxbenká. The provenance is unknown but it is a Saxche-Palmar vessel that is stylistically similar to vessels from both the Petén of Guatemala and the Belize River Valley.

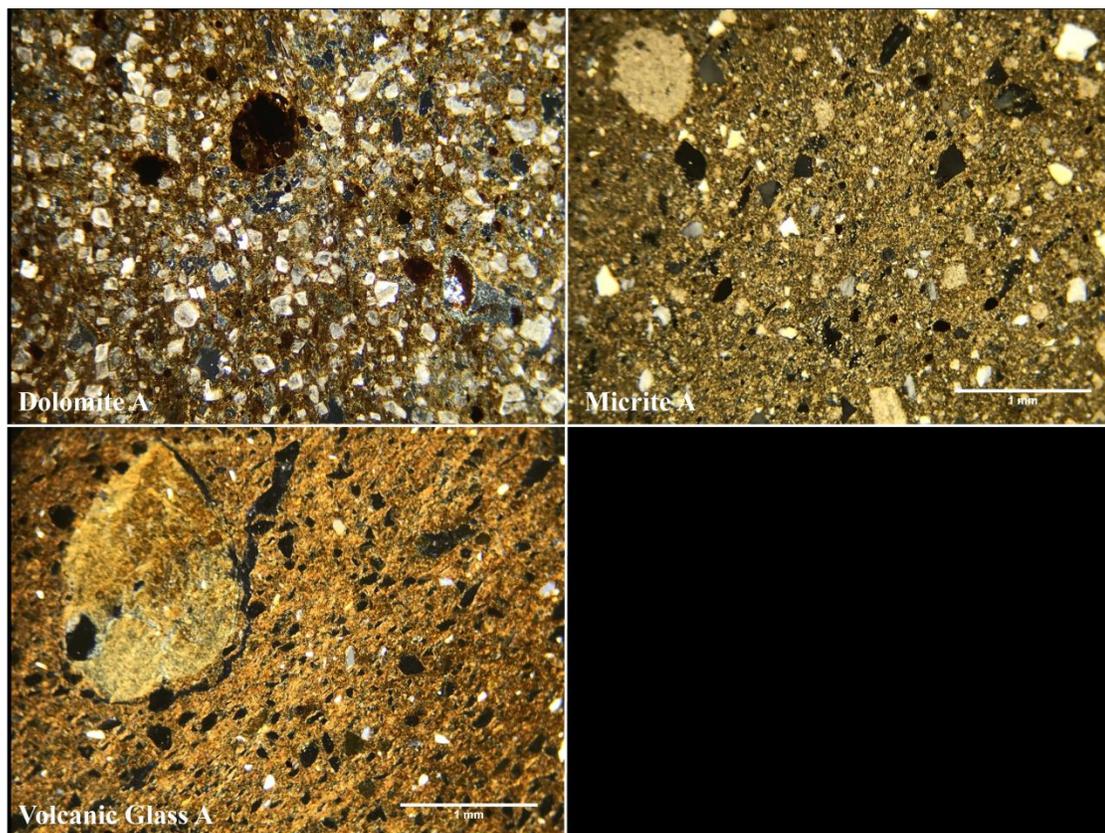


Figure E.4. Dolomite A, Micrite A, and Volcanic Glass A Micrographs (XPL).

APPENDIX F

THE UXBENKA CERAMIC TYPOLOGY

Prior to the petrographic analyses presented in this dissertation, ceramic analyses at Uxbenká have primarily been concerned with creating an internally significant ceramic typology for chronology building. This appendix is an updated ceramic typology based on Jordan's (2014) annual report for the Uxbenká Archaeological Project (UAP). This is not a complete typology with all ceramic types and data. However, it is all of the typological data, rim profiles, and whole vessel drawings that I have recorded as part of the UAP. The data in this appendix is organized according to the type-variety classification system and are presented in a similar format used by Hammond (1975) for the Lubaantun ceramics. This format is used in more recent ceramic analyses at Nim Lit Punit (Fauvelle 2012) and Lubaantun (Irish 2015). Type-variety is the predominant classification system for ceramics in the Maya Lowlands; it is a hierarchical system in which varieties are "nested" within types described as "an aggregate of distinct ceramic attributes that is indicative of a particular category of pottery produced during a specific time interval within a specific region" (Gifford 1960: 9). This framework has proved useful in chronology building and determining relationships between sites, and it is necessary to continue in this tradition in order to facilitate comparisons with other sites and regions of the Maya Lowlands. This appendix also includes petrographic data collected on whole and reconstructed vessels from primary contexts and rim sherds from household contexts (Appendix E). The petrographic data are primarily available for the Late Classic Period but some Early Classic pottery was also analyzed.

Ceramic groups and types were defined based on ceramics excavated from stratified, site core contexts (Groups A, B, D, F, G, I, and L). The ceramic chronology was created by integrating the typology and UAP's high-precision radiocarbon chronology. The integration of these two independently generated chronological sequences, combined with a detailed consideration of contextual information, provides a more robust framework for understanding site historical sequences and the timing of cultural developments at Uxbenká. The data generated from ceramic analyses are used to understand the relationship of Uxbenká with other sites in the southern Belize region as well as to southeastern Guatemala and the Belize Valley. Interaction with other regions is also supported by petrographic data. The ceramic groups presented in this report are the most represented at Uxbenká. Currently, sherds are identified to the group and type level. They are rarely identified to the varietal level except in obvious cases (e.g. McRae Impressed). The names assigned to the Late Preclassic/Early Classic are primarily Petén terminology (with a few local utilitarian types) because the Uxbenká assemblage most closely resembles southeastern Petén assemblages (Laporte 2007). Furthermore, Hammond did not identify an Early Classic Pottery at Lubaantun so the Uxbenká study is the first to formalize these data into a ceramic typology in southern Belize. More recently, work at Nim Li Punit has recovered pottery from this earlier time period (Borrero et al. 2016: 196).

The Late Classic terminology is predominantly derived from Hammond's (1975) Lubaantun classification to facilitate comparison between Uxbenká and the other major southern Belize sites; the more oft cited Petén terminology is also included. Polychrome vessels are assigned Petén terms as opposed to those used by Hammond for Lubaantun

(e.g. Louisville Cream Polychrome). See Fauvelle (2012) for the names assigned to the Nim Li Punit ceramic typology. The chronological periods presented herein are broad (e.g. not separated into Tepeu 1, 2, 3) due to the small sample size for most of the stratigraphic profiles. This appendix represents Jordan's work on the classification of the Uxbenká pottery and is not meant to be a final chronological sequence.

Early Classic I (AD 200/250-400/450) and Early Classic II (AD 400/450-600)

An independent AMS radiocarbon chronology indicates that the construction of monumental, stone masonry architecture began around AD 200 at Uxbenká (Prufer et al. 2012). Bayesian age modeling pushed the date of initial construction at Group A to 60 cal BC – cal AD 22, Group B to cal AD 60-310, and Group D to cal AD 20-240 (Culleton et al. 2012). All sherds included in this study were recovered from site core contexts and do not predate the Late Preclassic Period. Separating the Late Preclassic from the Early Classic Period (ca. AD 300) is problematic at Uxbenká as it is across the Lowlands because the typical Preclassic waxy wares continue to be produced well into the Early Classic Period (Awe and Helmke 2005; Brady et al. 1998; Chase and Chase 2005; Laporte 2001). Laporte (2001) refers to this phenomenon as the “Peripheral Chicanel” Sphere in the adjacent eastern Petén, Guatemala. Brady et al. (1998: 18) define the Protoclassic (75 ± 25 BC to AD 400 ± 20), as “a content-defined unit—or ceramic stage—delimited by the appearance and disappearance of a broad series of ceramic attributes, including those locally definitive of a Holmul I Style (polychrome decorated, orange glossware, mammiform tetrapod dishes and bowls); a Floral Park sphere (the

Holmul Orange Ware, Aguacate group types, Aguacate Orange and Gavilan Black-on-orange); the broader orange glossware tradition; and multicolor (polychrome), positive-painted decoration on orange, buff, and/or glossware pottery.” Due to the lack of many of the diagnostic Protoclassic ceramic attributes at Uxbenká, the term “Peripheral Chicanel” is preferred over Protoclassic.

The vast majority of the assemblage included in this study was recovered from architectural fill contexts in the site core and these contexts consistently produce assemblages that combine Paso Caballo Waxy and Petén Gloss Wares. Processes such as the use of older midden contexts and post-depositional processes could also produce this pattern; however, the consistency with which the mixing occurs suggests otherwise. Many (Chase and Chase 2005) have argued that primary contexts (e.g. caches and burials) should be used to build chronologies. Primary contexts have been notoriously difficult to find at Uxbenká.

The earliest ceramics at Uxbenka belong to the Sierra Group and are consistently comingled with Petén Gloss wares, although in smaller quantities than described by Juan Pedro Laporte for his Early Classic Peripheral Chicanel complex. We have found no purely Late Preclassic contexts at Uxbenká with the possible exception of deeply buried contexts in Group A that require more detailed analysis. Although it is possible that the co-occurrence of these sherds is due to recovery from construction fill, the consistent intermixing suggests that initial settlement began around the Late Preclassic/Early Classic transition. Moreover, modal and decorative attributes diagnostic of the “Protoclassic Period” have not been found at Uxbenká. The Uxbenká assemblage does have a number of basal flange orange polychrome bowls which may fall into Protoclassic 2 ceramic

period, however they are placed within the Tzakol ceramic sphere. This suggests that this Early Classic ceramic assemblage dates to before A.D. 300, consistent with the radiocarbon dates.

LOWLAND MAYA CERAMIC CHRONOLOGIES

YEAR	PERIOD	UAXACTUN	TIKAL	SEIBAL	PETEXBATUN	BARTON RAMIE	SE PETEN	UXBENKA
1300 1200	LATE POSTCLASSIC					Late Facet NEW TOWN	MOPAN	
1100 1000	EARLY POSTCLASSIC		CABAN		TAMARINDO	Early Facet		
900 830	TERMINAL CLASSIC	TEPEU 3	EZNAB	BAYAL	SEPENS	Late Facet SPANISH LOOKOUT	IXMABUY	TERMINAL CLASSIC
700 600	LATE CLASSIC	TEPEU 2 TEPEU 1	IMIX IK	TEPEJILOTE	NACIMIENTO	Early Facet TIGER RUN	SILTOK	LATE CLASSIC
500 400 300	EARLY CLASSIC	TZAKOL 3 TZAKOL 2 TZAKOL 1	MANIK 3 MANIK 2 MANIK 1	JUNCO	JORDAN	HERMITAGE	XILINTE	EARLY CLASSIC II EARLY CLASSIC I
200 100 A.D. 0 B.C. 100 200	PROTO CLASSIC LATE PRECLASSIC	CHICANEL	CIMI CAUAC	CANTUTSE	FAISAN	FLORAL PARK MOUNT HOPE BARTON CREEK	ATZANTE	
300 400 500 600	MIDDLE PRECLASSIC	MAMOM	CHUEN TZEC	ESCOBA	ESCARVADO	Late Facet JENNEY CREEK	RESUMIDERO	
700 800 900	EARLY PRECLASSIC		EB	REAL		Early Facet		

Figure F.1: Ceramic Chronologies in the Maya Lowlands (after Foias 1996: 1011).

The Early Classic is divided into two phases: Early Classic I and Early Classic II. Early Classic I, which dates from AD 200/250 to AD 400/450, is characterized by the intermixing of waxy wares and Petén Gloss wares. In addition to the traditional waxy slipped Sierra Group sherds, the Uxbenká Early Classic Period assemblage contains a large number of Sierra forms made with locally available materials resulting in a thick, matte appearance. The most common form is one that resembles Laguna Verde Incised

with groove incised rims though lacking the distinctive waxy finish. The Early Classic II begins with the disappearance of waxy wares around AD 400/450.

By far, the most common Early Classic type is the newly established Santa Cruz Red Group which is the precursor to the Late Classic Remate Red Group. The surface treatment is a matte buff to red, thick, flaky slip similar in texture to later locally produced monochrome red ceramics. Many of the bowls have sharply everted rims and closed bowl forms are often characterized by a roughened exterior. The Santa Cruz Red Group is present throughout the Early Classic assemblage. Early Classic sherds, particularly the earliest in the sequence, are tempered with large, crystalline calcite. Early macroscopic observations suggested that the use of crystalline calcite temper declined slowly over time and is virtually absent by the end Early Classic II Period. However, petrographic analysis of a large Late Classic sample indicates that this type of temper was still used, albeit in lesser quantities than in the Early Classic, but it was removed via post-depositional processes and therefore absent and impossible to identify via macroscopic observations or the use of hydrochloric acid.

The Early Classic assemblage most closely resembles that of the neighboring southeastern Petén with Aguila Orange, Balanza Black, Orange Polychromes, and Triunfo Striated. Unfortunately, the majority of the Early Classic polychromes are eroded and highly fragmented which precludes us from placing them into a ceramic group at this time (they have been tentatively placed into the Dos Arroyos Group). In general, the Uxbenká assemblage appears to be a more localized phenomenon characterized by the persistence of everted rims well into the Early Classic and the prevalence of a thick, matte rather than thin, glossy slip.

SIERRA GROUP

The presence of true, waxy Sierra Group sherds marks the distinction between the Early Classic I and Early Classic II. Unfortunately, these sherds are often difficult to identify because the highly diagnostic waxy slip is often not preserved at Uxbenká. Thus, distinguishing between these two time periods is not possible for all site core groups and virtually impossible for household contexts. Many of the sherds have been placed in the Sierra Group based on form characteristics. Most of the Sierra Group sherds are red slipped, though a few black slipped sherds are present.

Type: Sierra Red

Variety: Unspecified

Established: Smith and Gifford (1966) at Uaxactun

Ceramic Group: Sierra

Ware: Paso Caballo Waxy

Context: Sierra Red sherds have been recovered from the lower levels of all of the major site core groups. They are generally mixed with Tzakol Petén gloss wares making it difficult to isolate potentially Late Preclassic contexts at Uxbenká.

Ceramic Sphere Affiliation: Chicanel (Early Classic I)

1. Waxy red slip
2. Hard paste

Surface Finish and Decoration: When present, the slip is a waxy red to orange color that occasionally fades to a reddish brown. The slip is present on both the interior and exterior of open bowl forms.

Form: The dominant form is a large, open bowl with interior thickened, direct, and occasionally outflared everted rims. The lips are generally squared or beveled in, although direct lips are also present. Very few jar forms have been identified. This may be due to the fact that when the slip is not preserved, sherds in the Sierra group resemble those of the Santa Cruz Group (discussed below). No bases have been identified.

Paste: No data.

Petrographic Groups: Only one Sierra Group (Group F, Plaza Cache, Vessel 1) sample has been analyzed using thin section petrography and it belongs to the Mixed Sandstone and Carbonate A fabric group (locally produced)



Figure F.2: Sierra Group Rim Profiles.

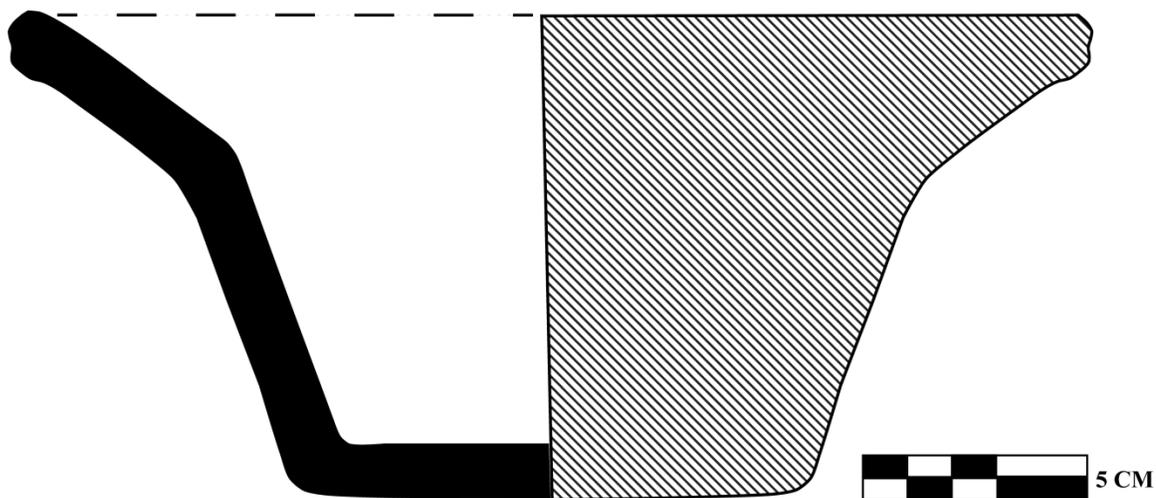


Figure F.3. Sierra Red Vessel (SG 4, Bottom Vessel in Lip to Lip Cache).

Type: Laguna Verde Incised

Variety: Unspecified

Established: Smith and Gifford (1966) at Uaxactun

Ceramic Group: Sierra

Ware: Paso Caballo Waxy

Context: Same as Sierra Red.

Ceramic Sphere Affiliation: Chicanel (Early Classic I)

Principal Identifying Modes:

1. Waxy deep red to brown slip (rarely present)
2. Deep, pre-slip circumferential groove incising on everted rims and on the exterior of bowls

Surface Finish and Decoration: When present, the thick, waxy slip ranges in color from red to orange to reddish brown. The slip is rarely well preserved. The type is identified by the deep, pre-slip circumferential groove incising on everted rims and exterior of bowl forms. Some Laguna Verde Incised types may have been misidentified at incised Santa Cruz Group sherds if the waxy slip was not preserved (which is often the case).

Forms: Large, open bowls. The grooved incised rims are generally the only form recovered. Laguna Verde body sherds are likely identified as Sierra vessels when the diagnostic incising is absent.

Paste: No Data

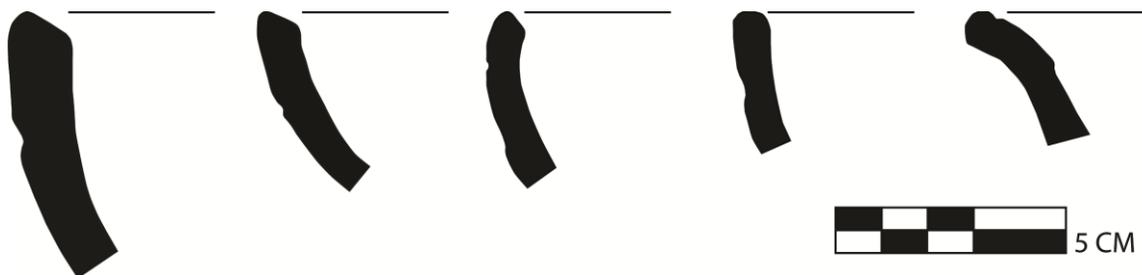


Figure F.4. Laguna Verde Incised Rim Profiles.

Type: Polvero Black

Variety: Unspecified

Established: Smith and Gifford (1966) at Uaxactun

Ceramic Group: Sierra

Ware: Paso Caballo Waxy

Context: Polvero sherds are found in the bottommost level of Groups A and F. This type is rare.

Ceramic Sphere Affiliation: Chicanel (Early Classic I)

Principal Identifying Modes:

1. Thick, waxy black slip

Surface Finish and Decoration: Polvero Black is characterized by a thick, waxy slip. The slip is usually applied to both the interior and the exterior though a few sherds are only slipped on the exterior and the interior is finished with a matte, red wash.

Principal Identifying Modes: No Polvero Black rim sherds have been identified. The body sherds suggest that these were large, open bowls though this designation is awaiting future research.

SANTA CRUZ GROUP

By far, the most common Early Classic type is the newly established Santa Cruz Red Group which is the precursor to the Late Classic Remate Red Group. The surface treatment is a matte buff to red, thick, flaky slip similar in texture to later locally produced monochrome red ceramics. Many of the bowls have sharply everted rims and closed bowl forms are often characterized by a roughened exterior. It appears that there may be two predominant types within the Santa Cruz Group: Santa Cruz Red (a precursor to Remate Red) and Santa Cruz Unslipped (a precursor to Turneffe Unslipped). However, the unslipped type, which are predominantly jars and open bowls with roughened exteriors, may simply be eroded Santa Cruz Red sherds. They are presented here as part of the Santa Cruz Group. Many of the Santa Cruz group ceramics are similar in form to the Sierra Group, and the two ceramics groups overlap chronologically. This ceramic group is very large and can be further divided into types and varieties in future research. At this time, this ceramic group cannot be subdivided based on chronological periods.

Type: Santa Cruz Red

Variety: Unspecified

Established: Jordan (2013) at Uxbenká

Ceramic Group: Santa Cruz

Ware: Unknown

Context: All site core groups and most household groups with an Early Classic component

Ceramic Sphere Affiliation: Tzakol (Early Classic I and II).

1. Thick red to maroon slip
2. Open bowl and jar forms
3. Outflared, everted rims with occasional groove incisions
4. Large, crystalline calcite inclusions

Surface Finish and Decoration: When present, Santa Cruz Group ceramics have a thick, matte red (ranging from pinkish to bright red to a deep maroon brown color) slip. The slip is similar to the Late Classic Remate group suggesting that the newly established Santa Cruz Group is the locally produced monochrome red ceramic group. Macroscopic

assessment is supported by the limited petrographic data collected on Santa Cruz Red sherds. Some of the sherds appear to have a thin red wash. Slip and wash colors vary (2.5YR-5/8; 2.5YR-6/6; 2.5YR-6/8; 5YR-5/6; 5YR-5/8). The surface finish may actually be due to a self-slip as the finish is present on the interior of jar forms. Many Santa Cruz Red rims have groove incised rims similar to Laguna Verde Incised. These pre-slip groove incised rims are distinguishable from Laguna Verde rims based on the characteristic thick, matte (rather than waxy) slip.

Paste Characteristics: The paste is generally red (5YR-5/8, 5YR-6/4, 2.5YR-5/8, 2.5YR-5/6) but can also be a yellow to brown (10YR-4/6) and occasionally contains a black to grey core. The core can be very thin to very thick and encompass the nearly the entire sherd. The paste is variable and can range from very hard to soft and friable. The paste contains numerous large inclusions including clearly visibly rhombic, crystalline calcite temper. Other inclusions are generally sandy, non-carbonate inclusions that range in from silt to coarse sand sized.

Petrographic Groups: Few Santa Cruz Red sherds have been analyzed petrographically. Three sherds were analyzed and they fall into three petrographic groups: Sandstone A, Mixed Carbonate A, and Quartz A.

Form: The Santa Cruz Red group encompassing a variety of forms including shallow dishes with flat bases and outflared rims, deep bowls with flat bases and outflared rims, incurving bowls with rounded sides, and jars with outcurving rims. Many of the vessels, both jars and dishes, have pre-slip groove incising. In general, the same variety of forms is present in the Santa Cruz Red group as has been documented for the Sierra Red Group across the Maya Lowlands.



Figure F.5. Santa Cruz Red Bowl with Groove Incision on Exterior.



Figure F.6. Santa Cruz Red Bowl with Groove Incision and Roughened Exterior. The white inclusions are crystalline calcite.



Figure F.7. Santa Cruz Red Bowl with Groove Incision on Outcurved Rim. The white inclusions are crystalline calcite.



Figure F.8. Santa Cruz Red Jar Rim Sherd.



Figure F.9. Santa Cruz Red Bowl (Tomb L2, Vessel 26), Sandstone A2 Fabric Group (Locally Produced).

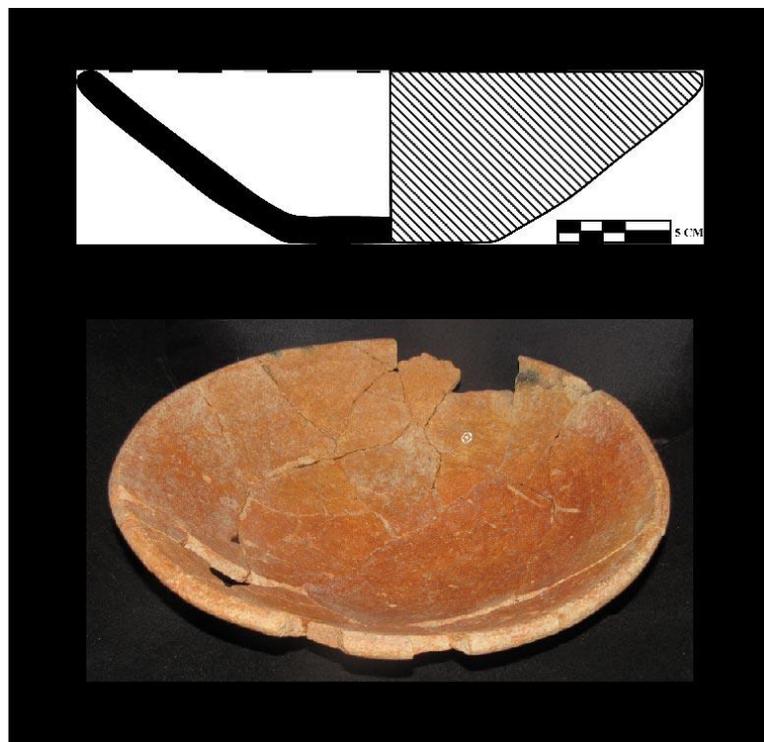


Figure F.10. Santa Cruz Red Bowl (Tomb L2, Vessel 5), Sandstone A Fabric Group (Locally Produced).

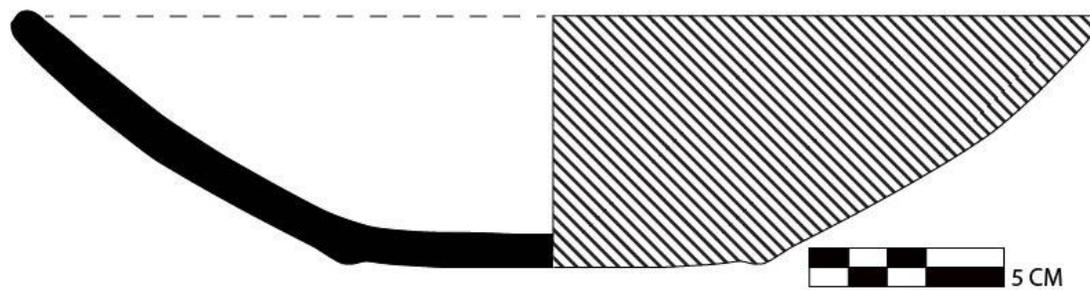


Figure F.11. Santa Cruz Red Bowl (Tomb F1, Vessel 4), Quartz A Fabric Group (Locally Produced).

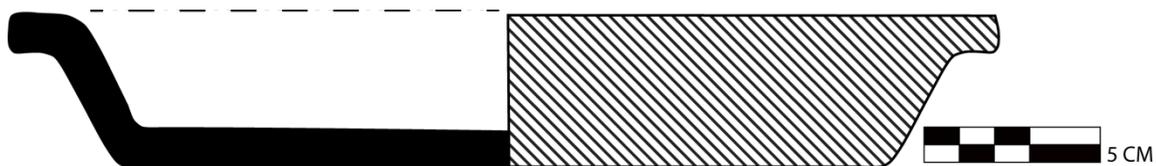


Figure F.12. Santa Cruz Red Bowl (Group L, Lip to Lip Cache, Bottom Vessel).

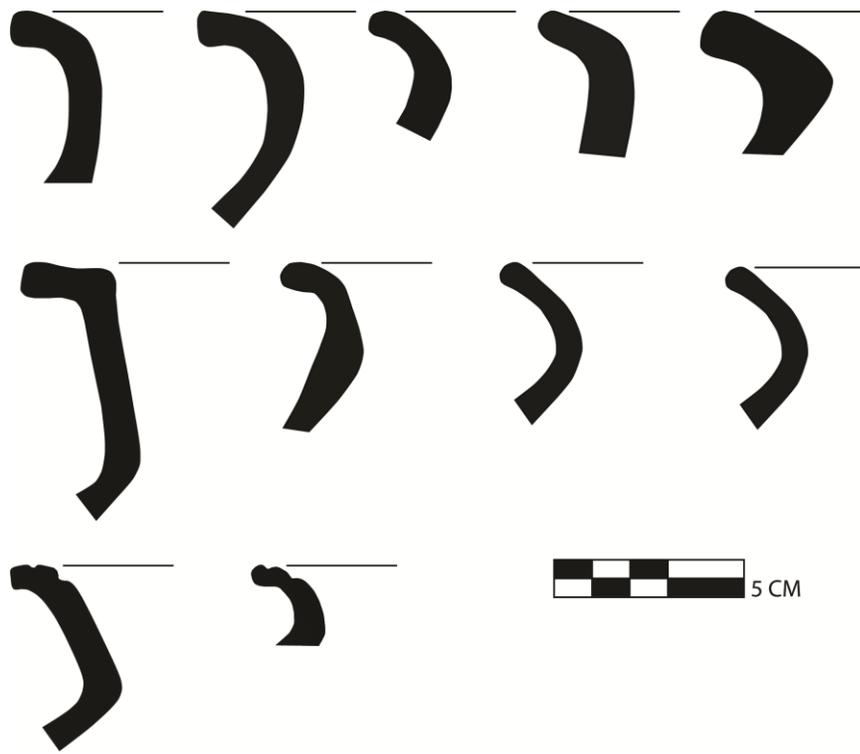


Figure F.13. Santa Cruz Group Rim Profiles.

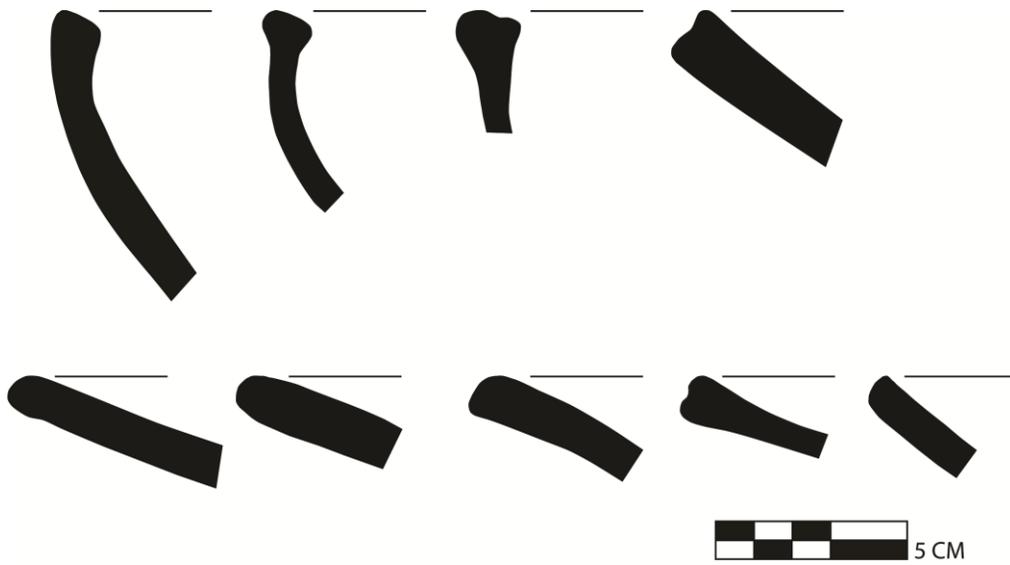


Figure F.14. Santa Cruz Group Rim Profiles

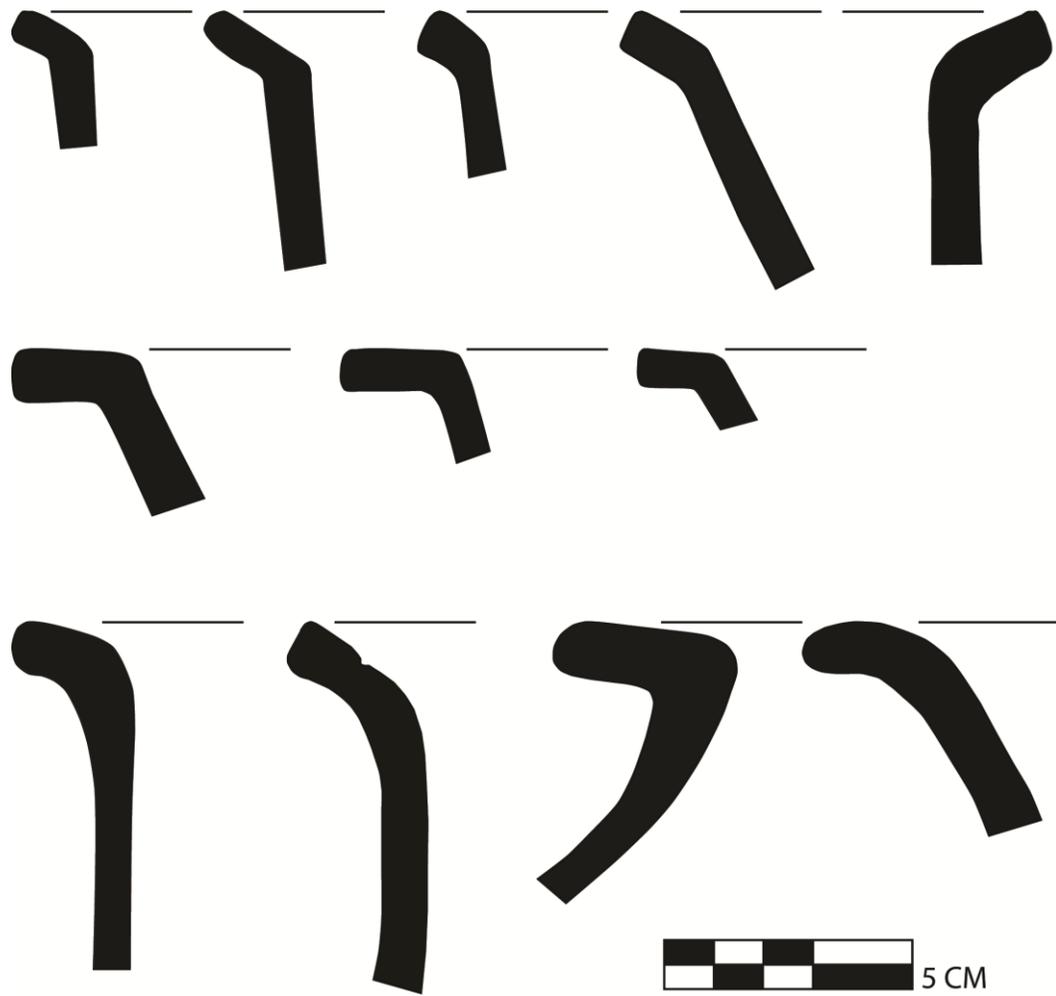


Figure F.15. Santa Cruz Group Rim Profiles.

QUINTAL GROUP

Type: Triunfo Striated

Variety: Unspecified

Established: Smith and Gifford (1966) at Uaxactun

Ceramic Group: Quintal

Ware: Uaxactun Unslipped

Context: All site core groups

Ceramic Sphere Affiliation: Tzakol (Early Classic I and II)

Principal Identifying Modes:

1. Faint, haphazard exterior striations
2. Predominantly thin-walled jars
3. Red to brown wash
4. Appliques, fingernail impression, filleting, and punctations

Surface Features and Decoration: Triunfo jars have faint, haphazard striations on the exterior. Tzakol jars can occasionally be distinguished from Tepeu jars based on the depth and directions of striations (the later jars have deeper, horizontal striations) but this is not true on all sherds. Many Triunfo sherds have a faint red to brown wash on the exterior which is most similar to striated Early Classic vessels from the Petén. In addition, many Triunfo sherds have appliques, fingernail impressions, filleting, and punctations (often on the same vessel) which against suggests a stylistic affiliation with the Petén.

Forms: The overwhelming majority of Triunfo sherds are very thin walled body sherds with faint exterior striations. Jars have tall, vertical neck with outflared or outcurved rims and squared or rounded lips. There is also an open bowl form with an interior red wash though bowls are rare. The necks are generally not striated, however, and future analysis may place some sherds within the Quintal Unslipped type.



Figure F.16. Triunfo Striated Body Sherds.

BALANZA GROUP

Type: Balanza Black

Variety: Unspecified

Established: Smith and Gifford (1966) at Uaxactun

Ceramic Group: Balanza

Ware: Petén Gloss

Context: Small quantities in site core groups

Ceramic Sphere Affiliation: Tzakol

Principal Identifying Modes:

1. Thick black to brown glossy slip
2. Open bowl forms with rounded sides

Surface Treatment and Decoration: Balanza sherds have a highly diagnostic black (that occasionally fades to brown) glossy slip. A few sherds are incised (which may dictate assignment to the Lucha Incised type of the Balanza Group in future analyses).

Forms: Balanza vessels are generally open bowl forms with rounded sides and direct rims. A complete Balanza Black vessel was recovered from a tomb in Group I (Figure 5.3). No bases have been recovered.

Paste: No Data

Petrographic Groups: A single Balanza Black sherd from (Tomb L3, Vessel 2) was assigned to the Mixed Sandstone and Carbonate A Fabric Group (locally produced).



Figure F.17: Balanza Black Rim Profiles.



Figure F.18. Balanza Black Bowl (Group I Tomb).

DOS ARROYOS CERAMIC GROUP

Type: Dos Arroyos Polychrome

Variety: Unspecified

Established: Smith and Gifford (1966) at Uaxactun

Ceramic Group: Dos Arroyos

Ware: Petén Gloss

Context: Small quantities in all site core groups

Ceramic Sphere Affiliation: Tzakol

Principle Identifying Modes:

1. Pinkish orange slip with black and red paint
2. Dark orange to brown slip with black, orange and red paint
3. Basal flanges

Surface Finish and Decoration: Some of the sherds have a pinkish orange slip while the others have a dark orange to brown slip. Both exhibit evidence of black and red paint; no decorative motifs can be determined.

Form: The vast majority of sherds assigned to the Dos Arroyos Group are body sherds. When rims are present, they are predominantly from shallow bowls/dishes with outflared sides, direct rims and rounded lips. Basal flanges are common. The basal flanges from pinkish orange slipped vessels tend to be much smaller than those from the orange to brown slipped vessels.

Paste: The paste is a very fine paste with few large, visible inclusions. The paste is a distinctive orange color (2.5YR-6/8; 2.5YR-5/8) and some have a thin grey to black core.

Petrographic Groups: A single Dos Arroyos polychrome sherd was analyzed petrographically (Group F Cache, Vessel 2) and was assigned to the Calcite B fabric group (non-locally produced).

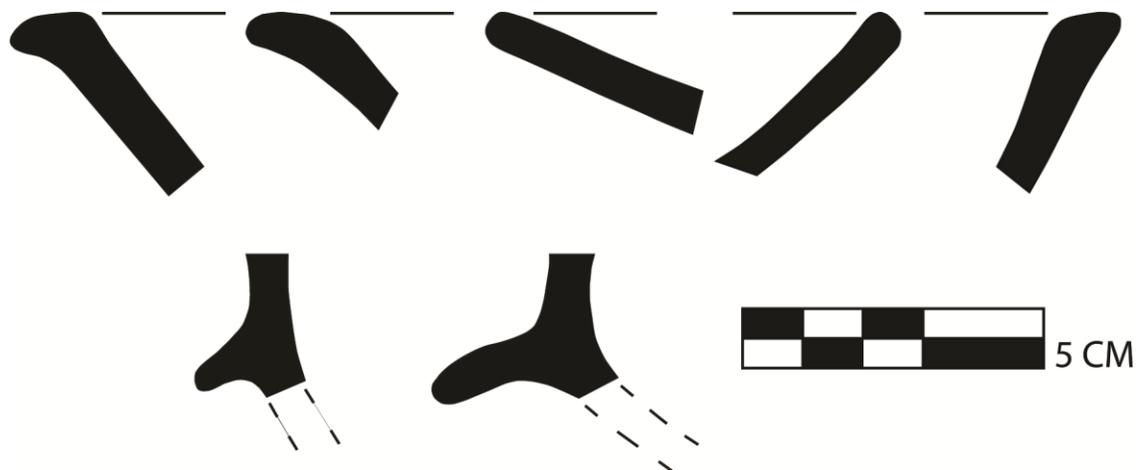


Figure F.19. Dos Arroyos Polychrome Profiles.

The Late to Terminal Classic Assemblage

Hammond's (1975) work at Lubaantun represents the first systematic study of a southern Belize ceramic assemblage. The Lubaantun typology generated a number of Late Classic ceramic groups though rarely were sherds further subdivided into types. According to Hammond (1975: 295), "for those who either wish to compare Lubaantun material with type-variety classified material from other sites, or to indulge in ceramic hairsplitting, a list of varieties which could be extracted from the group on the conventional system is provided." Hammond places the Lubaantun assemblage within the Late Classic Tepeu Sphere (AD 600-900) and more likely within the latter part (AD 700-900). The presence of Fine Orange sherds places many of the contexts into the Terminal Classic Period.

The Toledo Regional Interaction Project (TRIP) retained Hammond's group names and assigned new type names to the Nim Li Punit assemblage. According to Fauvelle (2012), "although considerable similarity between Lubaantun and Nim li Punit exists at the group level, substantial differences in vessel forms, decoration, and paste caused us to assign new type names for the ceramics of Nim li Punit." Notably, the Nim Li Punit assemblage is not calcite tempered in the Late and Terminal Classic. The new type names are similar (e.g. Chacluum is Ekluum at Nim Li Punit). While the paste difference is important, especially at the smaller regional level, I have chosen to retain Hammond's classification (though the names at Nim Li Punit are noted in the descriptions).

The radiocarbon and ceramic chronologies are more consistent for the Late Classic Period. Both indicate that Uxbenká is primarily a Tepeu 1 and 2 site with ephemeral Terminal Classic occupation. Unfortunately, the small sample sizes preclude me from further defining the Late Classic ceramics into finer grained chronological periods. The Late/Terminal Classic assemblage at Uxbenká is dominated by local types (Turneffe, Remate, Puluacax, and Chacluum) though imported types are present in limited quantities (Zacatel and Saxche Polychromes, Belize Red, Fine Orange). The Chacluum Ceramic Group is identified as a Late Classic phenomenon at Lubaantun although these sherds are present throughout the Uxbenká ceramic assemblage indicative of an Early Classic origin, perhaps at Uxbenká. Like in the Early Classic, the most abundant ceramics are monochrome reds (Remate Group). A small sample of Remate jars have radiate incising, which is present on earlier Santa Cruz Red ceramics, and triangle and s-shaped stamps. None of the more elaborate stamps, such as monkey and bird motifs, have been identified at Uxbenká (Hammond 1975).

As with the Late Preclassic/Early Classic assemblage, it is difficult to separate the Late Classic from the Terminal Classic at Uxbenká. Fine Orange and Sahcaba types firmly fall within the Terminal Classic Period based on cross-dating with other sites. Braswell (personal communication 2013) has suggested that Belize Red vessels do not arrive in southern Belize until the Terminal Classic Period. At least one type, McRae Impressed, is a Terminal Classic (post AD 780) marker at Xunantunich (LeCount 1996). Given that these vessels were likely imported from the Belize Valley (Hammond 1976), a Terminal Classic date is possible at Uxbenká as well.

Late Classic pottery of Uxbenka is similar to complexes from the Petén, but the ceramic assemblage reflects an increased southern Belize regionalism and independence of local polities. Although Puluacax Unslipped is often cited as a purely southern Belize phenomenon, Laporte (2007) reports the presence of this type at sites in the southeastern Petén suggestive of continued interaction but at a lesser degree than during the Early Classic Period. There are some vessels that are more similar to the Tinaja and Azote Groups but the majority of the Late Classic assemblage exhibits the closest similarities to Lubaantun (Hammond 1975). The majority of the Late Classic polychrome assemblage is fragmentary and eroded. Both Zacatel and Palmar polychromes are present at Uxbenká, but the locally produced cream slipped vessels with a deep, red paste, similar to the Louisville Polychrome Group at Lubaantun, are most abundant. Palmar polychromes are more abundant in tomb contexts at Uxbenká.

Additionally, Hammond (1975) reports a dramatic decline in the presence of cream slipped polychromes at Lubaantun at the transition between Tepeu 2 and 3, which he uses to define the Early and Late Facets of the Columbia Complex. The likely locally produced cream slipped polychromes at Uxbenká are present in nearly all upper levels further supporting the lack of a significant Terminal Classic occupation. We are currently unable to distinguish between Tepeu 1 and 2 ceramics due to a continuation in form and low sample sizes in these levels however everted rims on bowls and square lips continue from the Early Classic.

PULUACAX CERAMIC GROUP

Type: Puluacax Unslipped

Variety: Unspecified

Established: Hammond (1975) at Lubaantun

Ceramic Group: Puluacax

Ware: Temax Gross

Context: Puluacax has been found at Groups A, B, D, and I though the greatest quantities are in Group D. This type has only been identified at sites within southern Belize and vessel function is currently unknown.

Ceramic Sphere Affiliation: Tepeu 2/3 (Tentative)

Principle Identifying Modes:

1. Very coarse, gritty paste
2. Lack of carbonate inclusions
3. Occasionally slipped/washed on the interior and exterior surfaces

Surface Finish and Decoration: Puluacax vessels are predominantly unslipped with very coarse surfaces though a few exhibit faint traces of red to pinkish slip (possibly a wash).

Form: Only rim sherds have been recovered from Uxbenká and are from open bowls. The rims are generally outcurved. Hammond (1975) reports a Puluacax jar from at Lubaantun though none have been recovered at Uxbenká.

Paste: Identical to Hammond (1975)



Figure F.20 Puluacax Unslipped.

TURNEFFE CERAMIC GROUP

Type: Turneffe Unslipped

Variety: Unspecified

Established: Hammond (1975) at Lubaantun [Turnip Unslipped at Nim Li Punit]

Ceramic Group: Turneffe

Ware: Moho Grit (Uaxactun Unslipped in Petén Classifications)

Context: All Groups at Uxbenká

Ceramic Sphere Affiliation: Tepeu

Principle Identifying Modes:

1. Unslipped bowl and jar forms
2. Mostly open form bowls

Surface Finish and Decoration: Turneffe Group vessels are all unslipped. Currently, both striated and smooth bodied jars are grouped under the Turneffe name as Hammond (1975) did at Lubaantun. However, a more refined Uxbenká classification will likely separate striated jars and place them in the Encanto Group as is standard in Petén classifications (Foias 1996; Laporte 2007).

Form: Open and closed bowl forms with exterior thickened and slightly outcurved rims. The lips are generally rounded though a few are squared. Jars have shorter necks with outcurved necks and rounded or squared lips. Like at Lubaantun (Hammond 1975: 297), the majority of the Turneffe assemblage at Uxbenká consists of large jars.

Paste: The paste is generally a coarse, sandy, very friable texture (See Munsell colors in Chapter 3).

Petrographic Groups: Sandstone B and Mica A.



Figure F.21 Stamped Turneffe Jar Neck.

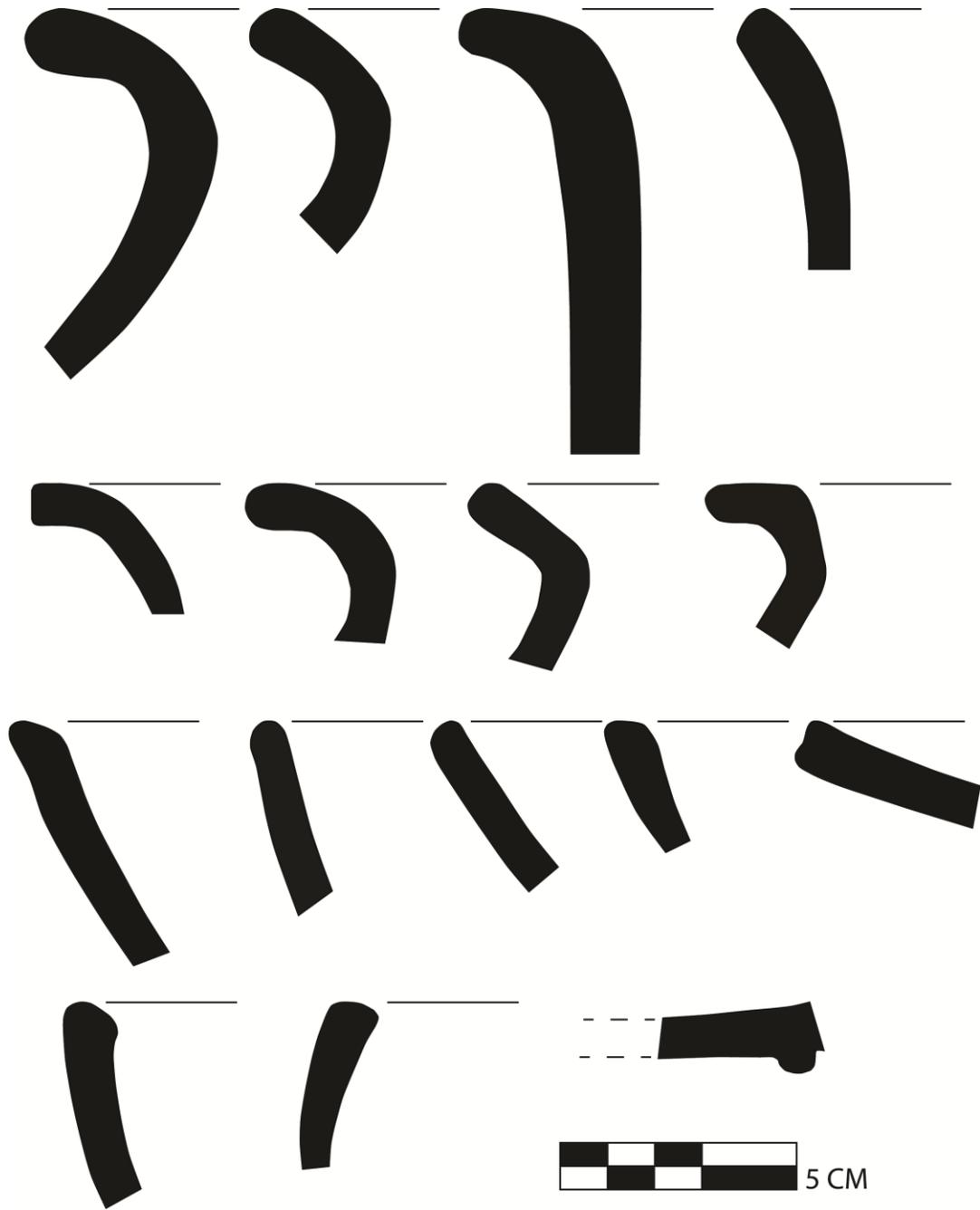


Figure F.22. Turneffe Unslipped Rim Profiles.

REMATE CERAMIC GROUP

Type: Remate Red

Variety: Unspecified

Established: Hammond (1975) at Lubaantun [Reminiscent Red at Nim Li Punit]

Ceramic Group: Remate

Ware: Petén Gloss

Context: Upper levels in all site core groups.

Ceramic Sphere Affiliation: Tepeu

Principle Identifying Modes:

1. Poorly preserved, deep red slip
2. Predominantly open bowl forms
3. Occasional stamping (far less frequent than at Lubaantun and Nim Li Punit) on jar necks

Surface Finish and Decoration: Remate sherds have a deep red, glossy slip that is generally poorly preserved due to their recovery from surface contexts. Open and closed bowl forms are slipped on both the interior and exterior. Jars are slipped on the interior and exterior neck and are occasionally lightly striated below the neck. Remate sherds at Uxbenká exhibit some stamping though in fewer numbers than at other southern Belize sites. Stamping (predominantly repeating triangles) has only been identified on jar forms.

Form: Open bowls with outflaring walls and flat bases. Rims are direct or slightly outflared (outcurved) with squared and rounded lips. Squared lips occasionally have a very faint, pre-slip incision. Closed bowl forms are present but relatively rare. Remate jars are rare (the majority of Late Classic jars are striated Turneffe Group vessels). Remate jars are necked with outcurving rims.

Paste: Same as the Turneffe Group. See Chapter 3 for Munsell colors.

Petrographic Groups: Sandstone B, Quartz A, Mica A

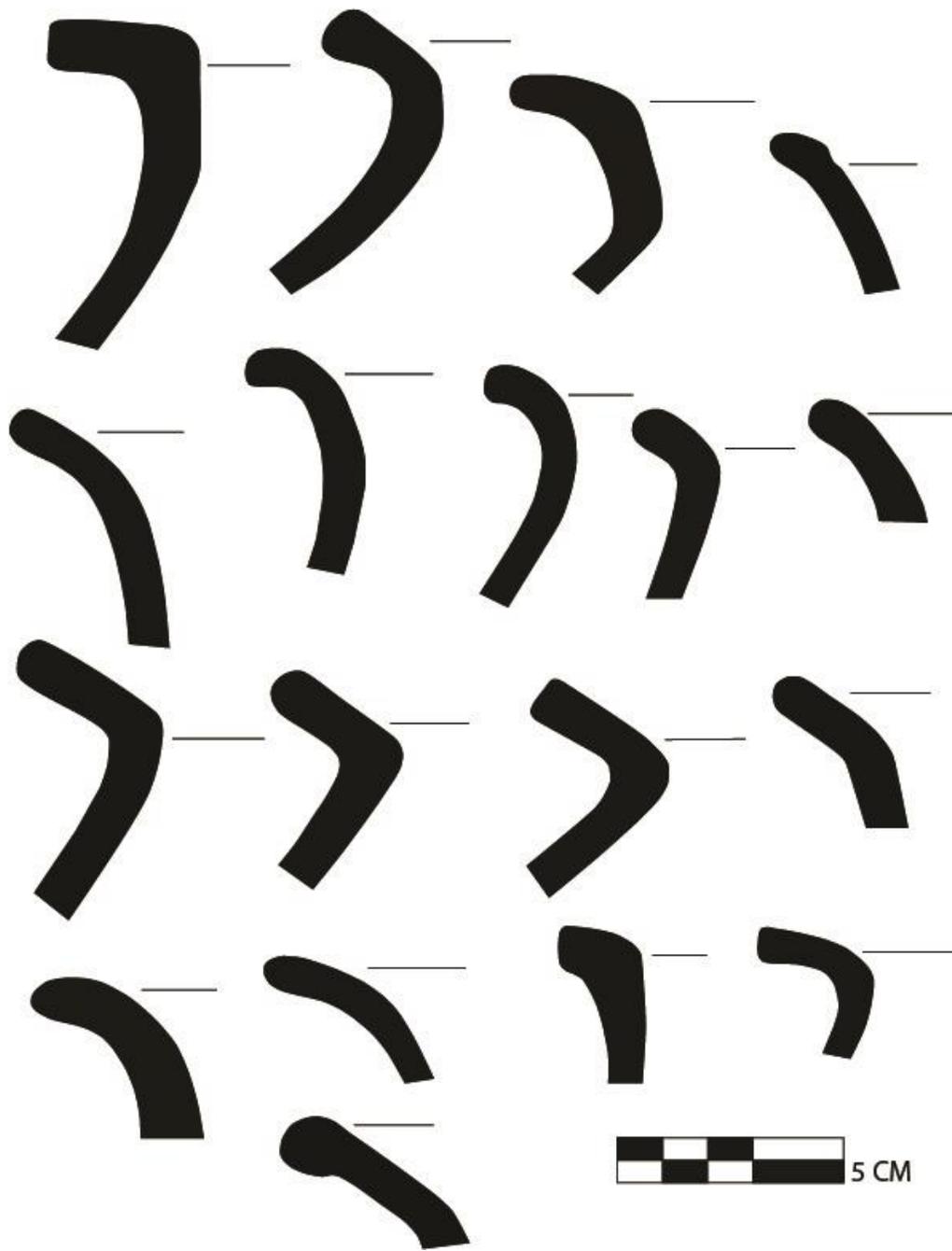


Figure F.23. Remate Red Profiles

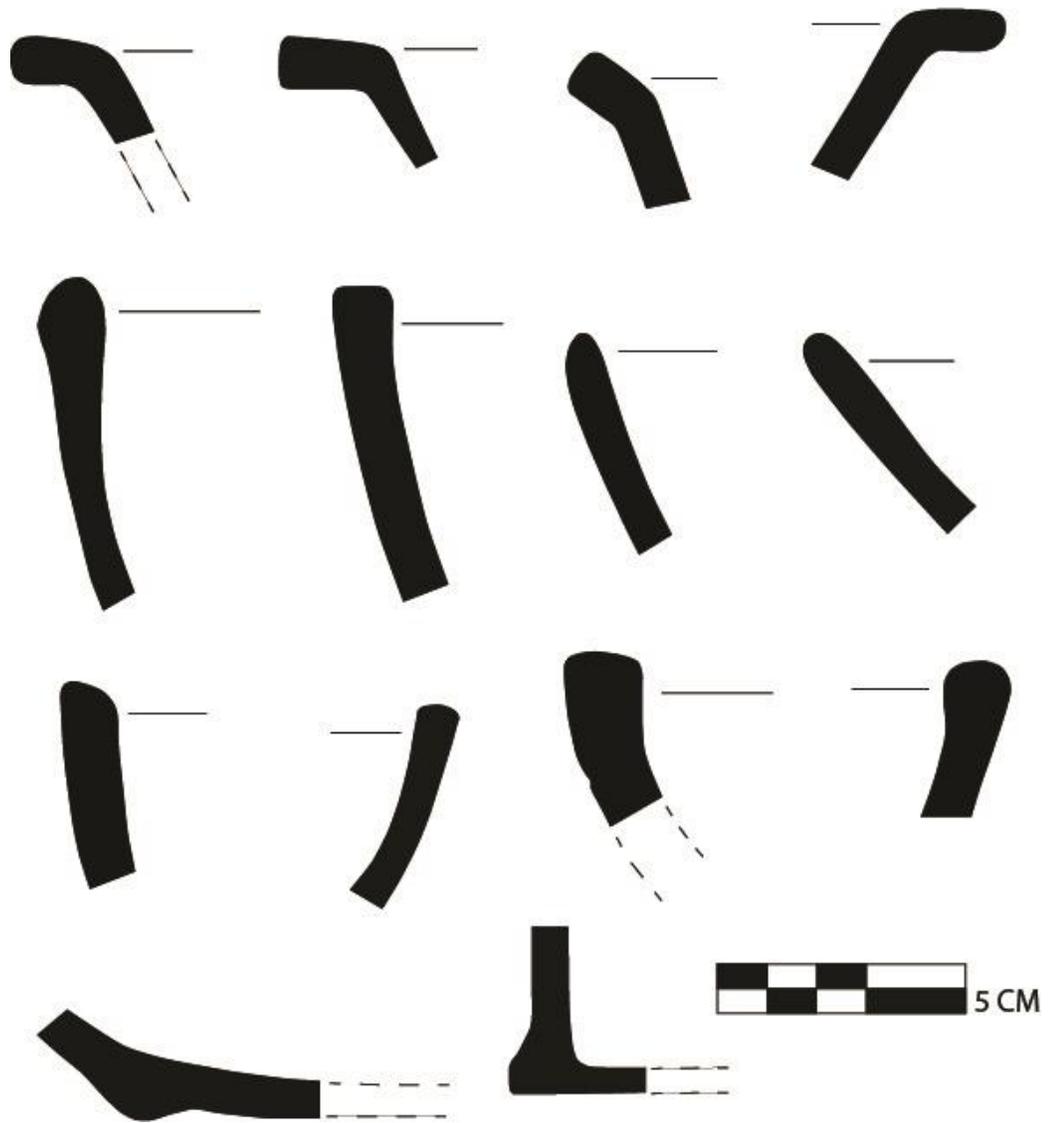


Figure F.24. Remate Red Rim Profiles



Figure F.25. Remate Red Rim Profiles

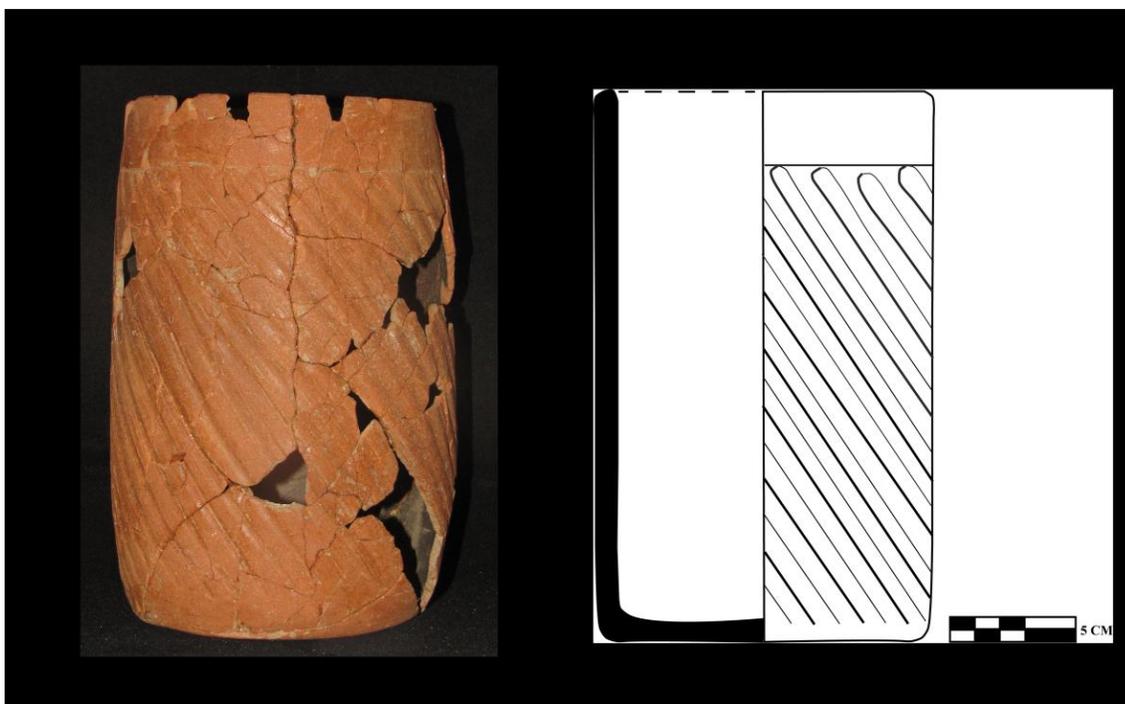


Figure F.26. Remate Red Fluted Cylinder Jar (Tomb L2 Vessel 23), Quartz A Fabric Group (Locally Produced).

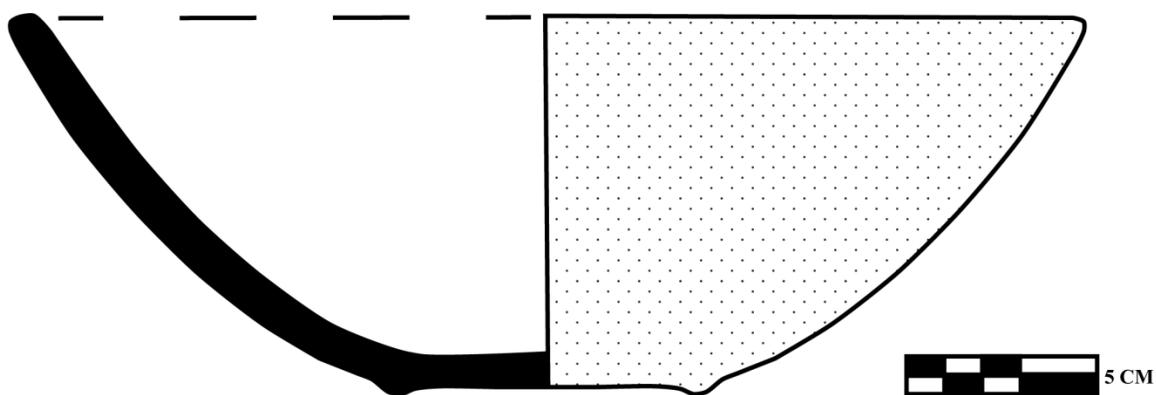


Figure F.27. Remate Red Bowl, Unslipped Exterior, Red Slipped Interior (Tomb L2 Vessel 27), Sandstone B Fabric Group (Locally Produced).

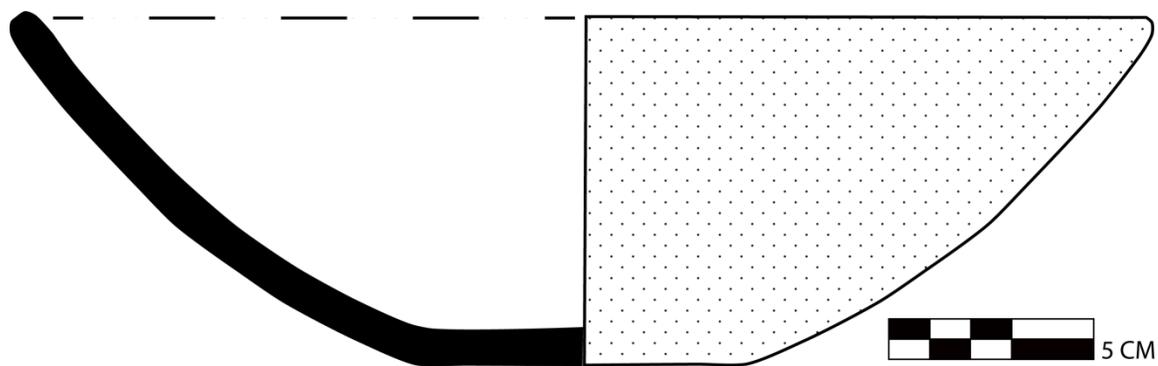


Figure F.28. Remate Red Bowl, Unslipped Exterior, Red Slipped Interior (Tomb L2 Vessel 7), Quartz A Fabric Group (Locally Produced).

Type: Chacluum Black

Variety: Unspecified

Established: by Hammond (1975) at Lubaantun [Ekluum Black at Nim Li Punit]

Ceramic Group: Remate

Ware: Petén Gloss

Context: Chacluum is found in small quantities in each Group in the site core of Uxbenká. Like at Nim Li Punit, Chacluum is the predominant black slipped monochrome type at Uxbenká; however, it is present in the earliest levels at Uxbenká and is often found in contexts with Late Preclassic/Early Classic transition sherds. The thin body and highly glossy surface treatment make it similar. Late Preclassic/Early Classic type and, thus, it will retain the Chacluum type name in all time periods. The Chacluum Black description is currently awaiting a more complete paste analysis to separate the early from late varieties.

Ceramic Complex: Columbia (Early and Late) [Lubaantun]

Ceramic Sphere Affiliation: Tepeu

Principal Identifying Modes:

1. Very glossy black to brown slip
2. Thin body
3. Occasional incisions on the exterior body

Surface Finish and Decoration: The surface is an extremely glossy slip that ranges in color from brown to black. The slip is also present on the interior of some vessels while others are unslipped or have a faint red wash. One sherd exhibits evidence of faint circumferential incised lines on the exterior body.

Form: The overwhelming majority of the Chacluum assemblage at Uxbenká is comprised of body sherds. The only forms identified at Uxbenká are bowls with incurving sides and a restricted orifice, bowls with rounded sides and rounded rims, and jars with rounded rims; ring bases are also present.

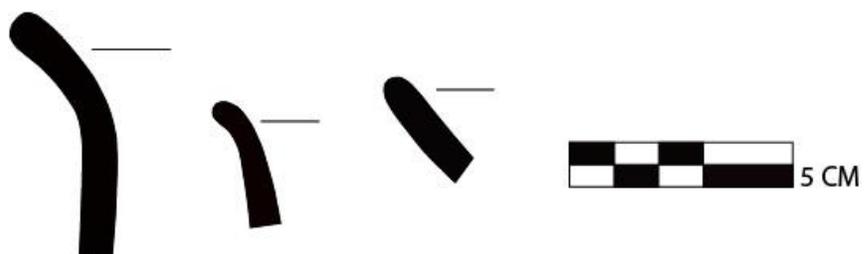


Figure F.29. Chacluum Black Rim Profiles.



Figure F.30. Incised Chacluum Sherd

POLYCHROMES

Most polychrome sherds recovered from Uxbenká are highly eroded and, thus, cannot be separated into previously established ceramic groups. That is, many of the sherds recovered from site core contexts are so highly eroded that they cannot be assigned to either Palmar (orange covers the entire vessel) or Zacatel (cream background with red, orange, and white decoration) ceramic groups (Foais 1996: 557). When sherds cannot be assigned to one of these groups they are catalogued as Late Classic Polychromes or Palmar-Zacatel Polychromes based on form and the presence of at least some visible polychrome decoration. Future work will focus on further defining these Late Classic types in order to create a tighter chronological sequence for this period of occupation at Uxbenká.

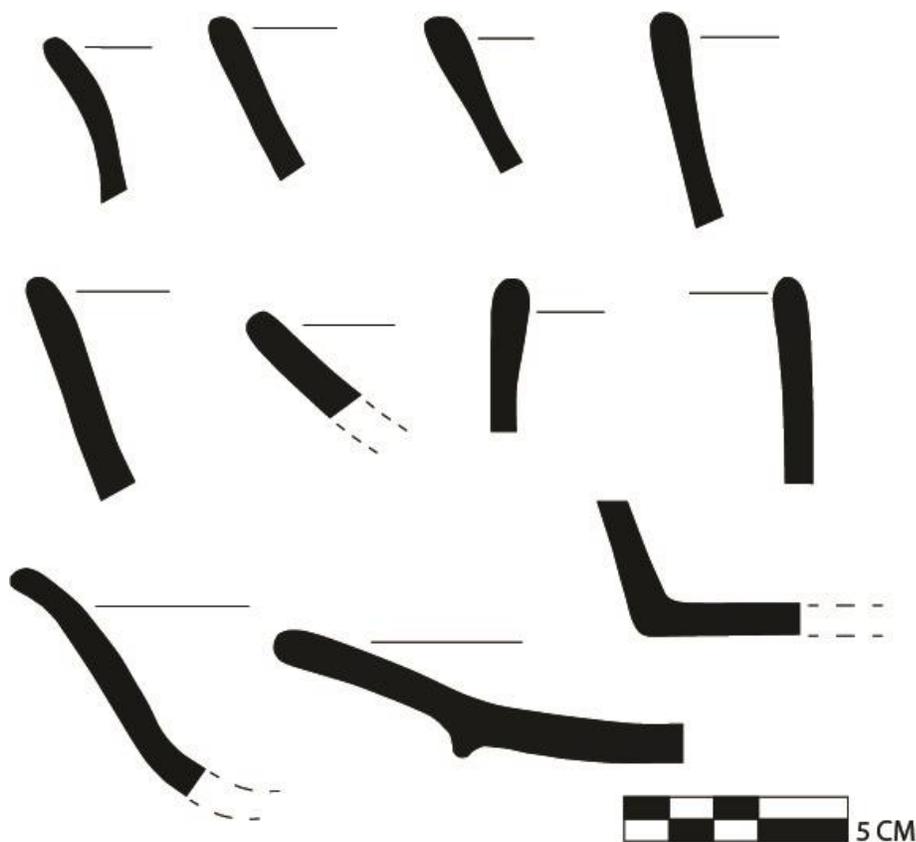


Figure F.31. Late Classic Polychrome Profiles

ZACATEL POLYCHROME GROUP

Type: Zacatel [Louisville Polychrome at Lubaantun; Indian Creek Polychrome at Nim Li Punit]

Variety: Unspecified

Established: Smith and Gifford (1966) at Uaxactun

Ceramic Group: Zacatel

Ware: Petén Gloss

Context: All site core groups

Ceramic Sphere Affiliation: Tepeu

Principle Identifying Modes:

1. Cream slip (usually eroded) with red, black, and orange paint
2. Red to reddish brown sandy paste

Surface Finish and Decoration: The cream slip is often very eroded though Zacatel Polychromes also have a distinctive buff to pink fine paste as well as a more coarse red paste similar to Remate Red. The sherds are painted with red, black, and orange on top of the cream slip. The sherds are generally too small or eroded to determine motif. However, when motifs are preserved they are geometric shapes and do not contain legible glyphs (i.e. they have pseudo glyphs).

Form: Bowls and dishes with outflared walls and flat bases, tripod dishes with hollow feet, tripod dishes with hollow feet and rattles, and cylinder jars (vases).

Paste: The majority of Zacatel Polychrome vessels recovered from Uxbenká are locally produced and have similar paste characteristics as Remate Red vessels. They are a red (2.5YR-4/8; 2.5YR-5/8; 5YR-5/8) and the paste is generally less coarse and harder than the paste for the Remate Red fabrics.

Petrographic Groups: Zacatel Cream Polychromes are represented by both locally produced and imported fabric groups. Local fabric groups are Sandstone A and Quartz A. Imported fabric groups include Dolomite A and Calcite A.



Figure F.32. Eroded Zacatel Polychromes with Coarse, Red Paste (locally produced)



Figure F.32. Incised Zacatel Polychrome (likely locally produced).



Figure F.33. Zacatel Cream Cylinder Jar (Tomb L2 Vessel 6), Quartz A Fabric Group (Locally Produced).

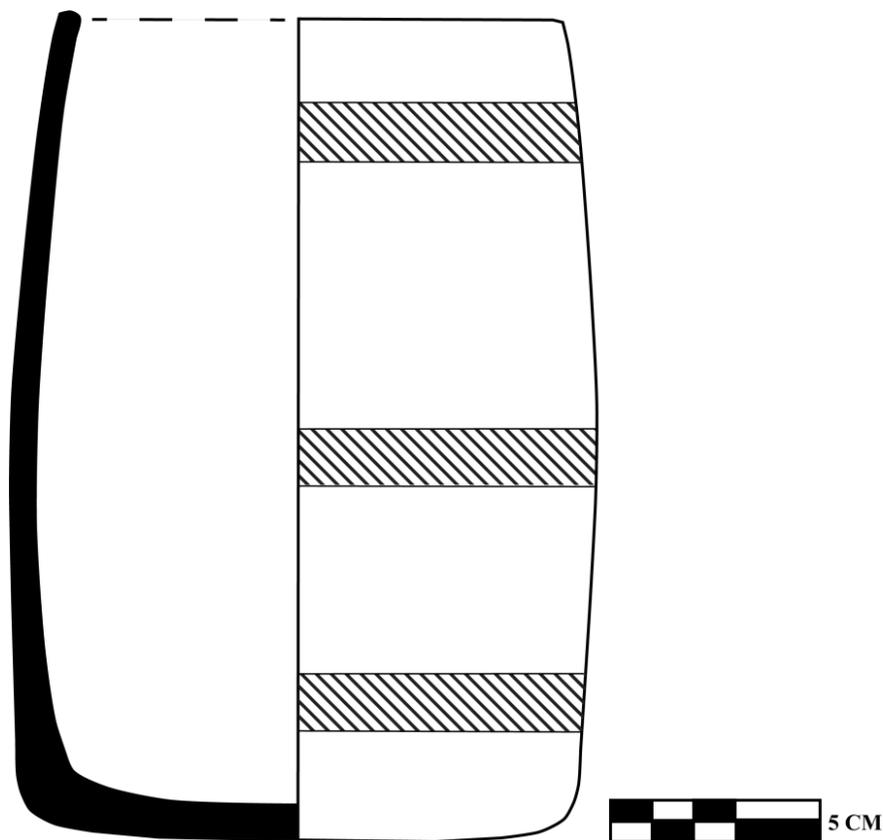


Figure F.34. Zacatel Cream Cylinder Jar (Tomb L2 Vessel 9), Quartz A Fabric Group (Locally Produced).

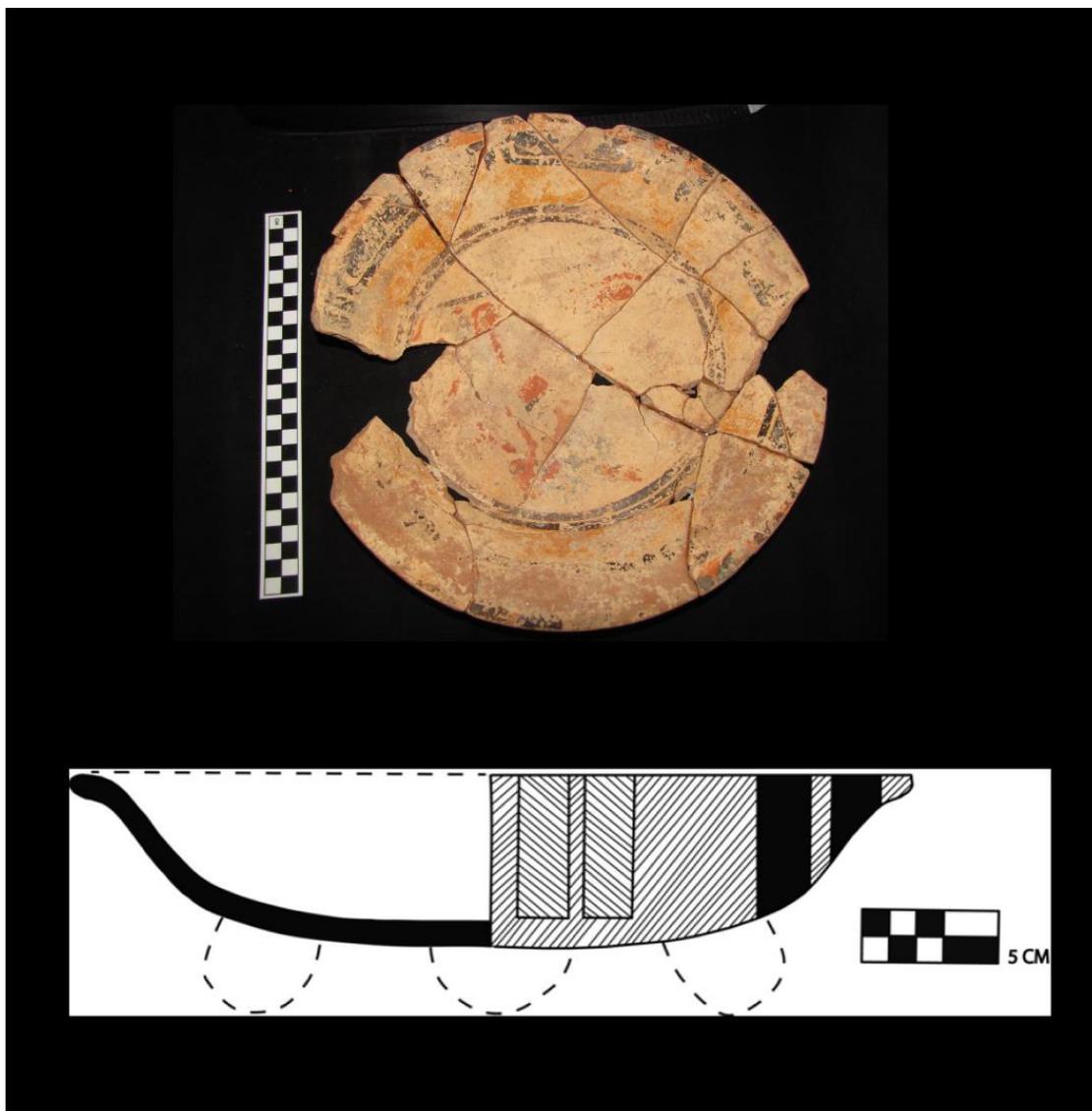


Figure F.35. Tomb L2 Zacatel Cream Tripod Plate with Hollow Feet (Tomb L2, Vessel 15), Sandstone A Fabric Group (Locally Produced).

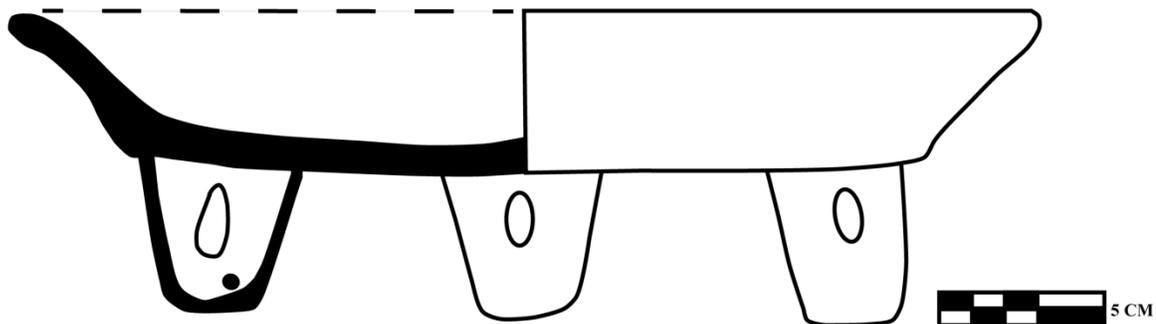


Figure F.36. Tomb L2 Zacatel Cream Tripod Plate with Hollow Feet (Tomb L2, Vessel 2), Sandstone A Fabric Group (Locally Produced).

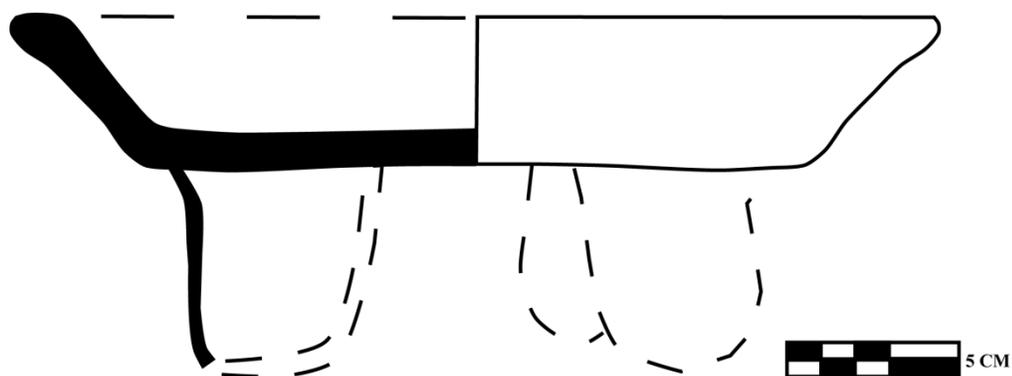


Figure F.37. Tomb L2 Zacatel Cream Tripod Plate with Hollow Feet (Tomb L2, Vessel 1), Sandstone A2 Fabric Group (Locally Produced).

SAXCHE-PALMAR POLYCHROME GROUP

Type: Palmar Orange Polychrome

Variety: Unspecified

Established: Smith and Gifford (1966) at Uaxactun

Ceramic Group: Palmar

Ware: Petén Gloss

Context: L2 Tomb (Vessel #8 and Vessel #28) and F3 Tomb (Vessel #1)

Ceramic Sphere Affiliation: Tepeu (Tepeu 2)

Principle Identifying Modes:

1. Orange Slip
2. Red, Black, and Orange Geometric Designs
3. Open bowls with rounded sides
4. Pink to orange paste with few inclusions (non-local); Red to reddish brown, sandy paste (local)

Surface Finish and Decoration: The cream slip is often very eroded though Zacatel Polychromes also have a distinctive buff to pink fine paste as well as a more coarse red paste similar to Remate Red. The sherds are painted with red, black, and orange on top of the cream slip. The sherds are generally too small or eroded to determine motif. However, when motifs are preserved they are geometric shapes and do not contain legible glyphs (i.e. they have pseudo glyphs).

Form: Open bowls with rounded sides.

Paste: The paste color varies between local and non-local vessels. All of the locally produced Saxche-Palmar Polychromes have the same paste as the Zacatel Cream Polychromes. They are a red (2.5YR-4/8; 2.5YR-5/8; 5YR-5/8) and the paste is generally less coarse and harder than the paste for the Remate Red fabrics. Non-local vessels have a very fine, buff to orange paste (5YR-6/8; 5YR-7/6) with few inclusions.

Petrographic Groups: Zacatel Cream Polychromes are represented by both locally produced and imported fabric groups. Local fabric groups are Sandstone A and Quartz A. Imported fabric groups include Calcite B, Volcanic Glass A, Carbonate Sand A, and Micrite A.



Figure F.38. Tomb L2 Saxche-Palmar Bowl (Tomb L2, Vessel 2), Quartz A Fabric Group (Locally Produced).



Figure F.39. Tomb L2 Saxche-Palmar Bowl (Tomb L2, Vessel 17), Quartz A Fabric Group (Locally Produced).

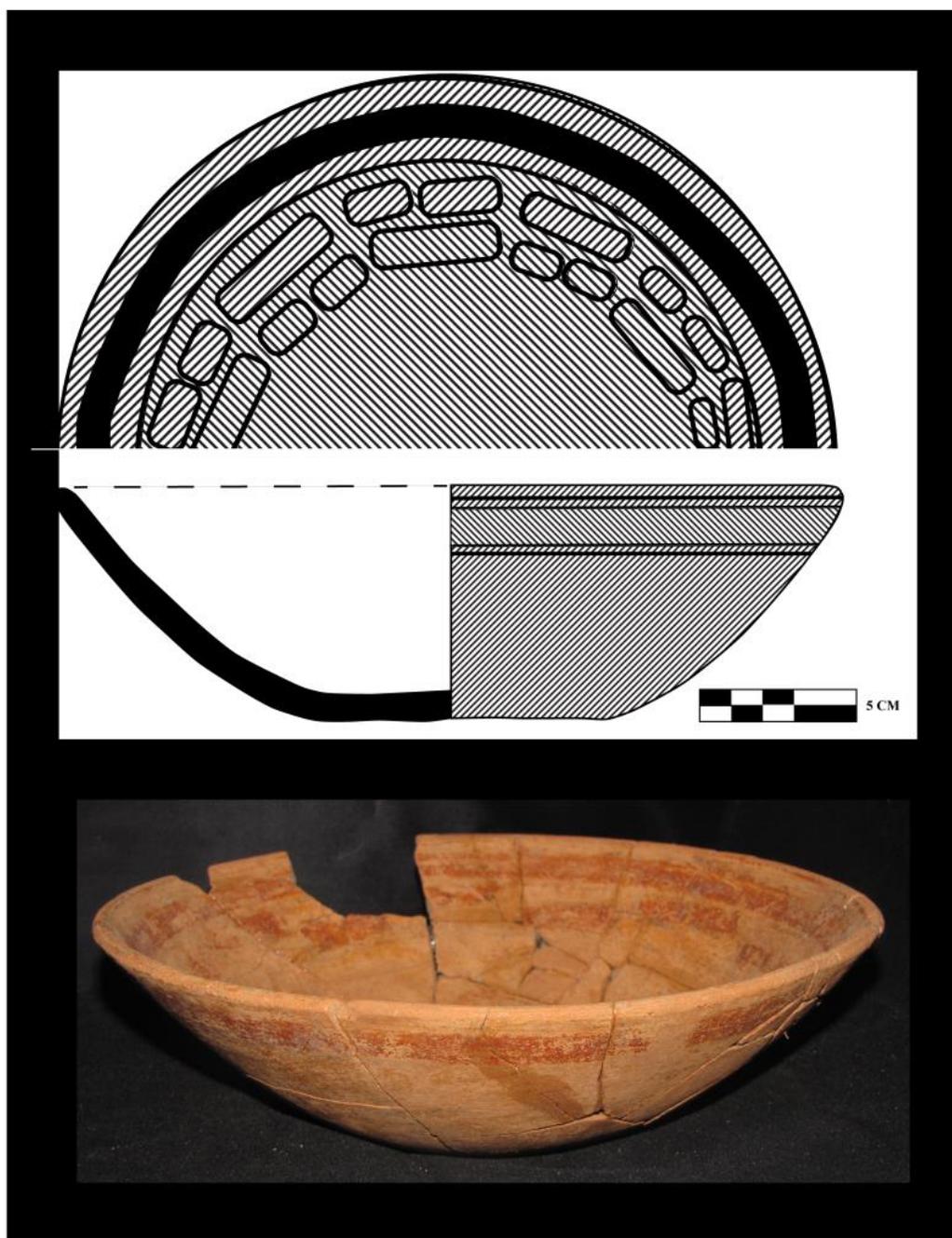


Figure F.40. Tomb L2 Palmar Bowl (Tomb L2, Vessel 13), Quartz A Fabric Group (Locally Produced).

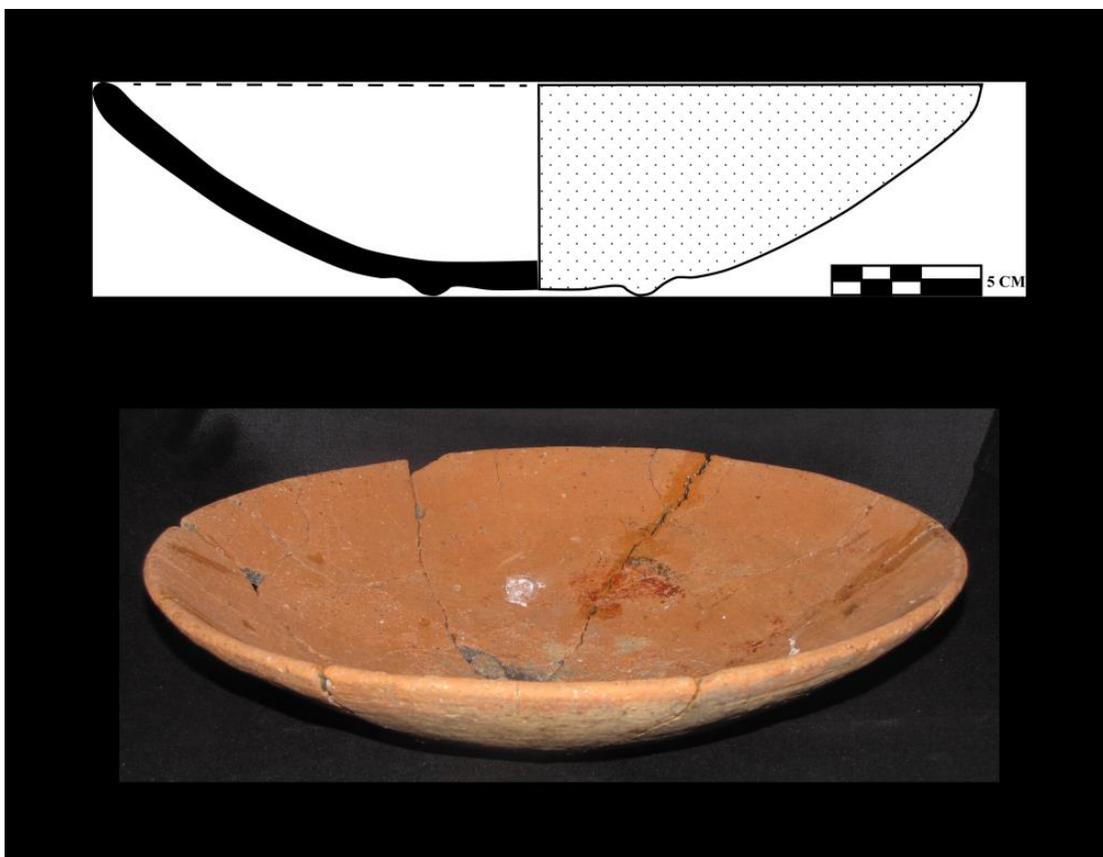


Figure F.41. Tomb L2 Palmar Bowl, Unslipped or Eroded Exterior, Slipped and Painted Interior (Tomb L2, Vessel 21), Calcite B Fabric Group (Non-Locally Produced).

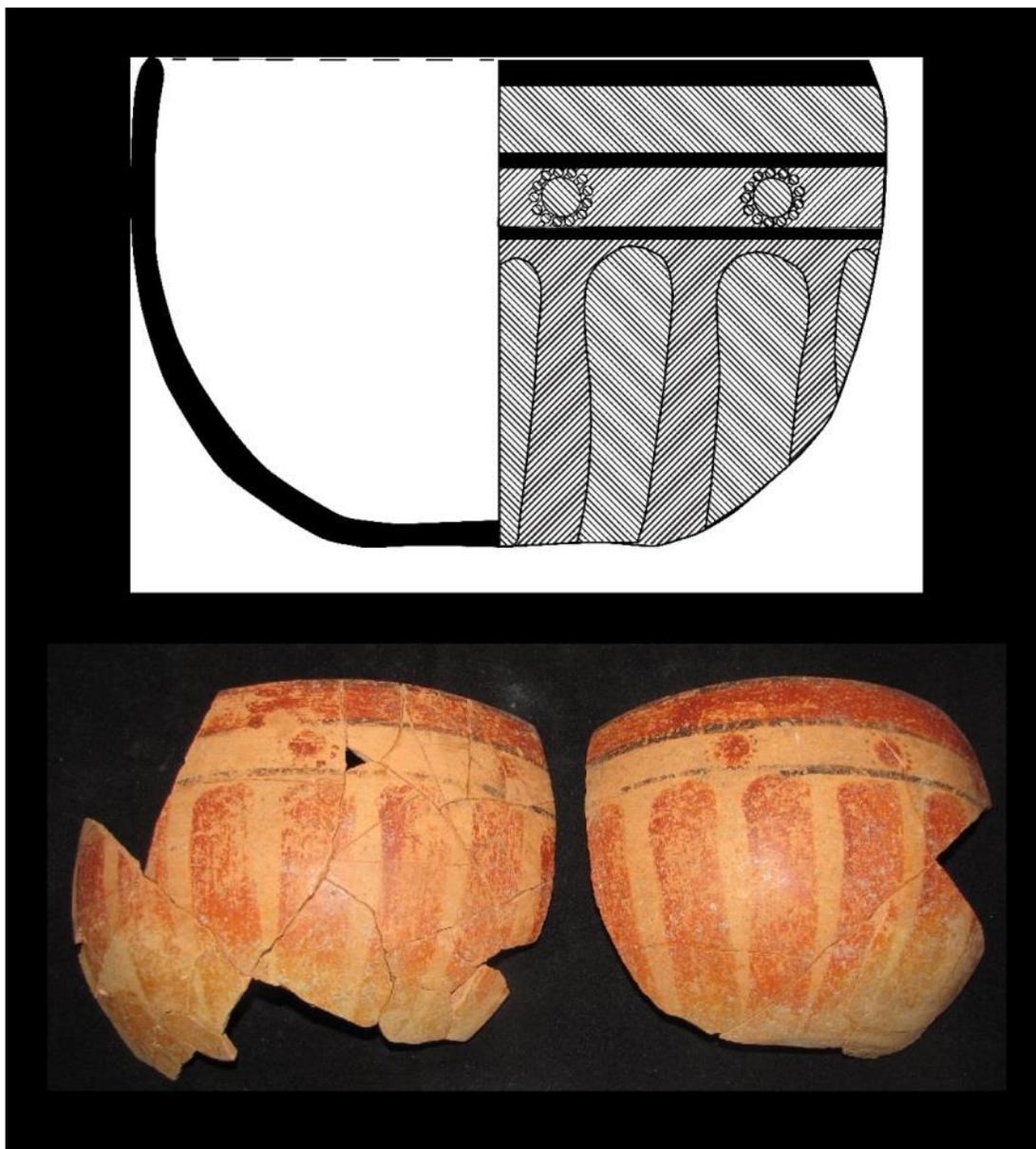


Figure F.42. Tomb L2 Saxche-Palmar Bowl (Tomb L2, Vessel 28), Volcanic Glass A Fabric Group (Non-Locally Produced).



Figure F.43. Tomb L2 Saxche-Palmar Bowl (Tomb F3, Vessel 1), Micrite A Fabric Group (Non-Locally Produced).

BELIZE CERAMIC GROUP

Type: Belize Red

Varieties: Belize Variety

Established: Gifford (1976) at Barton Ramie

Ceramic Group: Belize

Ware: British Honduras Volcanic Ash

Context: Belize Group ceramics are rare and generally only found in the box lum levels (Groups B, D, and I) at Uxbenká suggesting a Terminal Classic (Tepeu 3) date. Belize Group ceramics do not appear until the Terminal Classic at Lubaantun and Nim Li Punit (Braswell). The presence of a single McRae Impressed sherd, which dates to the Terminal Classic at Xunantunich (LeCount 1996: 145) in Group B and the co-occurrence of the Belize and Fine Orange Groups in the same level suggests a Terminal Classic date for Uxbenká.

Ceramic Sphere Affiliation: Tepeu/Spanish Lookout (Terminal Classic?)

Surface Finish and Decoration: This red slip on both the interior and exterior of vessels (see Gifford 1976: 255-257).

Principal Identifying Modes: The majority of Belize Group sherds are body sherds though are distinct due to the highly diagnostic volcanic ash paste and thick red slip. They are open bowls and dishes with direct rims and rounded lips. Ring bases are the only base form.

Type: McRae Impressed

Variety: McRae Variety

Established: Gifford (1976) at Barton Ramie

Ceramic Group: Belize

Ware: British Honduras Volcanic Ash

Context: A single McRae impressed sherd was recovered from Group B. A notched basal apron is a Terminal Classic indicator at Xunantunich (LeCount 1996: 165). Given that these vessels likely originated in the Belize Valley (Hammond et al. 1976) it is likely that this is also a Terminal Classic marker at Uxbenká.

Ceramic Sphere Affiliation: Tepeu/Spanish Lookout (Terminal Classic)

Surface Finish and Decoration: Same as Belize Red: Belize Variety

Form: Notched basal apron; no identifiable rims.

Type: Belize Red

Variety: Unspecified

Established: Gifford (1976) at Barton Ramie

Ceramic Group: Belize

Ware: British Honduras Volcanic Ash

Context: Group I tomb salvage excavations. The tomb appears to have been reentered and a single Belize Red: Variety Unspecified bowl was deposited.

Ceramic Sphere Affiliation: Tepeu/Spanish Lookout (Terminal Classic)

Surface Finish and Decoration: Same as Belize Red: Belize Variety with a dark red painted line near the exterior rim.

Form: Likely an open bowl or dish with a ring base; no identifiable rims.

FINE ORANGE GROUP

Type: Fine Orange

Variety: Unspecified

Established: Adams (1971) at Altar de Sacrificios

Ceramic Group: Fine Orange

Ware: Fine Orange

Context: Only 2 Fine Orange sherds (Group B) have been recovered.

Ceramic Sphere Affiliation: Tepeu 3 (post AD 830)

Principal Identifying Modes:

1. Very fine, bright orange paste

Surface Finish and Decoration: Distinctive fine orange paste with no surface decoration. One of the sherds has a fine, ashy paste while the other is hard and does not seem to contain any ash.

Form: Unknown



Figure F.44: Fine Orange Body Sherd (Group B)

TEABO GROUP

Type: Sahcaba Molded Carved

Variety: Sahcaba

Established: Smith and Gifford (1966)

Ceramic Group: Teabo

Ware: Puuc Rojo

Context: Sahcaba has only been recovered from Group B (see Aquino 2011). The same type has been identified at Nim Li Punit though was placed into the Fine Orange Group (Fauvelle 2012). While many Lowland Terminal Classic molded carved vessels are of the Fine Orange Group, the Sahcaba Group has a much coarser paste than those originally identified at Altar de Sacrificios (Adams 1971). The sherds assigned to the Sahcaba

Group at Uxbenká differ from the description from Uaxactun; however, are similar to those identified in the southeastern Petén. The Uxbenká material does not appear to have elaborate scenes but this may be due to preservation. Like Fine Orange they seem to date to the Terminal Classic Period though it is unclear if the AD 830 date applies.

Principal Identifying Modes:

1. Coarse Orange Paste
2. Molded Exterior
3. Red slip (rarely present)

Surface Finish and Decoration: Sahcaba Molded vessels are poorly preserved though the molded exterior is clearly visible. The decoration is abstract and differs from Fine Orange vessels in that there are not figural representations or hieroglyphic texts. All of these vessels were likely red slipped although the slip is rarely preserved.

Form: Open bowls with direct rims and rounded lips.



Figure F.45. Molded Sherd (Group B)

Ceramic Group: Unknown Miniature Vessel

Type:

Variety:

Established:

Ware:

Context: Tomb L2

Ceramic Sphere Affiliation: Tepeu

Principal Identifying Modes:

1. Miniature size

2. Shiny reddish brown slip
3. Circle and scroll incisions
4. Red paste

Form:

Miniature vessels have been identified at Barton Ramie during the Tiger Run (approximately AD 600-700 which is roughly equivalent to Tepeu 1) and Spanish Lookout Ceramic (AD 600-900) Complexes and at Uaxactun during the Tepeu 2 Ceramic Complex (AD 830-900). The majority of miniature vessels have been recovered from Late/Terminal Classic contexts (Awe pers. Comm.) however, the surface treatment, form, and paste characteristics suggest that this miniature vessel could also belong to the Sotero Group (Tiger Run).



Figure F.46. Miniature Vessel (Tomb L2)

Historic Period Vessels

In addition to the Late and Terminal occupation of the site, Uxbenká has a considerable Historic component consisting of thin walled bowl and jar forms with clear paddle and anvil forming technique and uneven rims. Historic ceramics have been recovered from the surface of numerous SGs as well as in the site core. Future analyses will focus on defining Historic Period ceramics, both chronologically and spatially, to understand this understudied period of Belizean history.

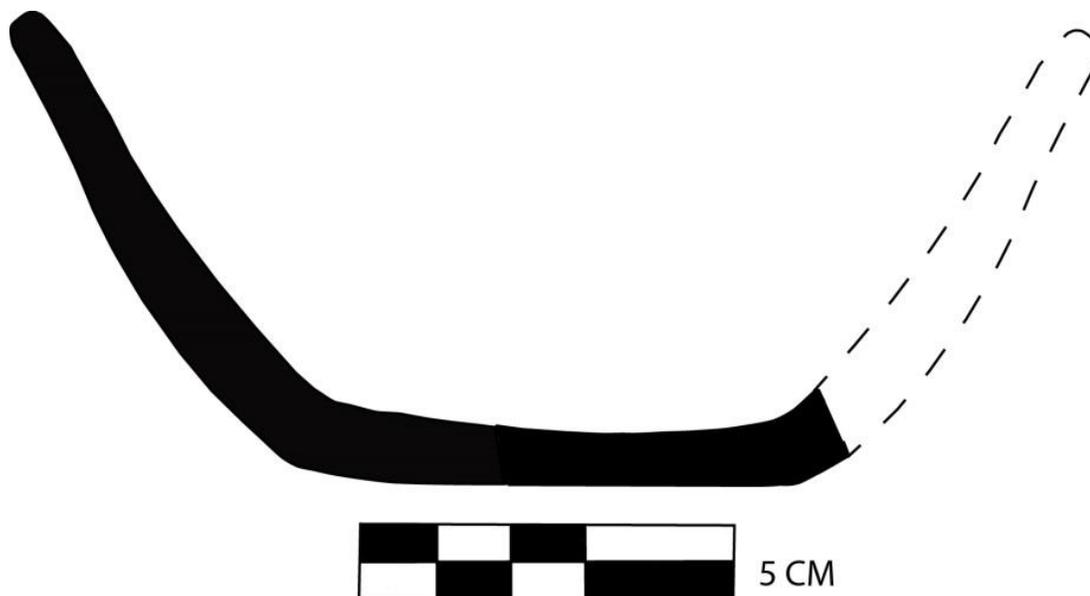


Figure F.47. Historic Bowl (SG 9)

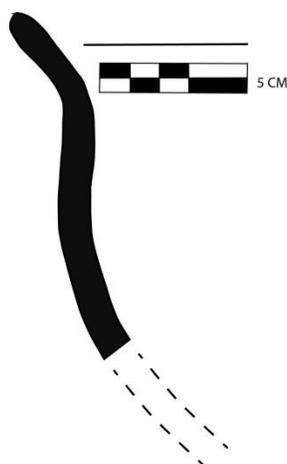


Figure F.48. Historic Bowl (SG 9)

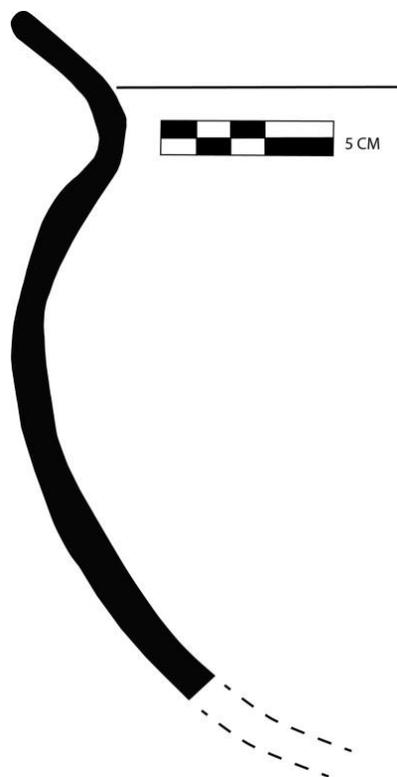


Figure F.49. Historic Jar (SG 10)



Figure F.50. Historic Jar (SG 10)

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