6 *RECONSTRUCTING PRECLASSIC MAYA HOUSEHOLD ECONOMIES IN THE BELIZE RIVER VALLEY*

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Archaeologists traditionally attribute the emergence of socio-economic inequality to elite control of local craft production and regional redistribution systems. Households also employed a diverse set of economic strategies to access raw materials and finished craft items that formed the foundations of the domestic economy. This study uses geochemical sourcing of obsidian and ceramics to characterize the economic behaviors that structured the domestic economy at the ancient Maya community of Cahal Pech, located in the Belize Valley of west-central Belize, during the Preclassic Period (1200 BC–AD 300). Portable X-ray fluorescence (pXRF) geochemical analyses of obsidian from Cahal Pech document decentralized domestic obsidian exchange systems based on the differential consumption of source material, which developed during the Preclassic and persisted through the Terminal Classic Period (~1200 cal BC-cal AD 900). Instrumental neutron activation analysis (INAA) of Preclassic ceramics from Cahal Pech identified contrasting provisioning strategies based on long-distance and local ceramic exchange monopolized by some households. Understanding the irregular distribution of economically important resources between households can shed light on the social and economic contexts that led to the emergence of institutionalized hereditary inequality.

INTRODUCTION

Archaeologists have long focused on exploring the dynamics of prehistoric economies because production, distribution, and consumption of resources are embedded within larger social processes. Researchers examining the emergence of social and economic stratification in Mesoamerica during the Formative (Preclassic) Period have argued that elite status was maintained through the monopolization of regional distribution of specialized crafts (e.g., Clark 1987:280; Santley 1984). The redistribution of these goods by aggrandizing elites generated economic and social debt for subordinate members of society, resulting in transgenerational social hierarchies (Clark and Blake 1994). More recently, studies of ancient Mesoamerican economies have shifted their focus to examine the structural and functional aspects of household economic organization to examine broader socio-economic developments (e.g., Douglas and Gonlin 2012; Hirth 2009, 2016). Households were the most basic economic unit in ancient Mesoamerican societies (Ashmore and Wilk 1988; Wilk and Rathje 1982), and the domestic economy, which was structured for the acquisition of subsistence resources by all segments of society, formed the foundation upon which all other economic activities were based (Hirth 2012, 2016). Ranked social organization developed when a household, or group of households, formalized their economic well-being into social status and authority through the institutional economy, which underwrote the social, political, and religious activities for the society as a whole (Hirth 2016:21). The irregular distribution of subsistence and non-subsistence resources probably encouraged economic variation and may have motivated some households towards production and distribution of specific resources intended to improve not only their household well-being, but also their status within the community.

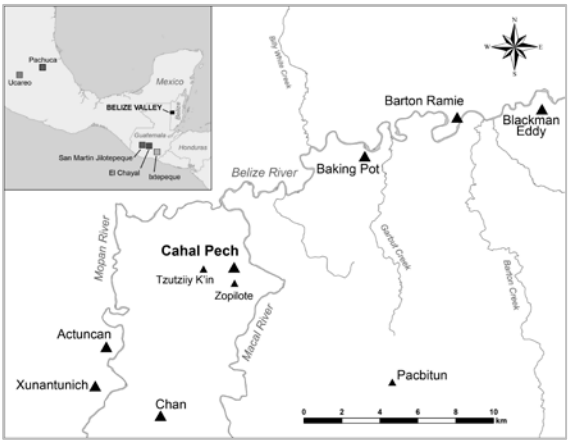

Figure 1. Map of the Belize Valley with locations of Preclassic period sites mentioned in text. Inset map shows locations of obsidian sources identified from Preclassic contexts in the Belize Valley region.

In this study, we use geochemical compositional data of obsidian and ceramic artifacts from the lowland Maya community of Cahal Pech, located in the Belize Valley of western Belize (Figure 1), to examine the structure and function of the domestic and institutional economies during the Preclassic Period (~1200 BC-

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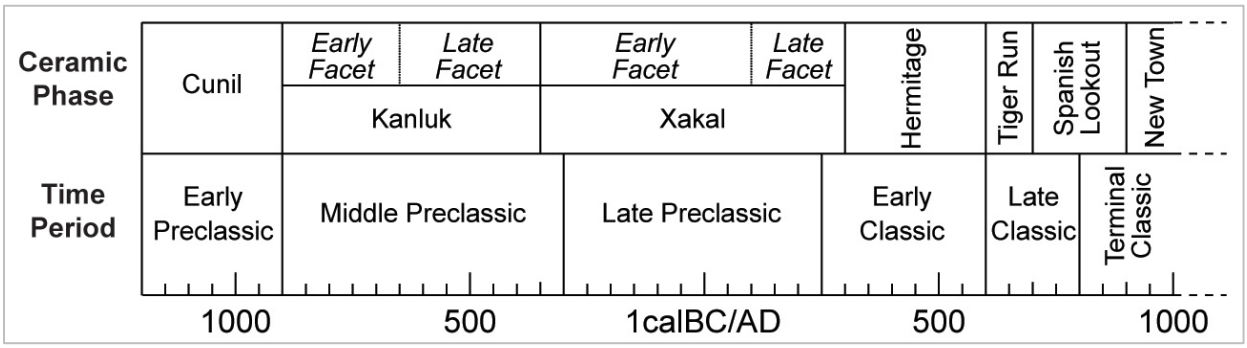

Figure 2. Chronological periods for Cahal Pech with associated ceramic phases.

AD 300; Figure 2). The Preclassic represents a critical transition in Maya prehistory, when the development of settled village life, increased reliance on maize agriculture, and the adoption of ceramic technology appeared across the lowlands. By the Late Preclassic, Maya society had become complex and hierarchical, with small village settlements developing into large centralized polities serving as the focal points of economic and political activity (Chase and Chase 2012). While evidence exists for the long-distance movement of many different commodities into Belize Valley during this dynamic period (e.g., greenstone, Powis et al. 2016; granite, Tibbits 2016), our focus is on obsidian and ceramics because they are ubiquitous in all contexts and were essential for the daily subsistence of the majority of Maya households through time. Documenting distributional patterns of these key items within and between households can be used to determine how access to overlapping and contrasting economic networks may have impacted household wealth and status beginning in the Preclassic Period.

To understand differences in Preclassic economic networks associated with the development in socio-economic inequality at Cahal Pech, we performed technological and portable X-ray fluorescence (pXRF) geochemical sourcing of obsidian artifacts (*n*=1189) from the site's civic-ceremonial site core and peripheral household groups. The results indicate that all households relied primarily on imported obsidian blades from sources in the southern highlands of Guatemala. El Chayal obsidian dominated assemblages from Preclassic domestic contexts, a pattern that persisted until the abandonment of Cahal Pech in the Terminal Classic (~AD 850/900). Differential use of source materials between households, however, suggests that obsidian was obtained through decentralized domestic procurement systems from the Preclassic through Terminal Classic periods. Comparisons of our data from Cahal Pech to previously sourced assemblages from the sites of Blackman Eddy and Chan in the Belize Valley indicate this pattern was present across the region. Instrumental neutron activation analysis (INAA) of ceramics (*n*=192) from radiocarbon dated Early to Late Preclassic Period deposits in the site core and two peripheral domestic groups identified contrasting long-distance and local economic networks. INAA identified seven compositional groups corresponding to changing production patterns. By the Middle and Late Preclassic, the ceramics from higher status households were compositionally distinct when compared to peripheral household settlements. Comparative analysis of ceramic assemblages from Cahal Pech and sites in the central Petén region of Guatemala suggest that Mars Orange wares were exchanged between high status groups. Ceramic exchange may have been one avenue for Maya households to underwrite economic status within a developing institutional economy.

The Preclassic Cahal Pech Economy

Cahal Pech is a medium sized center located ~2 km south of the confluence of the Macal and Mopan Rivers in the Belize Valley (Figure 3). Stratigraphic excavations and radiocarbon dating conducted by the Belize Valley Archaeological Reconnaissance (BVAR) Project in the Cahal Pech epicenter at Str. B4 and Plaza B indicate the site was first settled between ~1200-1100 cal BC as a

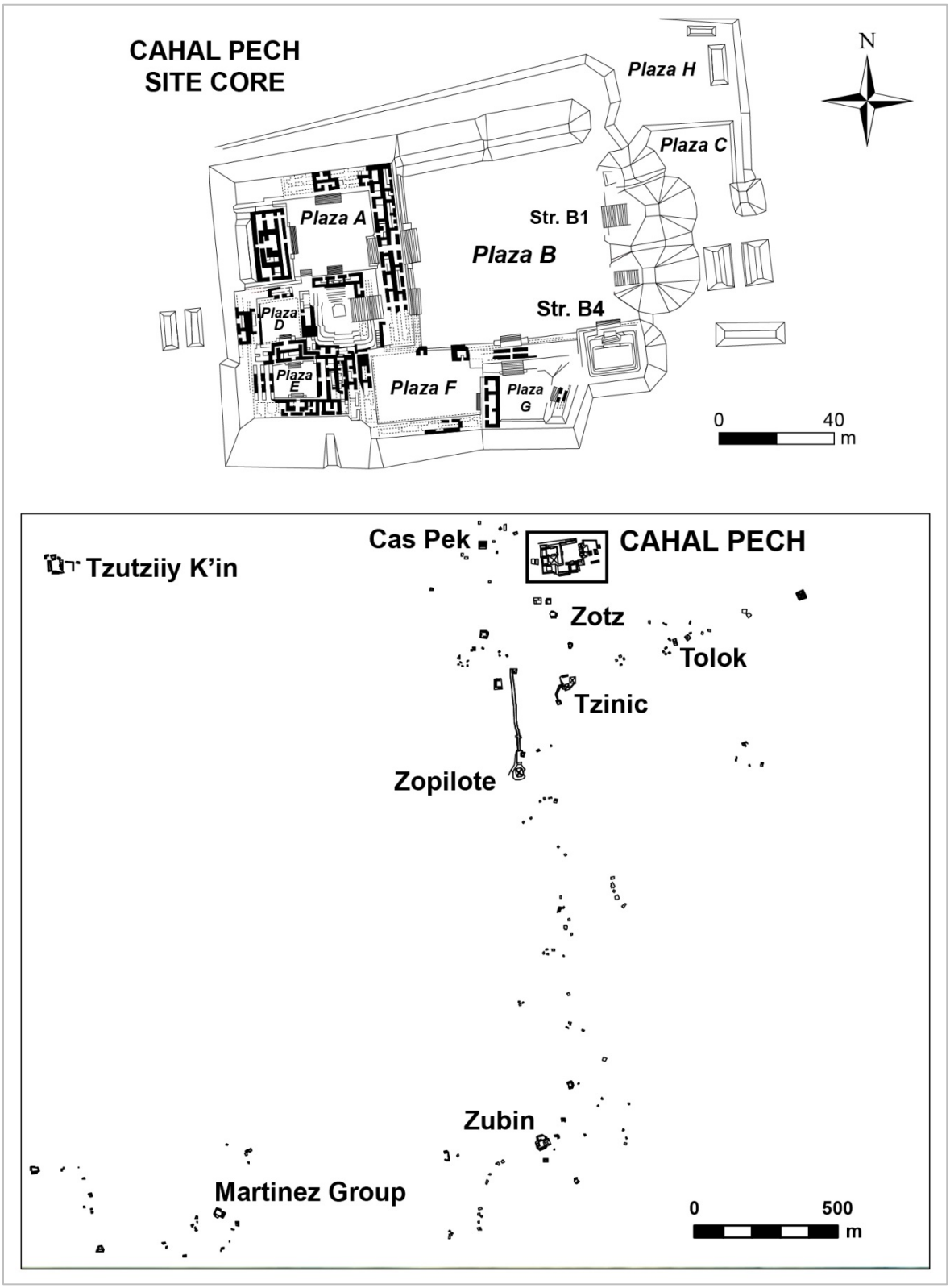

Figure 3. Map of Cahal Pech showing the civic-ceremonial site core (top) and location of house groups (bottom) sampled for obsidian and ceramic compositional studies.

small agrarian village composed of economically autonomous households (Awe 1992; Ebert 2017; Ebert et al. 2017). The earliest residential occupation is associated with the appearance of Cunil complex ceramics (~1200/1100-900 BC), the majority of which are utilitarian wares including jars, bowls, and gourd-shaped *tecomates* (Sullivan and Awe 2013). The Cunil assemblage also contains decorated serving vessels including slipped bowls, plates, and censers depicting *k'an* cross, avian-serpent, and flamed eyebrow designs (Awe 1992; Garber and Awe 2009; Sullivan and Awe 2013). The presence of El Chayal obsidian flakes and nodules in the earliest levels at Cahal Pech indicate integration of the Belize Valley into broader regional economic networks (Awe 1992; Awe and Healy 1994; Ebert 2017; Stemp et al., this volume).

Population expansion and economic growth at Cahal Pech and other Belize Valley sites during the Middle Preclassic were accompanied by the construction of public architecture restricted to larger house groups, signaling the emergence of higher status individuals within local communities. The appearance of increasingly standardized ceramics and evidence for the expansion of long-distance exchange networks dealing in exotic items also appear at this time. Obsidian blades, decorated pottery, jade, and other valuables have been identified throughout the Belize Valley region in Middle Preclassic contexts (Awe 1992; Hohmann 2002; Kersey 2006; Powis et al. 2016). At Cahal Pech, the Middle Preclassic Kanluk ceramic complex (900-350 BC) was composed primarily of coarse paste utilitarian ceramics (Jocote Orange-brown) and fine paste Mars Orange serving wares including slipped Savana Orange and Reforma Incised types (Awe 1992; Gifford 1976; Horn 2015; Peniche May 2016). Little archaeological evidence exists for the centralized control of production or redistribution of imported items by higher-status groups at Cahal Pech. While Awe and Healy (1994) documented a transition in obsidian technology in the Middle Preclassic assemblage towards finished prismatic blades, obsidian coming from both the El Chayal and San Martín Jilotepeque (SMJ) sources were consumed differentially between households at the site (Awe and Healy 1994; Peniche May 2016). Other crafting activities, such as shell bead production (e.g., Hohmann 2002; Lee and Awe 1995; Peniche May 2016), connected some Cahal Pech households with different long-distance exchange networks. Bead production, however, is not evenly distributed across the site, likely indicating that acquisition of shell via long-distance exchange was directly regulated by individual households.

The Late Preclassic Period (350 BC-AD 300) saw the fluorescence of large civic-ceremonial centers throughout the Belize Valley and evidence for the development of institutionalized elite rulership at Cahal Pech and other Belize Valley sites such as Blackman Eddy, Xunantunich, and Barton Ramie (Awe 1992; Brown et al. 2013; Garber et al. 2004; Healy et al. 2004; Willey et al. 1965). The construction of elaborate tombs and offerings within monumental temple architecture appeared at Cahal Pech during the corresponding Xakal ceramic phase, signaling the development of a royal lineage at the site (Awe 1992; Awe n.d.; Garber and Awe 2009; Healy et al. 2004). The presence of symbolically significant items such as high-quality jade crafts within burials suggest that high-status individuals were involved in exchange of exotic items that were translated into wealth and prestige. Evidence for status differentiation appears also within the settlement zone after 350 BC in the form of larger-scale domestic and non-domestic architecture. Radiocarbon dates of construction phases indicate that low masonry platforms and temple structures were built at several house groups around the Cahal Pech site core (e.g., Tzutziiy K'in, Zopilote, Zubin, and Cas Pek groups), which likely functioned as public temple buildings associated with nearby domestic structures (Ebert et al. 2016, 2017). Radiocarbon dates from burials and ceramic associations from several other large house groups suggest that this pattern of social, economic, and spatial growth occurred throughout the Cahal Pech hinterlands during the Late Preclassic (Ebert 2017; Ebert et al. 2017).

Obsidian pXRF Analyses

Obsidian samples analyzed in this study were derived from surface collection and stratified contexts within the Cahal Pech monumental site core, and from ten residential groups located throughout the site's periphery. A total of 1189 artifacts were subjected to pXRF geochemical sourcing analyses. Temporal assignments are based on relative ceramic associations and radiocarbon dates where possible (see Awe 1992;

Ebert 2017; Ebert et al. 2016, 2017). Technological analyses of the assemblage were performed by Cassana Popp and Ken Hirth in the Mesoamerican Economy and Archaeology Lab at The Pennsylvania State University. Results are reported by Ebert (2017). General patterns in obsidian technology show that the Cahal Pech assemblage was composed primarily of finished prismatic blades. Medial segments of blades are the most common artifact from Preclassic and later Classic Period contexts, with blades becoming more common beginning in the Middle Preclassic. Obsidian blade cores and manufacturing debris are not common in the Preclassic assemblage, or the assemblage for any time period, indicating that finished blades were likely imported to Cahal Pech in a pattern consistent with whole-blade or processed-blade trade (De León et al. 2009, Stemp et al., this volume).

Geochemical characterization of obsidian artifacts was conducted at The Pennsylvania State University Ceramics Laboratory according to standard procedures using a Bruker Tracer III-V+ SD handheld XRF spectrometer with X-rays emitted from a rhodium tube (see Ebert et al. 2015). Cluster analysis of pXRF data identified five obsidian source groups in the Cahal Pech assemblage (Figure 4). The majority of artifacts were imported from the El Chayal source (61.5%, *n*=732), with smaller amounts from the Ixtepeque (19.3%; *n*=230) and SMJ (18.5 %, *n*=220) sources. Ucareo (>0.01%, *n*=1) and Pachuca (>0.01%, *n*=6) blade fragments from the central Mexican Highlands are also present.

The Early Preclassic obsidian assemblage was derived exclusively from excavated contexts at Str. B4, located in Plaza B of the site core (Table 1). Obsidian nodules and percussion flakes compose more than half of the Early Preclassic assemblage (~68%, *n*=15), with only one pressure blade artifact (3rd series corner blade) present in early contexts. All the Early Preclassic artifacts were assigned to the El Chayal source. Additional types of obsidian appear during the Middle Prelcassic, as the percussion flake tradition was replaced by prismatic pressure blades technology at Cahal Pech (Awe and Healy 1994; Ebert 2017; Stemp et al., this volume). While the inhabitants of the site core primarily consumed blades from the SMJ source, blades from El Chayal are the dominant type found in peripheral household

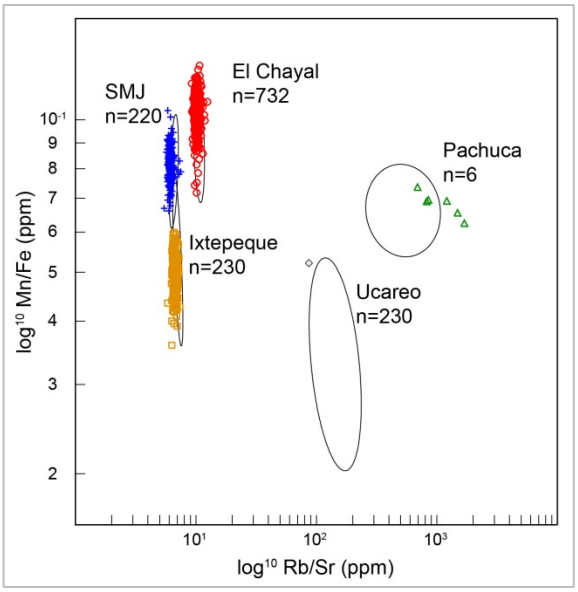

Figure 4. Bivariate log10 transformed elemental concentrations for obsidian sample from Cahal Pech. Ellipses represent 90% confidence intervals for group membership based source samples with known proveniences (data courtesy of Archaeometry Lab at MURR).

groups. Imported blades continued to compose the majority of the obsidian assemblage throughout the Preclassic. One obsidian blade from the Ucareo source, recovered from late Middle Preclassic levels at Str. B4, documents possible connections with the central Mexican Highlands.

El Chayal blades continued to dominate the obsidian assemblage both in the site core and settlement (63%) throughout the Classic Period, with smaller but relatively even amounts of SMJ obsidian through the Terminal Classic. Ixtepeque obsidian composes ~24% of the Late Classic assemblage, and is found in higher proportions in the settlement (*n*=134) compared to the site core (*n*=60) during this period. Blades from the Pachuca source also enter the assemblage during the Early Classic, though the total number in the Classic Period sample analyzed for this study is small (*n*=6). By the Terminal Classic, El Chayal blade fragments make up over 83% of the assemblage.

Ceramic INAA Analyses

Ceramic samples subjected to INAA were chosen from common types of diagnostic ceramics (total *n*=192) from radiocarbon dated contexts in the site's civic-ceremonial core and from two peripheral settlement groups (Ebert 2017). All sherds were identified to type: variety-mode

Table 1. Comparison of obsidian sources for site core, settlement, and surface/unknown contexts analyzed for Cahal Pech by chronological period. The San Martín Jilotepeque source is abbreviated as SMJ. Time periods abbreviated as follows: EPC = Early Preclassic, MPC = Middle Preclassic, LPC = Late Preclassic, EC = Early Classic, LC = Late Classic, TC = Terminal Classic, UNK = Unknown Period.

Source	EPC	MPC	LPC	EC	LC	TC	UNK	Total Source
El Chayal	**22**	**44**	**19**	**13**	**517**	**106**	**11**	**732**
Site Core	22	20	18	7	210	102	9	388
Settlement		24	1	6	307	4	2	344
SMJ		**82**	**18**	**8**	**100**	**10**	**2**	**220**
Site Core		65	18	6	34	10	1	134
Settlement		17		2	66		1	86
Ixtepeque		**10**	**6**	**7**	**194**	**11**	**2**	**230**
Site Core		2	6	5	60	11		84
Settlement		8		2	134		2	146
Pachuca				**1**	**5**			**6**
Site Core				1	3			4
Settlement					2			2
Ucareo		**1**						**1**
Site Core		1						1
Settlement								
Total Period	22	137	43	29	816	127	15	1189

classification according to standard classifications for Cahal Pech and the Belize Valley (Awe 1992; Gifford 1976; Sullivan and Awe 2013). A total of 125 sherds from contexts radiocarbon dated to the Cunil and Kanluk phases (Awe 1992; Ebert et al. 2017; Peniche May 2016) were sampled from excavations in Str. B4 and Plaza B in the Cahal Pech site core. Samples were also chosen from Middle and Late Preclassic contexts at two house groups in the Cahal Pech periphery: the Tzutziiy K'in (*n*=40) and Zopilote (*n*=27) groups. Samples from the Zopilote Group come from late facet Kanluk (750-350 BC) and early/late facet Xakal phase (350 BC-AD 300) contexts at Structure 1 (Ebert and Fox 2016). Samples from Tzutziiy K'in are derived from excavations of domestic buildings at Structure 2 and 3, and date to the early/late facets of the Late Preclassic Xakal ceramic phase (Ebert et al. 2016, 2017).

All ceramic samples were prepared for INAA using standard procedures at MURR by Daniel Peirce and Michael Glascock (see Glascock 1992; Neff 2000). Initial identification of compositional groups was based on mean and standard deviations for concentration data for each element within the sample. Hierarchical cluster analysis and principal component analysis were then applied to elemental data to refine

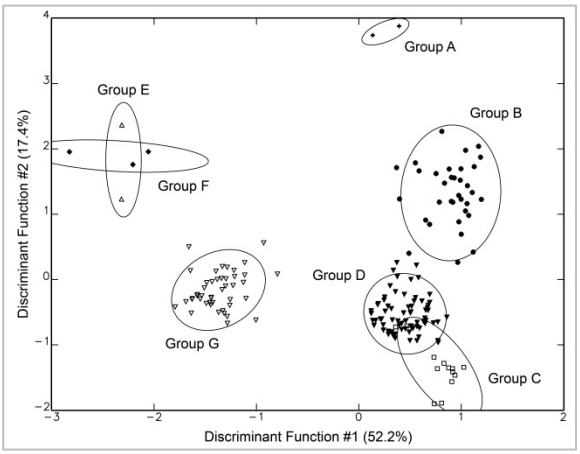

Figure 5. Bivariate plot of INAA samples displayed based on canonical discriminant functions #1 and #2. Ellipses represent 90% confidence of membership for identified groups in the assemblage.

compositional group membership. INAA results for the Cahal Pech sample were also compared to the results of over 12,000 previous analyses by MURR using Euclidian Distance searches to identify similarities with other identified geochemical compositional groups in Mesoamerica. The Cahal Pech ceramics divide into seven groups that generally correspond with type:variety classifications from different time periods and contexts (Figure 5 and Table 2).

Table 2. Ceramic compositional groups at Cahal Pech identified by INAA for each chronological period and ceramic phase, listed by context. Early facet (EF) and Late Facet (LF) components of ceramic phases are listed when present. Time periods abbreviated as follows: EPC = Early Preclassic, MPC = Middle Preclassic, LPC = Late Preclassic.

Compositional Group	Context	EPC	MPC		LPC		% Total
		Cunil	EF Kanluk	LF Kanluk	EF Xakal	LF Xakal	
Group A							1%
n=2	Site Core	2					
	Settlement						
Group B							18%
n=34	Site Core	12	18	1			
	Settlement		3				
Group C							7%
n=13	Site Core		3	5			
	Settlement			2	3		
Group D							37%
n=71	Site Core	21	17	24			
	Settlement			1	7	1	
Group E							1%
n=2	Site Core		1				
	Settlement					1	
Group F							2%
n=3	Site Core			3			
	Settlement		2				
Group G							23%
n=45	Site Core	1	1	1			
	Settlement		1	10	24	7	
Unassigned							11%
n=22	Site Core	2	4	9			
	Settlement		1	2	3	1	
Total *n*		**37**	**50**	**58**	**37**	**10**	**100%**

Group A consists of two Cunil sherds of an unspecified white-slipped type, the only two samples from excavations at Plaza B with ash temper. Group B (*n*=34) contains all other sherds analyzed for this study with ash temper, as well as vessels characterized by fine texture calcite/quartzite pastes. Many of these samples are decorated with dull slips and post-slip incising (e.g., Baki Red Incised, Mo Mottled, and Kitam Incised types). Euclidean Distance searches indicate that the Cahal Pech specimens are compositionally unique to previously analyzed samples in the MURR database from the Maya region.

Groups C and D contain ceramic samples attributed primarily to the late facet Kanluk ceramic phase (750-350 BC). Group C (*n*=13) ceramics are primarily Mars Orange wares (Savana Orange and Reforma Incised types; Gifford 1976:73-76) and were distributed between late Middle Preclassic site core (62%) and settlement contexts (38%). Group D is the largest compositional group (*n*=71) in the INAA sample. Most specimens come from site core contexts (87%) with Cunil and Kanluk ceramic phase temporal assignments. The group is composed primarily of unslipped utilitarian pottery (57%, e.g., Sikiya and Jocote types), but also contains high frequencies of Savana Orange wares (37%). Euclidean Distance searches indicate that many of the specimens in this group are compositionally similar to previously analyzed samples of Middle Preclassic Mars Orange ceramics from the site of Holtun, Guatemala (Callaghan et al. 2017).

Group E (*n*=2) and Group F (*n*=3) ceramics compose only 3% of the total Cahal Pech INAA sample. While both groups are compositionally distinct, they exhibit high degrees of internal compositional variability, which indicates slightly different paste recipes for each sherd. Groups E and F are found relatively evenly between site core and settlement contexts, and are composed primarily of Joventud Red sherds from the Kanluk

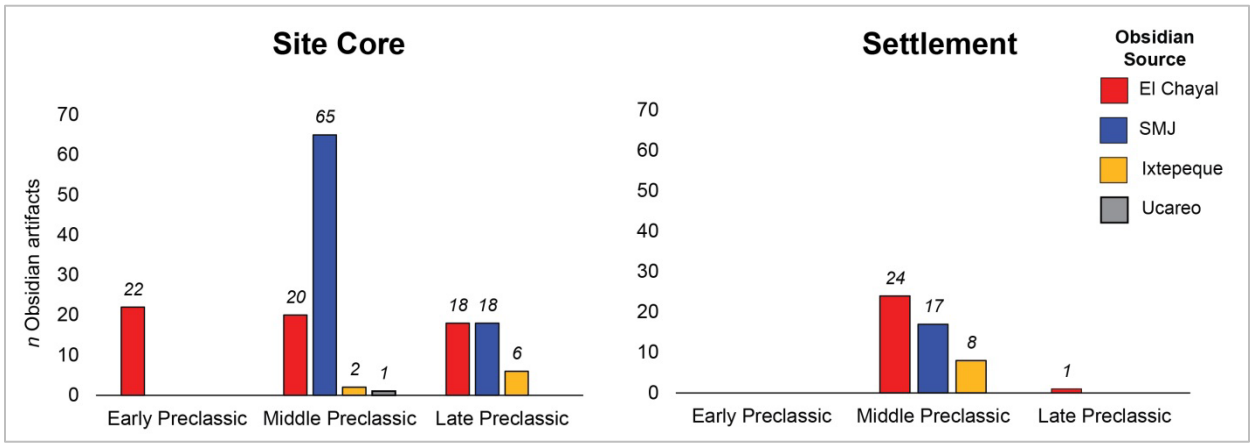

Figure 6. Comparison of obsidian sources between Cahal Pech site core and settlement contexts for the Preclassic period.

ceramic complex. Group G (*n*=45) is the second most common group in the Cahal Pech INAA sample, and is composed of sherds from the Late Preclassic Xakal ceramic complex (350 BC-AD 300), suggesting a preferences for this paste recipe within household groups during later time periods. Specimens in this group are found almost exclusively at peripheral household groups, with ~74% of sherds samples from the Tzutziiy K'in Group and ~65% of the sherds samples from the Zopilote Group assigned to this group. The most common ceramic types include Sierra Red and Joventud Red, with small numbers of unslipped utilitarian wares (Jocote Orange-brown and Sayab Daub Striated types).

Discussion

We used geochemical compositional methods of obsidian and ceramics to identify the economic mechanisms associated with developing inequality among Preclassic households at the site of Cahal Pech. The results indicate that, while obsidian and ceramic economies overlapped to supply households with items needed for everyday subsistence, they were structured in different ways. The pXRF data reported in this study document a relatively decentralized network of domestic obsidian consumption at Cahal Pech throughout the Preclassic. The inhabitants of Cahal Pech were active participants in long-distance obsidian exchange systems with the southern highlands of Guatemala as early as 1200 cal BC (Awe and Healy 1994; Ebert 2017; Peniche May 2016). The results of pXRF analyses of obsidian indicate the presence of El Chayal percussion flakes and one pressure blade artifact within the earliest Cunil domestic contexts at the site core. The sample size for this period is small (*n*=22), however, and is derived from only one context (Str. B4) in the Cahal Pech site core, making it difficult to assess hypotheses about differential obsidian consumption between households.

The long-distance procurement networks accessed by Cahal Pech expanded during the Middle Preclassic. SMJ obsidian became the most abundant source at the site, with El Chayal and Ixtepeque artifacts found less frequently. Different types of obsidian, however, were not evenly distributed between households. While SMJ blades became prevalent in the site core (~74% of all site core artifacts for the period), El Chayal remained the primary source for blades consumed by peripheral households (~49% of all settlement artifact for the period; Figure 6). The differential procurement of obsidian types suggests a lack of centralized control over redistribution. Instead, it is more likely that obsidian moved through a network of decentralized exchange relationships operating at the household-level. By the Late Preclassic, both El Chayal and SMJ blades became more evenly distributed within the Cahal Pech site core, with Ixtepeque also composing a smaller portion of the assemblage. A small sample size for peripheral house groups (one El Chayal blade) limits our interpretation of obsidian consumption in the settlement versus the site core for this period. Based on patterns in the geochemical data for later periods, however, it appears that decentralized

Table 3. Comparison of Preclassic obsidian sources from Cahal Pech and other Belize Valley sites.

Site	El Chayal	SMJ	Ixtepeque	Other	Total *n*	Citation
Blackman Eddy						Kersey 2006
Early Preclassic						
Middle Preclassic	1	35	1		37	
Late Preclassic	3				3	
Cahal Pech						Ebert 2017
Early Preclassic	22				22	
Middle Preclassic	44	82	10	1	137	
Late Preclassic	19	18	6		43	
Chan						Meierhoff et al. 2012
Early Preclassic						
Middle Preclassic		6			6	
Late Preclassic	8	22	11		41	

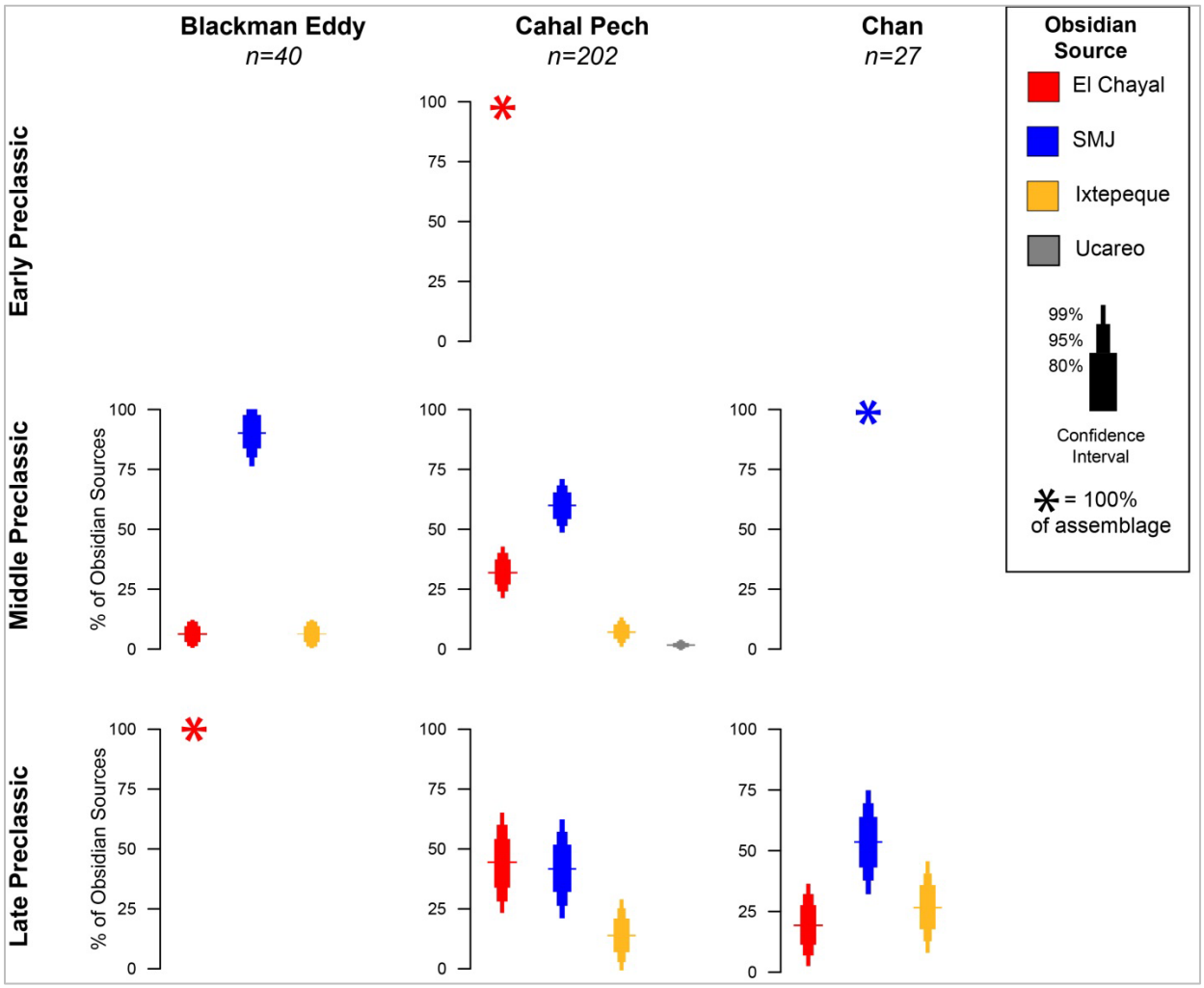

Figure 7. Proportions of obsidian sources at Blackman Eddy, Cahal Pech, and Chan for Early through Late Preclassic periods.

domestic procurement of blades persisted through the end of the Terminal Classic at Cahal Pech.

Comparisons to obsidian provenance studies for other Preclassic sites in the Belize Valley document a similar pattern of local and regional decentralized procurement of obsidian (Table 3). While published data for geochemically sourced assemblages is relatively limited, we consider obsidian source data from Blackman Eddy (Kersey 2006) and Chan (Meierfhoff et al. 2012) to interpret differences in obsidian consumption between these sites and Cahal Pech during the Preclassic (Figure 7). Cahal Pech possesses the only evidence for obsidian during the Early Preclassic Period (Stemp et al., this volume). Whereas Cahal Pech relied solely on El Chayal obsidian (*n*=22) at this early date, provenance data for Middle and Late Preclassic assemblages show the development of differential procurement networks at the site-level at other sites across the Belize Valley. Compared to the almost complete reliance on SMJ obsidian by Blackman Eddy and Chan, Cahal Pech consumption patterns indicate the use of higher proportions of El Chayal obsidian imported as blades. By the Late Preclassic, the Cahal Pech and Chan assemblages are relatively evenly spread between obsidian types, while Blackman Eddy became reliant on El Chayal obsidian. Despite small samples sizes for some periods, theses comparisons indicate that Preclassic sites developed independent procurement strategies to provision themselves with non-local obsidian, and that dominant sources shifted through time.

Ceramic INAA data from Cahal Pech suggest the development of craft specialization and distribution beyond the household-level that may have contributed to status and wealth of some households. INAA identified three compositional groups (A, B, and D) that contained diagnostic Cunil ceramic types, indicating a preference for these paste recipes during the Early Prelcassic. Both Groups A and B contained high proportions of fine paste slipped and grooved-incised Cunil vessels derived exclusively from the Cahal Pech site core. Specimens in these two groups were also found to be compositionally unique compared to previously analyzed ceramics in the MURR database, suggesting that Cunil ceramics were produced and distributed locally in the Belize Valley. While vessels attributed to Groups A and B were primarily decorated types, the Cunil complex sherds in Group D are utilitarian, including unslipped jars and bowls used for daily tasks including water storage and cooking (Sullivan and Awe 2013). The differential distribution of Cunil utilitarian versus decorated serving wares between compositional groups may suggest individual (household) specialized production.

The Middle Prelcassic Kanluk complex ceramic assemblage from Cahal Pech was composed primarily of Jocote Orange-brown utilitarian ceramics and fine Mars Orange Paste serving wares including undecorated and decorated types (e.g., Reforma Incised; Awe 1992; Peniche May 2016). A correlation between compositional groups for Middle Preclassic Jocote vessels and earlier Cunil utilitarian wares suggests persistence in local production of these types for domestic consumption. Typological studies from sites in the Belize Valley have also documented high frequencies of Mars Orange ceramics (~60-50%) in Middle Preclassic ceramic assemblages, possibly suggesting local production within the Belize Valley region (Awe 1992; Gifford 1976; Kosakowsky 2012; Peniche May 2016). Over 77% of the Savana Orange sherds analyzed in this study were assigned to compositional Groups C (*n*=27) and D *(n*=35). These sherds were derived primarily from site core contexts associated with high-status residences and public architecture (Horn 2015; Peniche May 2016). Euclidean Distance searches for the Cahal Pech Mars Orange ceramics within the MURR database identified compositionally similar ceramics from the site of Holtun, located in the central Petén of Guatemala (Figure 8). Non-local Mars Orange sherds from Holtun, also associated with monumental architecture in that site's civic-ceremonial epicenter, formed a distinct compositional group (Group 1; Callaghan et al. 2017). Though Holtun and Cahal Pech assemblages possess similar paste recipes, higher frequencies of Mars Orange paste wares in the Cahal Pech assemblage (77%) versus Holtun region (~12%; Callaghan and Neivens de Estrada 2016), suggest the Belize Valley as the likely origin of the Holtun Mars Orange assemblage.

The Late Preclassic (early/late facet Xakal ceramic phase) at Cahal Pech and sites across the lowlands saw the introduction of distinctive Chicanel style ceramics, characterized by matte or waxy-finish red and black slips (Awe 1992; Gifford 1976). The development of this regional ceramic

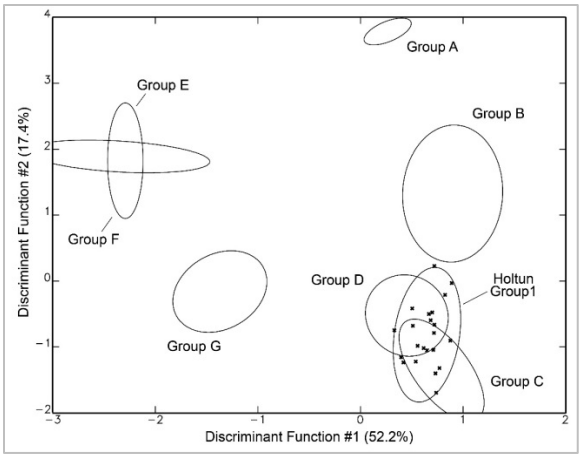

Figure 8. Bivariate plot of Cahal Pech ceramic compositional groups compared Middle Preclassic Group 1 ceramics at Hotlun, Guatemala (after Callaghan et al. 2017) based upon canonical discriminant functions #1 and #2. Ellipses represent 90% confidence of membership for identified groups in the assemblage.

style and more tightly integrated obsidian exchange networks corresponds to the rapid growth of major civic-ceremonial centers (Ebert et al. 2017). At Cahal Pech, a program of large-scale monumental construction occurred in the site epicenter (Plazas A and B; Awe 1992; Healy et al. 2004). Several peripheral settlements also witnessed the construction of larger-scale residential buildings after ~350 cal BC (see Awe 1992:207; Ebert et al. 2016, 2017). The Xakal complex ceramics sampled for INAA in this study derive from contexts at the peripheral Tzutziiy K'in and Zopilote settlement groups (Ebert 2017). The majority (~96%) of these ceramics are restricted to compositional Group G, which includes common Xakal types (Sierra Red, Joventud Red, Sayab Daub-striated) with both utilitarian (e.g., large jars, bowls, spindle whorls) as well as more specialized forms (e.g., serving dishes, spouted vessels). While most of the later samples were derived from household contexts, the correlation between time period and context may have important implications for understanding diachronic patterns of ceramic production and consumption at Cahal Pech, and more broadly within the lowland region. Because our sample from Cahal Pech is derived primarily from peripheral households, Group G ceramics may represent differential production between the households and site core. The shift in paste recipe at Cahal Pech may also correspond to the adoption of Chicanel style ceramics as a result of the development of regional interaction networks. Additional INAA analyses of Late Preclassic ceramics from the Cahal Pech site core and from other Maya sites are necessary to characterize differential production and consumption patterns that may be associated with local tradition and status.

Conclusions

Domestic economies were essential links in local communities to larger regional socio-economic systems among early Maya societies, and household production and exchange likely shaped the function of broader institutional economies (Hirth 2012, 2016). The results of this study indicate that economic networks became increasingly complex and interconnected throughout the Preclassic, with the function of production and exchange varying by the type of goods consumed through time. Both obsidian pXRF and ceramic INAA data indicate that households were self-sufficient and procured or produced most of the items necessary for daily activities. Obsidian source data connect Preclassic households at Cahal Pech to a diversity of economic networks operating between the Belize Valley, highland Guatemala, and highland Mexico. The differential procurement of blades produced from different obsidian types suggests a lack of centralized control over redistribution (e.g., Clark 1987; Santley 1984). Our data show instead that obsidian moved through a network of decentralized exchange relationships operating at the household level. These results indicate that the exchange of finished blades likely did not contribute to unequal economic relationships between households at Cahal Pech. INAA data show that ceramics were differentially consumed through time. Local production of specialized ceramic serving vessels with ideologically significant designs first appear at Cahal Pech during the Early Preclassic Cunil phase, and were produced and consumed locally. The patterning of INAA data also provides evidence for the development of inter-regional exchange of specialized Mars Orange pottery between high-status groups at Cahal Pech and sites in the central Petén. Production and distribution of these specialized vessels may have been used as one strategy by emergent high-status households at Cahal Pech to link people in other regions of the lowlands into networks of interdependency within a

developing institutional economy organized above the level of the household. Future research focused on characterizing obsidian and ceramic assemblages from other Preclassic contexts at Cahal Pech, other Belize Valley sites, and sites across the Maya region will help us reconstruct variation in assemblages may reveal the economic strategies that shaped both local and regional economies and contributed to institutionalized social and economic differentiation.

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