UNCOVERING ANCIENT MAYA EXCHANGE NETWORKS:

USING THE DISTRIBUTIONAL APPROACH TO

INTERPRET OBSIDIAN EXCHANGE AT

ACTUNCAN, BELIZE

by

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A THESIS

Submitted in partial fulfillment of the requirements
for the degree of Master of Arts in
the Department of Anthropology
in the Graduate School of
The University of Alabama

TUSCALOOSA, ALBAMA

2012

ABSTRACT

This study seeks to understand the type of exchange at work at Actuncan, a mid-sized Maya site located in the upper Belize River valley, by examining the distribution of obsidian across households of differing rank. Hirth's (1998) "distributional approach" is applied at Actuncan and later critiqued as an inappropriate model for identifying marketplace exchange at lowland Maya sites. Comparative distributional analyses were conducted on six elite households and six non-elite *plazuela* groups. In addition, the obsidian was evaluated for type and efficiency of production, color, and geological source. The color and source were analyzed in order to better understand whether different types or colors of obsidian were exchanged differently by the ancient Maya of Actuncan.

The evidence provided by this research led to a better understanding of the obsidian sources accessed at Actuncan which include the central Mexican source, Pachuca, and Guatemalan sources: El Chayal, Ixtepeque, and San Martin Jilopeteque. In addition, it became clear that households of all ranks had access to obsidian, but the amount of access varied over time and across space. The data was inconclusive as to the type of exchange occurring at Actuncan, since differing forms of standardization provided inconsistent results. When the results of this study are examined in the light of other investigations at Actuncan, it seems unlikely that marketplace exchange ever emerged at this site, however more research is required before any well supported arguments can be made for or against a marketplace at Actuncan.

LIST OF ABBREVIATIONS AND SYMBOLS

ESRI Environmental Systems Research Institute, Inc.

p Probability associated with getting as extreme or more extreme than observed value if the null hypothesis is correct.

NAA Neutron activation analysis

SPSS Statistical Package for Social Sciences

XRF X-ray fluorescence analysis

ACKNOWLEDGEMENTS

This research could not have been completed without the tireless academic and personal support provided by the faculty at the University of Alabama, my cohort, family, and friends. I had the pleasure of working under one of the hardest working and intelligent people I have ever have ever known, Dr. Lisa J. LeCount. Despite responsibilities to complete her own fieldwork while on sabbatical, she thoroughly reviewed my thesis and was always available to keep me track. I would also like to thank my committee members, Dr. Steven Kosiba, Dr. Jason DeCaro, Dr. Marysia Galbraith, and Dr. Alberto Perez-Huerta for taking time to give me comments on my prospectus that directed the remainder of my research. Dr. Ian Brown also deserves a thank you for his help getting me through the rigorous program and introducing me to new and interesting fields of archaeology.

If it had not been for my cohort, Joe Anderson, Hillary Burt, Denise Gonzalez and Max Stein this certainly would not have been as fun. Their constant encouragement and friendship made my time in Tuscaloosa better than I ever could have expected. Erik Porth taught me what it means to be a friend and colleague by always offering a helping hand and guidance on the tough decisions grad school presents. There are numerous other students in the department who I considered great friends. I appreciate their support and camaraderie.

Last, but certainly not least, I owe my family an enormous thanks and lots of hugs. They have always supported me, even when they did not understand my decisions. And finally, thanks to Logan Elmore, who kept me sane while writing my thesis and was patient when I was overwhelmed.

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Chapter 1: Introduction to the Study

This archaeological study seeks to understand the economy of the ancient Maya, and how it changed over time at Actuncan in Belize, Central America by observing changes in the distribution of obsidian, an imported volcanic glass used for tools, across households. The diachronic study of the distribution of obsidian in households of differing economic status will provide insight as to how access to this imported stone changed over time. Understanding how obsidian was exchanged at Actuncan could lead to further inferences about the overall economy and political system. In addition, this study is applies Hirth's "distributional approach" and assesses its efficacy in regions farther from the geological source of obsidian (Hirth 1998). This model was chosen since it allows for deducible hypotheses, but many have and will argue that the model is too simplistic and the distribution of goods can be affected by many variables not simply exchange.

The ancient Maya, like most ancient societies, practiced multiple forms of exchange, but the primary mechanism for the exchange of long-distance trade items is not fully understood. Current anthropological theories on exchange are informative to archaeologists studying ancient exchange patterns. Anthropologists focus on three main forms of exchange: market exchange, redistribution, and reciprocal exchange. Some archaeologists suggest that these categories are more constrictive than constructive since they force ancient societies into types in which each form of exchange is associated with a specific form of political organization: bands, tribes, chiefdoms, and states (Pauketat 2007; Service 1962). These rigid categories limit our understanding of the complexities of political systems, as a whole, and ancient economies more specifically (Dahlin 2009; Wells 2006). Modern and ancient households participate in multiple forms of acquisition, especially in complex societies such as the Maya (Wells 2006).

Table 1.1. Temporal correlation of Maya time periods to the Gregorian calendar.

Time Period	*Years*
Spanish Contact	~1511
Postclassic	AD 900-1511
Terminal Classic	AD 800-900
Late Classic	AD 600-800
Early Classic	AD 250-600
Late Preclassic	300 BC –AD 250
Middle Preclassic	900-300 BC

Although Spanish accounts document the presence of elaborate marketplaces, many Mayanists argue they could not have arisen until the Postclassic period (Rice 1987; Potter and King 1995). Still, others insist there is evidence of marketplaces among the ancient Maya during the Classic period (Dahlin 2009). Since Spanish accounts were written centuries after the time periods in question, there is no direct evidence for marketplaces among the ancient Maya during the Late and Terminal Classic periods. Determining when and if marketplaces arose at Actuncan, a mid-size site (14.9 ha) located in the upper Belize River valley, will provide important clues as to how increased access to utilitarian and ritual items affected the social status of ancient Maya commoners and elites (Rathje and McGuire 1982).The presence of a marketplace should not preclude the presence of other types of exchange since reciprocal exchange of gifts and redistribution of goods continued after the institution of a marketplace. Nevertheless, marketplaces impacted society by allowing individuals of differing classes to interact through the buying and selling of goods (Blanton et al. 1993). Because in many societies markets foster entrepreneurship, it is possible that some common individuals were finally able to acquire higher socioeconomic status by providing services and goods that were in demand (Braswell 2010). Determining if and when a marketplace arose at Actuncan would greatly impact how archaeologists interpret and understand the ancient Maya in this region.

Marketplaces Among the Ancient Maya

Some scholars support the hypothesis that ancient Maya centers were not only locations of political and economic administration but also home to marketplaces (Keller 2006; Tozzer 1957). Recently, Bruce Dahlin (2009) claims to have identified a marketplace at the Early Classic site of Chunchucmil in Yucatan using two indirect lines of evidence: 1) the distribution of long-distance imports across households and 2) soil chemistry data supporting the existence of concentrated food residues that might be associated with a marketplace. Diane and Arlen Chase (Chase and Chase 1987, 2001) suggest that Caracol in Belize acted as an administrative "hub" where open plazas acted as areas of redistribution or market activity during the Late and Terminal Classic period (A.D. 600-900) . They provide evidence of small, basic constructions that may represent remnants of market stalls (Chase and Chase 1987:52).

Mayanists have also tried to identify marketplaces by examining household activities and the role of various utilitarian items. Marilyn Masson's (2002) study investigates when market exchange became prevalent in the Postclassic period. Her study specifically looks at the quantity of imported tools within households to reveal how the activities within households shifted as the Maya economy changed from the Classic to Postclassic period at the island sites of Laguna de On and Caye Coco in northeastern Belize (Masson 2002). She found an increase in obsidian from Early to Late Postclassic periods while local lithic consumption decreased. She suggests this could be due to an increase in the significance of obsidian. At both sites she found a heavier dependence on obsidian than on local lithic tools for daily tasks. This pattern is counterintuitive since plentiful high quality lithic resources are present nearby and obsidian had to be traded over a long distance from Guatemala. Interestingly, there were no apparent differences in distribution of obsidian between sites or households, which Masson contributes to involvement of people living in both the small village and large center in a market system (Masson 2002).

Others have focused on the quantity of imports at sites within a region to determine how and where obsidian was accessed. Braswell and Glascock (2011) suggest that there were different forms of exchange taking place simultaneously in some large Late Classic Maya capitals, especially at Tikal in Peten Guatemala. As early as the Classic period a marketplace administered by elites offered local and imported goods to the greater Tikal community, the largest Maya site in the lowlands. Evidence for this is seen in the massive quantity of obsidian brought into Tikal from the highlands and the lack of obsidian found at nearby Calakmul, a competing polity (Braswell and Glascock 2011:129). Tikal elites had the ability to control how much surplus was allowed into the marketplace and who as allowed to access it. Alternatively at Copán, located in the southeastern periphery of the Maya lowlands, elite control of obsidian limited access of this good to commoners until the Postclassic period (Aoyama 2011). Based on these studies of the ancient Maya, it can be suggested that the impetus of market exchange occurred differently at site and regional scales.

Some have argued for marketplaces at mid-sized sites such as Xunantunich and Buenavista del Cayo in the upper Belize River valley, but the studies have been limited in number and scale (Cap 2011; Garcia 2008; Keller 2006). In addition, the data are ambiguous.

During portions of the Late Classic period Xunantunich acted as the provincial capital in this region under the tutelage of Naranjo, the center of a large state located about 15 km west. Keller (2006) provides architectural and lithic evidence she interprets as "market-related production". She believes the marketplace was located in the Lost Plaza section of the north of Sacbe II where large quantities of production-related lithic debris were excavated (Keller 2006:71). At Buenavista del Cayo, Bernadette Cap (2011) used a combination of methodologies, including architectural and activity area analysis. She found evidence that the East Plaza was the locus of a marketplace where chert bifaces, obsidian blades, and likely other perishable items were sold in distinct areas of the plaza. The data provided in these studies provides direct evidence for production, but it is difficult to make the leap from production to marketplace without other direct indicators of market exchange.

Krista Garcia (2008) examined the local pottery from Actuncan, Xunantunich, and San Lorenzo to see if stylistic attributes and paste composition became more standardized during the Late and Terminal Classic periods. She suggests that marketplace exchange would have led to specialized production of local pottery for sale in the marketplace because full-time craft specialists at workshops would likely standardize methods of production to enable more efficient production of goods (Garcia 2008). Unfortunately, Garcia did not find significant evidence to suggest the presence of marketplace exchange.

These previous studies have contributed greatly to the current understanding of market exchange in provincial capitals, but they have not been conclusive. Garcia's study seems to contradict Keller's findings about the presence of a marketplace and neither provides direct evidence. My study of long-distance imports at Actuncan could be more revealing than studying locally made goods since formal arrangements are necessary for their movement and exchange.

Obsidian is an excellent artifact for this purpose since it preserves well in the archaeological record and was consumed throughout the Maya area. In addition, it is easily identified to its initial geological source which allows for a better understanding of trade routes and relationships. Thus far, obsidian has not been studied for this purpose in the upper Belize River valley.

Models of Market Exchange

In the last few decades archaeologists have devised many models from which testable hypotheses can be deduced to explore exchange. Currently, the most methodologically rigorous archaeological model of exchange relations is Kenneth Hirth's (1998) "distributional approach" for identifying modes of exchange in ancient societies, specifically those in Mesoamerica. He assumes that households produce many of the resources they consume, but rarely do they produce everything necessary for survival (Hirth 1998:454). Therefore, households had to procure some resources from others. According to Hirth, in a marketplace individuals interact through buying and selling of basic commodities, items bought and sold regularly in a society, regardless of their social rank. Therefore, markets permit well-organized dispersal of goods throughout a society with individuals of any rank having equal access to some commodities. In the archaeological record, marketplace exchange is identified through the relatively even distribution of artifacts across residences of differing socioeconomic status (Hirth 1998).

Marketplace exchange can be distinguished from other forms of exchange based on the distribution of goods. Redistribution is the collection of goods by elites through taxation or tribute to fund community projects and political institutions. The leader often rations necessities to the population as he sees fit while limiting access to certain resources to small number of households that are supporters of the state (Dahlin et al. 2007; Garraty 2010). Carol Smith

(1976) defines this type of exchange as taking place between a 'high-status individual" and one or more subordinate individuals. While redistribution does provide a centralized flow of goods, it does not always allow each household to access resources. In addition, resources were often hoarded by the controlling authority rather than distributed to the group as a whole (Hirth 1998). This situation can be seen in the Bunyoro of western Uganda. There, people were required to give the king large quantities of food, goods, and services (Ember and Ember 2007:119). The king passed on resources and land rights to his subordinate chiefs who then granted them to common people at their discretion. The king often retained much of the wealth for this kin, while the rest was distributed among his subordinates. Very little resources ever made it back to the common people (Ember and Ember 2007:119).

Hirth (1998:455) suggests that redistribution "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." Garraty (2009) explains that since political relationships define how redistribution occurs, this will be reflected in how products are distributed. Redistribution might allow for some small scale uniformity (mainly in imported items) by households sharing the same political linkages, while a market would show that all households over a large region share a single, uniform provisioning source. In other words, with redistribution there will likely be a disparity between households of varying socioeconomic status. Further, concrete evidence of redistribution would exist in the form of state controlled storehouses (Renfrew 1975).

Reciprocity is a form of exchange seen in all societies. Reciprocity is defined as "giving and taking without use of money" (Ember and Ember 2007:114). Often times this occurs as gift giving, other times as generalized reciprocity where the gift is given with no expectation of a return gift. Even in such apparently altruistic instances sharing is often helpful in the long run because those who share are more likely to benefit from another person's generosity. Balanced reciprocal exchange involves two or more producers exchanging equitable goods directly (Ember and Ember 2007:116; Smith 1976). Because these exchanges are often bound by gift-giving obligations established through long-time trade partnerships and kin relationships, they limit the circulation of goods within a given society, especially long-distance trade items, in comparison with the more open circulation of items in market societies, because buying and selling stimulate exchange and promote production (Garraty 2010; Hirth 1998; Smith 1976).

In the archaeological record, reciprocal exchange can be distinguished from redistribution based on the kinds and frequencies of artifacts within households (Blanton et al. 1993; Hirth 1998). Households limited to reciprocal exchanges display fewer kinds of items from fewer sources than those who are involved in redistribution due to limited spheres of exchange (Hirth 1998:455). Therefore, each household would likely have only a few types of imports, household assemblages should be fairly uniform in the amount of imports they have. However, differences between the sources of these imports could be quite variable between households because individual families may receive locally-made goods from a narrow set of kin and imports from different trade partners (Hirth 1998:455). This may not be true in societies where reciprocal exchanges are more open and involve dozens of trade partners. During the Colonial period, the Iroquois of North America traded deerskin to Europeans in exchange for brass kettles, iron hinges, steel axes, woven textiles, and guns (Ember and Ember 2007:116). While they may have had to limit their exchanges to one European group, either English, French, or Spanish, each Iroquois group likely had multiple trading partners; however, none of them lasted long periods of time. In such cases, it might be difficult to decipher this type of exchange from gift-giving or markets based solely on the distribution of goods. Garraty (2009) also notes that kin-based exchange can also produce uniformity but not on the same scale as marketplace exchange (Blanton et al. 1993).

While quantity of artifacts is often equated with access, variable quantities of artifacts could be the result of accumulated wealth that allows some households, often elite, to purchase more (Hirth 1998). Quality, which is often appraised by the rarity source or appearance of the item, is also important since it is possible that higher quality goods were only distributed within a certain strata of society. I would suggest that if elites controlled the distribution of goods, it is probable that they would retain the highest quality items for themselves. Similarly, in reciprocal exchange, those with access to higher quality goods only exchange with households in the same social stratum so the highest quality items stay within that stratum. Reciprocal exchange might allow for individuals to access whatever quantity of goods they like, but it would be difficult to access goods of higher quality than those traded in their segment of society. Market exchange differs from both redistribution and reciprocal exchange in that it allows individuals to interact with multiple vendors offering a variety of goods. While elites may still restrict access to the highest quality products, this does not necessarily imply that others were not offered similar opportunity to purchase these items in a market society (Hirth 1998). The only limiting factor in this situation would have been price.

Exchange networks can be seen in the archaeological record through a number of different techniques besides the distributional approach. Since marketplaces were often organized into craft-specific sections, including metalworkers, weavers, potters, and flint knappers, some archaeologists prefer a *configurational* approach that involves locating a particular area that appears suitable for a marketplace through its ease of access, architecture, and central location (Dahlin et. al 2007; Hirth 1998; Potter and King 1995). Similarly, some apply a *contextual* approach in which the type of exchange is inferred from cultural features often associated with markets that appear to require organization and allocation, such as the presence of large cities and craft specialists. This approach has inherent weaknesses in that it makes the inference that marketplaces may have emerged as a result of urban growth rather than actually examining the specific contexts of market exchange (Hirth 1998). The *spatial* approach is another common technique that attempts to reconstruct ancient exchange patterns based on the tracking of certain commodities from the source of their production to their ultimate location of consumption. But this approach only informs the researcher that the item was, in fact, imported. The spatial approach does not reveal the mechanism of exchange, rather it simply informs us that exchange did take place and the distance items were required to travel before arriving at the site (Garcia 2008; Hirth 1998).

Obsidian: An Ancient Maya Import and Possible Commodity

Commodity is a term normally reserved for economic studies and is defined as an item that is bought and sold regularly with a standardized value (Appadurai 1986; Gregory 1997). Items can be traded without being commodities. In addition, it is possible for an item or resource to be a commodity in some societies or time periods and not in others. Commodity exchange is defined by Gregory (1982:12) as the trade of goods between independent groups or individuals, which separates it from reciprocal and redistributional exchanges because no prior relationship is required.

This study seeks to understand if and when obsidian became a commodity in the upper Belize River valley. Obsidian is a volcanic, silicate glass that fractures in a highly predictable manner making it ideal for use as a fine-cutting tool. While obsidian was clearly used for tasks including scraping hides, shaving, and hunting, it was also used in ritual contexts for blood-letting ceremonies (Dreiss 1988; Moholy-Nagy 2003). Its use was ubiquitous in ancient Mesoamerica and in many other regions of the world including the Mediterranean and American West. Obsidian is popular in archaeological studies because it is not affected by decompositional processes. In addition, it can be sourced to its geological origin using chemical and visual analyses and easily located in use-contexts at archaeological sites (Hammond 1972; Hirth and Andrews 2002). Archaeologists, therefore, can reconstruct the chain of exchanges from producer to consumer, making obsidian an ideal artifact with which to study markets.

In Mesoamerica, the only known obsidian sources are located in the highlands of Guatemala and Central Mexico, yet this artifact is found at sites hundreds of kilometers from these locales. In lowland Maya sites, three Guatemalan outcroppings dominate the obsidian assemblage: El Chayal, Ixtepeque, and San Martin Jilotepeque (Braswell 2003; Brown et al. 2004; Dreiss et al. 1993; Hammond 1972; Sidrys 1979). In addition, Pachuca, green obsidian from the Teotihuacan region of central Mexico, is found in low frequencies at many sites throughout Mesoamerica (Asaro et al 1978; Hammond 1976; Nelson 1985). Since the geological source is far removed from areas of consumption, long-distance trade was required to distribute this resource throughout Mesoamerica (Hammond 1976; Nelson 1985). The high frequency of obsidian found at Mesoamerican sites provide evidence that there was an organized exchange system that circulated this good, not simply down-the-line trading as seen for prestige goods in many smaller-scale societies. This leads archaeologists to question the mode of exchange for obsidian in Mesoamerica. Perhaps market forces controlled the distribution of obsidian with motivated merchants transporting the commodity over great distance with the goal of increasing their own wealth (Hirth 1998; Dahlin 2009; Wells 2006). Alternatively, the system may have been controlled by a complex elite or kin-based trade network with organized routes and relationships. Raymond Sidrys (1976) argues that central place redistribution determined how obsidian was distributed at lowland Classic Maya sites. In addition, he purports that it was a high status commodity conspicuously consumed for political and ritual acts since obsidian is found concentrated in residences of wealthy individuals or used in burials and caches. While others claim to have found even or random distribution of obsidian within sites (Rathje 1972; Moholy-Nagy 1974). Sidrys (1976) attributes this to their confusion between presence of obsidian and quantity of obsidian. Sidrys asserts that while there may be small quantities of obsidian in random areas of a site, it will not be evenly distributed.

Examining the quantity and quality of obsidian used through time can lead to a better understanding of how Maya economy, in general, and exchange, specifically, changed over time in the central lowlands, perhaps leading to the rise of marketplaces. Since the type of exchange was likely dependent on political organization, it is important to view how it changed over time while acknowledging assumptions about the changing authority and political environment at sites across a range of sizes and times. Actuncan is a good candidate for this study since it will give a clearer view of how the majority of people accessed goods in ancient Maya society, which was likely very different from the way people accessed goods in very large political centers such as Tikal.

Economy and Politics at Actuncan

Actuncan sits almost 50 meters above the Rio Mopán, a tributary to the Belize River that flows from the west. The site overlooks the river and the bottomlands. The site was occupied for nearly 2,000 years, and has held shifting levels of influence during this time (LeCount and Keller 2011; McGovern 2004). Its initial occupation began in the early Middle Preclassic period (1000-

300 B.C.) and persisted until its abandonment during the Terminal Classic period (A.D. 800 to 1000).

James McGovern surveyed and mapped the site in 1993 and counted at least eighty structures concentrated around seven plazas. McGovern (2004) asserts that Actuncan showed a great deal of political autonomy and power in the Late Preclassic and Early Classic periods, a time when it shared links with a handful other developing sites in the Belize River Valley. The city's power was lost when large political centers outside the valley, including Naranjo in Guatemala, rose to power and wielded power over smaller centers throughout the Maya lowlands during the Late Classic period (A. D. 600-850). In addition, nearby centers such as Xunantunich and Buenavista del Cayo gained power that greatly limited the political autonomy once present at Actuncan (LeCount and Yaeger 2010).

In 2001, Lisa LeCount initiated new excavations and mapping at Actuncan North, an area containing ritual, administrative, elite-residential, non-elite domestic, and special purpose structures (Figure 1.2). The Actuncan Archaeological Project, directed by LeCount, aims to understand the role of households in the rise of divine kingship (LeCount and Blitz 2002; LeCount et al. 2005). Over the course of four field seasons, the project has focused on excavating noble, elite and commoner households thus providing distributional data.

Chase and Chase (1992) argue that too often the term elite is used without defining what archaeological signatures define an elite and the role they played in society. In this study, elites were selected based on household architecture, proximity to civic center, and wealth seen through artifacts. In addition, Mayanists assume that elites held an ascribed status and were likely separated from non-elite in most daily activities (Chase and Chase 1992). Nonetheless, the non-elite households analyzed at Actuncan were likely still quite prosperous. While the individuals do not appear to have been ascribed elite status, Group 1, the largest non-elite household at Actuncan, is situated near the plaza and civic buildings on large house mounds that required substantial resources (LeCount et al.2005). In fact, many of the household groups are located very close to civic architecture, including a noble palace, indicating that the families who lived at these places were closely aligned with Actuncan elites. In addition, they occupied this central location for several centuries. It is also important to note that Group 1 predates some elite households, including Structures 29 and 41. According to LeCount and colleagues (2005), elite families likely prospered during the rise of kingship, while the power of commoner families, such as those at Group 1, rose and fell during the Classic period.

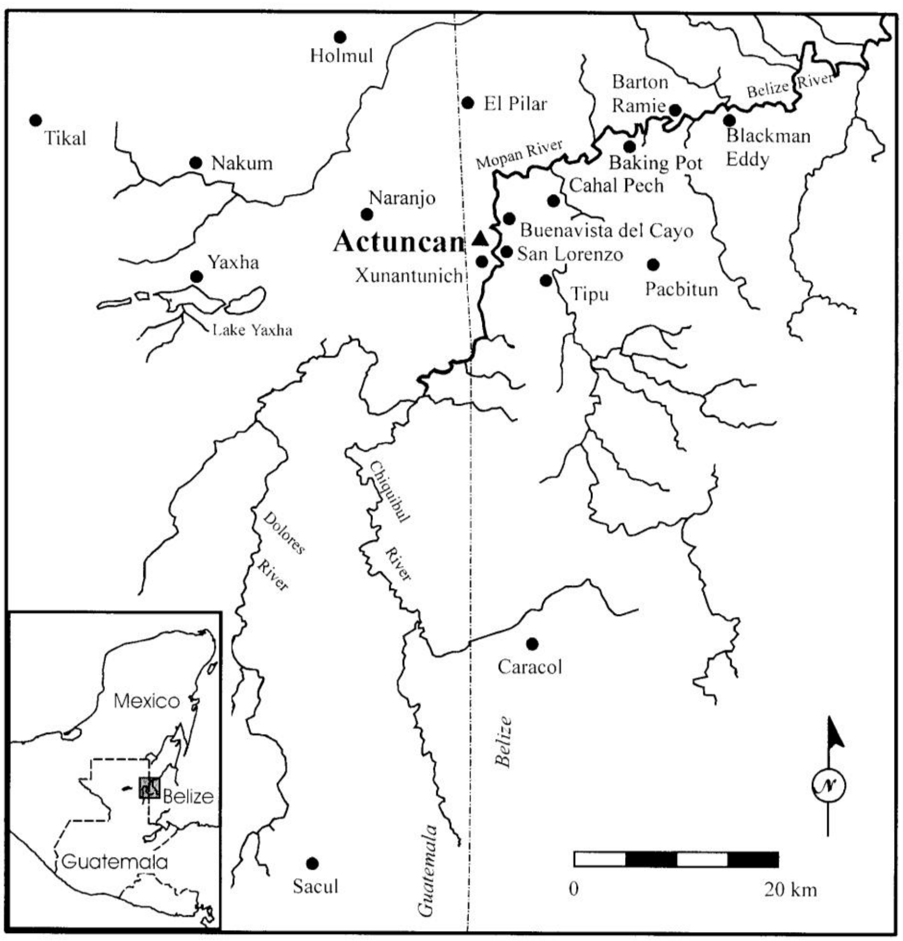

Figure 1.1. Map showing ancient Maya sites Upper Belize River valley.
Used with permission of Lisa LeCount

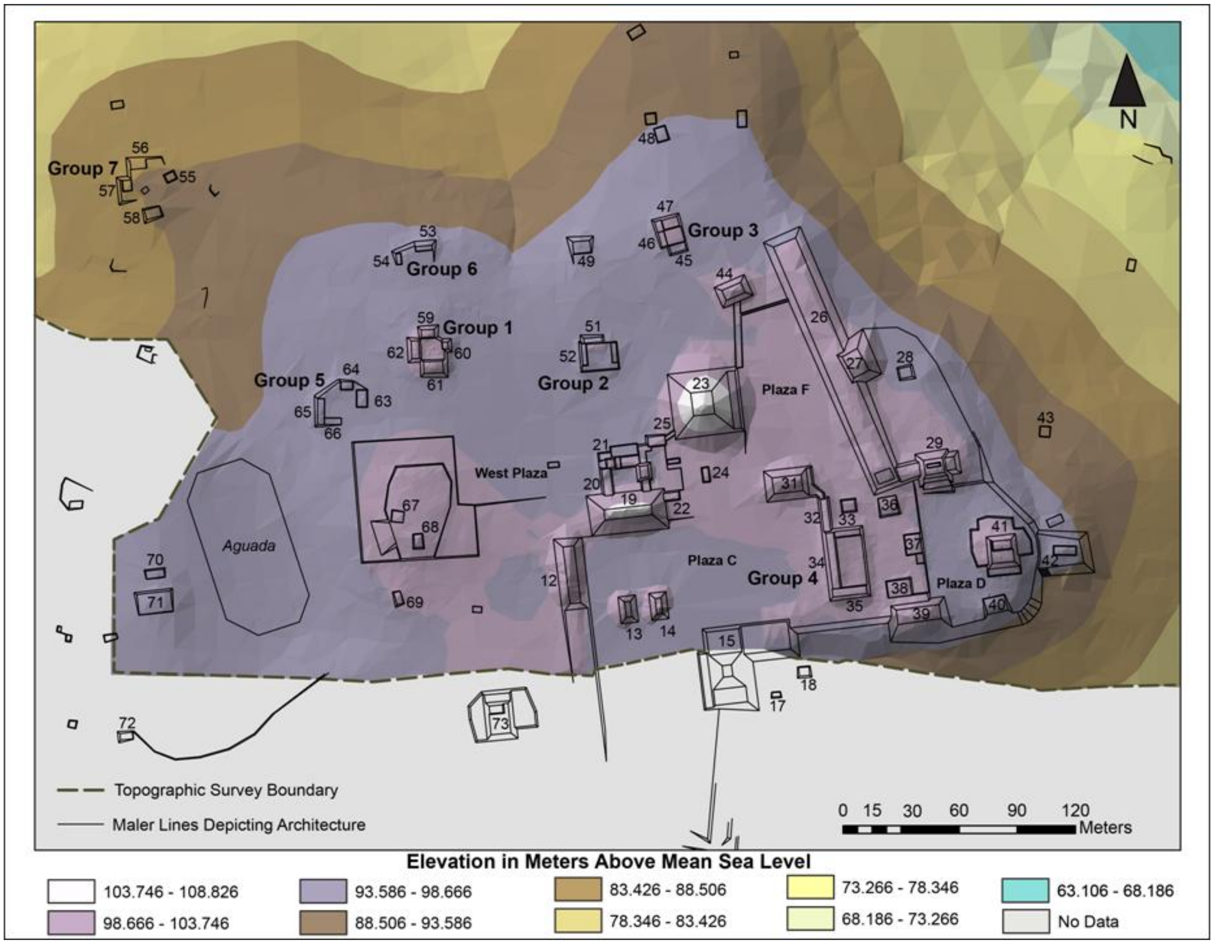

Figure 1.2. Map of Actuncan North showing elevation and features at the site. The area gray in color indicates the extent of the topographic survey.

The people living at Group 1, along with others, are considered non-elite, but this should not imply that they were economically powerless. It is likely that they had enough affluence to obtain long-distance goods in markets or well-connected to kin-based trade partners (LeCount et al.2005). This study seeks to understand whether the elite controlled the exchange of goods like obsidian, and when, or if, obsidian became a commodity. If elites did administer the circulation of obsidian, Actuncan's common households should have significantly lower frequencies of obsidian than elite households. Alternatively, if a market was the main means of obsidian circulation, then we should expect both groups to access these goods as needed. Commoner access should increase during the Late and Terminal Classic periods since that is when marketplaces most often arise at other sites.

Methodologies

Three primary methods of inquiry were used to examine the mechanisms of exchange that transported obsidian to Actuncan households from distant sources. First, the distribution of obsidian at households was examined by applying Hirth's (1998) "distributional approach"; however, the methodology in the present study differs from Hirth's on three points. First, I look at the distribution of obsidian diachronically, since it allows for comparison of how this valued item was accessed during different time periods. This methodology allows me to reconstruct the different ways obsidian was exchanged through time and when, or if, obsidian became a commodity at the site. In addition, rather than looking at both imported ceramics and obsidian as Hirth (1998) did in Oaxaca, I focus exclusively on obsidian. Krista Garcia (2008) conducted a regional study of local ceramic types, including those found at Actuncan, but there has not been a systematic study of imported items – obsidian or ceramics - at the site. Due to the limitations of thesis research, I was only able to examine one artifact type, but will refer to Garcia's previous research in my conclusions.

Second, I conducted a study of the form, size, color, and type of fragment for each obsidian artifact in the Actuncan collection in order to understand how the obsidian objects were being produced and used at the site. The size of the prismatic blade can be revealing as to the efficiency with which it was produced, and color was crucial in determining the source. A quantitative approach that involves obsidian densities (obsidian weight standardized by volume of dirt excavated), obsidian-to-sherd ratios, or obsidian-to-chert ratios, as well as cutting edge-to-mass (CE/M) ratio which indicate the efficiency of blade production, specifically using as little raw obsidian as possible to make the blades (Fowler 1992). These studies operate under the assumption that long-distance trade items will be scarce in comparison to locally made goods, and if elites were in control of exchange, there should be evidence in elite residences for blade production and larger, more lustrous blades. This research was conducted in Belize at the Actuncan Archaeological Project's lab during the first week of July in 2011.

Third, I examine the physical source of obsidian used at Actuncan using a combination of chemical and visual sourcing in order to understand the nature of its exchange. Chemical sourcing of obsidian found at ancient sites can be achieved using x-ray fluorescence analysis (XRF) or neutron activation analysis (NAA) that create chemical groups that are matched to samples of obsidian extracted from quarries (Fowler 1991; Sidrys 1976). Chemicals are highly consistent within each particular geological outcropping. Obsidian from ancient Maya sites has been sourced to outcroppings in Guatemala, Honduras, and Mexico. In this study, a combination of these approaches is applied.

I wanted to better understand the use of varying colors and sources of obsidian at the site, so that I could see if elites had control of certain types of high-value obsidian, like Pachuca, that was never circulated in markets. I initially sorted the assemblage into nine color categories based on refracted color, reflected color, texture, and types of inclusions. Then, I used these groups as the basis for a stratified random sample of 27 pieces that were sent for XRF analysis at the Institute for Integrative Research in Materials, Environments, and Society (IIRMES) at California State University Long Beach under the supervision of Hector Neff. The chemical source for each color group was applied heuristically to the remaining members of the visually identified color group to reconstruct the frequency of each source within households across time.

Since a comparative collection was not available and this was my first time visually sourcing, there are likely errors, but it was the best data that could be achieved on a limited budget.

Reconstructing Exchange Patterns at Actuncan

After all the data were collected and organized, I divided the data into broad time periods: Middle Preclassic, Late Preclassic, Early Classic, Late Classic, Terminal Classic, and Postclassic periods based on ceramic data of excavation proveniences. Next, I standardized obsidian counts and weights by ceramics counts and weights, lithic counts and weights, and volume, for each group and individual structure. I produced both tabulated data and maps to document the distribution of obsidian through time and across space. For more data about the distribution of obsidian across households and through time, see Chapter 5. Analysis revealed a consistent, yet surprising, trend that will be documented in Chapter 5 and discussed in Chapter 6. This study has led to a better understanding of obsidian trade and political economy at Actuncan and how it changed through time. Further research should explore the distribution of imported pottery to verify the results of this study.

Chapter 2: Significance of the Study

The role of states in the administration of the ancient production and exchange of long-distance goods is still quite unclear to archaeologists (Aoyama 2011). The predominant model in archaeology is that control over long-distance trade goods by elites was an important factor in the evolution of political systems (Hirth 1996). Although archaeologists postulate that political power was based on the control of food and subsistence resources in ancient societies, they admit that the exchange of long-distance goods may have had a greater impact on the evolution of societies since a more organized and interconnected administration was required to control long-distance trade goods (Aoyama 2001; Earle 2002; Hirth 1996).

Determining the mechanism of exchange used by the ancient Maya for long-distance trade items will be helpful in determining the role of elite administration in economic transactions (Blanton et al. 1993; Hirth 1996). While market exchange is the most efficient way of moving goods across the landscape, it is unclear if this was, in fact, the mechanism of exchange preferred by the ancient Maya during the Classic period (Hirth 1996).

Archaeologists have developed ways of understanding exchange systems first defined by anthropologists from their studies of living societies. Types of exchange are seen through the visibility of supply and demand forces (Pryor 1977). When exchange is controlled by supply and demand, participation is voluntary. Transactions are solicited, but individuals can choose to welcome or refuse these solicitations without social repercussions (Pryor 1977). In a system subject to forces of supply and demand, entrepreneurship flourishes since it allows for individuals to increase their wealth. In a market system, supply and demand forces are clearly visible, but in systems using reciprocal exchange supply and demand is dampened by social structures of society that determine what, when, and with whom items can be exchanged. While participation can be voluntary, the exchange ratio is fixed and enforced either socially or by higher authority (Pryor 1977).

According to Polanyi (2001 [1944]) forms of exchange are largely a result of the society from which they arise, since different types of exchange require different levels of centralization. For him, market exchange largely occurs in highly organized and complex societies, but it is not the cause of this organization. Rather, market exchange is the result of population increase that allows for craft specialization, as well as demand for resources not easily accessible in the region (Polanyi 2001[1944]). On the same note, redistribution implies a central force for the collecting and redistributing of goods, but like markets, redistribution was already in existence before centralizing authority and complex societies developed (Polanyi 1957).

Reciprocity functions on the symmetry, or duality, that exists in many social systems (Polanyi 2001[1944]). Trade partners are generally found in a similar social position and often within the same kin group. While there is no money or bartering involved, reciprocity is still a form of exchange and a highly complicated one, at that. In reciprocal exchanges of long-distance trade goods, each village, or individual, has its counterpart in another region. For example, in the Kula of the Trobriand Islands each individual has trading partners on other islands with whom they exchange ornamental jewelry (Malinowski 1950). Trading partnerships are life-long, and violating the rules of Kula does not go unpunished. The basis of the Kula exchange relations is that gifts remain in circulation throughout the islands like a ring. If someone were to violate these rules by passing the jewelry in an inappropriate direction or keeping the jewelry for longer than is fair, the entire system would be affected. Therefore, people generally played by the rules and exchanged only within their socially defined boundaries.

Redistribution relies on a central force that collects, stores, and redistributes goods and services to all who are under the central leader. It implies a mandatory payment of some kind to a central authority which uses these resources to support leadership positions and fund public works (Dalton 1975). In foraging societies redistribution can be seen when a hunting group brings their kill directly to the headman who distributes it among the villagers. Many times this ruler uses the distribution of goods as a way to gain power by fostering a feeling of indebtedness. Often the person who performs the redistribution, whether it be an individual, family, or bureaucrat, will use this as an opportunity to increase his or her political influence by strategically redistributing in a way that will benefit them most (Polanyi 2001[1944]). Redistribution is also seen in larger, more organized societies in the form of taxation or tribute. From Babylonia to the New Kingdom of Egypt, all complex societies and large-scale economies practiced redistribution in some form (Polanyi 2001[1944]). For the Greco-Romans, the tax was grain, and Americans today pay monetary taxes. These taxes go to fund building projects, protect borders and to support the government infrastructure.

When discussing market exchange, it is important to define the term market exchange and how it differs from a marketplace or market economy. Unfortunately, even economists have struggled to clearly distinguish among these systems (Pryor 1977). Polanyi (2001[1944]) was a pioneer in discussing markets in the anthropological literature. He defined a market and marketplace in much the same way - the location in which individuals barter, buy, or sell. Market exchange differs from marketplace exchange in that market exchange can take place outside of a market. Marketplace exchange, on the other hand, is used to describe those transactions that take place at a regularly scheduled location which is the marketplace. Marketplaces are direct evidence of market exchange that have become a fixture, or institution, within society. According to Polanyi (2001 [1944]), in order for market exchange to have a large effect on the overall nature of society, exchanges must be recurring and standardized in a way that results in the effective regulation of prices. Once prices have been standardized through an agreement of equivalencies, a marketplace has been formed and marketplace exchange occurs. Marketplace exchanges are often considered contractual because the buyer and the seller understand the formal rules or "contract" of exchange.

Hirth (1998) and Garraty (2009) also make a clear distinction between "markets," as a place, "market exchange" as a mode of exchange, and "marketplace exchange" as contractual transactions occurring in a specific location. For them, market exchange implies negotiated exchange, or buying and selling, wherever it may take place. Market exchanges, in the form of travelling merchants, were likely occurring long before there was a formal marketplace. Unlike many forms of exchange, involvement was voluntary (Pryor 1977). In markets, there is no social expectation to participate or reciprocate. In this study, I am searching for evidence of "marketplace exchange", since it implies an established and reoccurring system of market exchange that would have had a greater effect on the distribution of resources in the society than "market exchanges" that could have taken place occasionally when individuals interacted with merchants. The terms "marketplace" and "market exchange" address the differences between structural and situational buying and selling.

Long-distance trade may have led to the formation of marketplaces, since marketplaces are the primary places where long-distance trade converged (Polanyi 1957; Pryor 1977). Local trade could have occurred between individuals without need for a marketplace, but when demand created a larger influx of imported goods, a central location for exchange was needed. External trade is not subject to kinship relations, so this situation allows rules of balanced reciprocity to be overlooked (Pryor 1977). In addition, goods are imported using long-distance trade when they are unavailable locally. If the demand for such material is great enough, the rules of supply and demand would override any social repercussions of negative reciprocity (Pryor 1997:110).

Polanyi (2001[1944]:45) described a market economy as a "self-regulating system of markets". For him, this type of economy is controlled solely by market value, and therefore does not require regulation. Based on this set of parameters, no society prior to the industrial revolution practiced such an economy. Ancient Mesoamerican groups, such the Maya or Aztec, likely had markets, but their role within society was incidental and marketplaces did not effectively alter the subsistence or political economy. Most Mayanists would disagree with Polanyi on many of these assumptions (Blanton et al. 1993:28-31).

In many forms of market exchange, the connection between producer and consumer is indirect, because merchants or middlemen act as intermediaries (Braswell 2010). In administered market exchange, political leaders control commerce. (Braswell 2010; Hirth 1998; Smith 1976). Braswell (2010:130) states that producers supply middlemen goods based on demand, but elites control middlemen by extracting surplus items and regulating "who, when where, what, and how much trade takes place." In general, elites control how goods are retailed but are not involved in production. Alternatively, in commercial market exchange, such as that found in Western capitalist societies, the retail value of goods is determined solely by the market forces of supply and demand (Braswell 2010:131). Competitive market systems are unbounded and can cover large territories (Braswell 2010:132). Some archaeologists today suggest that all ancient markets were administered, because it seems unlikely that ancient markets in the Mesoamerica ever fully relied on supply and demand to determine value as is seen in modern societies (Braswell 2010; Braswell and Glascock 2011).

Identifying Ancient Exchange Systems

Kenneth Hirth (1984, 1996, 1998, 2008) has conducted numerous studies on ancient trade and exchange, particularly obsidian exchange, in Mesoamerica. He proposes the distributional approach for identifying types of exchanges in these societies (Hirth 1998). Hirth (1998) initially developed this approach while working at the Epiclassic center of Xochicalco in highland central Mexico. This site was abruptly abandoned due to warfare; therefore, artifacts were left on the ground surface. In his study of 118 houses, he conducted surface surveys and compared artifact assemblages. He also examined obsidian workshops near the site to determine the types of sources being worked and whether workshops control access to sources. He anticipated finding homogeneity in the distribution of imported goods, like obsidian, that would indicate that these items were commodities. He also expected to see more variation between high and low status households as a result of "purchasing power", but in his opinion these differences would be negligible (Hirth 1998:456).

Hirth (1998) documented that Xochicalco had three large plazas located along roads with potential administrative buildings and asserted that these conditions make them likely candidates for marketplaces. In addition Xochicalo is located in a relatively unproductive agricultural area but had a large urban population. Hirth asserts that these two factors would have required some provisioning through a marketplace. In addition, seven obsidian production workshops were identified, all of which showed evidence of craft specialization. Still, Hirth (1998) required more evidence before he could confidently identify a marketplace at Xochicalco, which is why he developed the “distributional approach”.

Hirth (1998) explored the distribution of both imported ceramics and obsidian to better understand market exchange at the site. Imported ceramics constituted 3 to 6 percent of the household ceramic assemblage at Xochicalco. While they were affordable enough to be found in most households, they were likely more expensive than local vessels of similar quality due to transportation costs. Had the cost of imported ceramics been very high, it would be difficult to distinguish an expensive marketplace purchase, from redistribution or gift exchange since elites would probably have been the only ones wealthy enough to purchase such items. Analysis of variance was used to compare the mean frequencies of imported ceramics at 14 elites and 60 “ordinary” houses (Hirth 1998:461). He found no significant difference in the percentage of imports, density of imports, or density of imported service-ware bowls. While a higher frequency of imported ceramics were often found at elite households, this appears to be a result of larger house size. When houses were regrouped by house size, rather than status, analysis of variance revealed no significant difference in density of imports or the ratio of imports to total ceramics. Hirth (1998) suggests that this shows that imported ceramics entered the site as consumer goods, rather than prestige goods.

Similar results were found when Hirth (1998:462) examined the distribution of obsidian tools in domestic contexts at Xochicalco. He decided there were three possibilities for how households acquired obsidian: (1) reciprocal exchange as a form of direct procurement, (2) elite redistribution (through the control of both workshop production and distribution), or (3) exchange in a marketplace. He then laid out archaeological conditions for each of these possibilities.

If reciprocal exchange was the primary means of procurement, then obsidian from a domestic context should be of the same type, or source, as the type produced at the workshop. Variation between households would display variation between workshops. He assumed that households would procure obsidian from the nearest workshop, if all other things were equal. If elites were distributing the obsidian to households, then an alternate scenario should arise in the archaeological record (Hirth 1998). Elite households should have the highest quantity and/or diversity of obsidian. Access would be determined by social, rather than physical, distance from elite households (Hirth 1998). The third alternative seen in the archaeological record would be a result of marketplace exchange. Households will procure obsidian as needed, regardless of social rank.

After reviewing the production debris from seven workshops, Hirth concluded that there was variation in production technology and obsidian sources used, but all of the workshops were producing prismatic blades and the same set of tools fashion from modified blades. Obsidian at Xochicalco came primarily from three sources: Ucareo, Zacualtipan, and Pachuca. Pachuca stands out as green obsidian, but Ucareo and Zacualtipan are both gray. It was clear after comparing sources used in production at the workshops that the workshops were accessing their source supply independently of one another. Operation H stood out among the workshops because its proportion of Pachuca obsidian was 24 percent, while the other workshops ranged from 0.1 to 10.5 percent (Hirth 1998).

Since workshops were clearly procuring their resources independently, if households procured their obsidian through direct reciprocal exchange then this should be clear in the distribution of sources across households. Households should have the same color obsidian as nearby workshops. If households relied on elite distribution then elite households linked to workshop H should have noticeably more Pachuca obsidian (Hirth 1998:463). Since the quality of the green and gray obsidians is the same, its preference is largely ideological, so marketplace exchange should create homogeneity in the distribution of Pachuca obsidian among all households. The results of Hirth's statistical analyses showed that all household at Xochicalco had equal access to green and gray obsidian, despite their location in relationship to the workshops. The combination of these lines of evidence led Hirth to conclude that marketplaces were an important part of the economy at Xochicalco during the Epiclassic period.

Hirth (1998) also provides contextual and configurational evidence for a marketplace at Xochicalco. He suggests that the size and context of the site located in an unsuccessful agricultural area promoted the involvement in a marketplace because crafts people could trade their products for food. He suggests that three plazas located near roads within in the site could have been marketplaces. Nonetheless, he feels this indirect evidence is not strong enough to support the hypothesis of a marketplace at the site, but that these data combined with his distributional evidence would provide a more convincing case (Hirth 1998).

Many scholars have critiqued Hirth's "distributional approach" because he did not compare his distributional results to a site with a known marketplace in order to verify that his assumptions pertaining to the distribution of artifacts across households were indeed correct (Smith 1999). Michael Smith (1999) published a helpful critique in which he demonstrates how the Aztec site of Morelos in Mexico would be a good comparative site in which to document the inventory of artifacts expected in an area known to have marketplace. Historic documents, as well as the high incidence of imported goods at the site, testify to the presence of marketplaces at the capital of Morelos and in surrounding settlements. He tabulated ceramic data from commoner and elite households dating from A.D 1350-1440 that confirms Hirth's model. The quantity of other imported items, like stone beads, bronze needles, and bells, also support the idea that marketing impacted the types and quantities of goods households accessed (Smith 1999). Overall, Smith supports Hirth's model, but he feels it will be difficult to the find the same patterns that Hirth found at Xochicalco at other sites. Xochicalco is an odd case in that the site was abandoned abruptly during the Postclassic period with artifacts left lying on the ground offering a clear view of life during this time period. In addition, Xochicalco is located within a reasonable distance to obsidian sources. Therefore, obsidian could be accessed with fewer middlemen than are necessary in many other parts of Mesoamerica.

Others have critiqued the way Hirth characterizes marketplaces. Hassig (1998) and Wilk (1998) contend that marketplaces come in varying forms, frequencies, and importance. They argue that while the presence of a marketplace in an urban setting may always have similar effects, in rural settings where market dependence is quite low, the effects of a marketplace may not be detectable. Plunkett (1998) questioned whether elites *should* have more obsidian than commoners, in both market and non-market societies, as Hirth asserts. She argues that commoners are craftspeople who scrape hides, make sandals, grate pigments, and produce crafts for sale in the market; therefore, they require more obsidian blades than elites who are less likely to work in such types of production. Feinman (1998) argues that it is obvious, even in today's world that market activities can lead to inequitable distribution of commodities and high-value items.

Overall, these critiques document that Hirth has contributed a new and helpful way of understanding markets, but that researchers, like myself, should avoid making gross generalizations concerning the degree of homogeneity in assemblages that must be evident to confirm unequivocally the existence of a marketplace. More controlled studies are needed to understand the factors that impact market exchange.

Christopher Garraty (2009) evaluated the efficacy of Hirth's "distributional approach" in a study based in the lower Blanco region of Veracruz, Mexico by incorporating some of the methods suggested by Smith (1999) in his critique. In this region, a market was assumed to have functioned at the site of El Sauce. Garraty used a diversity measure of "heterogeneity", or *H* scores, of pottery types to quantify the difference in artifact ratios among households. In addition, he measured the number of obsidian prismatic blades per 100 rim sherds. These data come from the Postclassic period context collected as part of the Proyecto Arqueológico La Mixtequilla (PALM). He compared diversity scores from the PALM data to those from Late Postclassic Teotihuacan, a place known to have had a large, functioning marketplace. The data give evidence of a marketplace centered at El Sauce, as expected, but his study was designed to test the approach, not necessarily to determine the presence of a marketplace.

Garraty (2009) found Hirth's distributional approach to be a useful way of looking at exchange. Having a standard of measure, like a site with a known marketplace, and other contextual evidence would allow the archaeologists to make a more confident and well supported claim to marketplace interactions at a site. These data address Hassig's (1998) and Wilk's (1998) concern that market interaction is widely variable and had differing affects on sites depending on their reliance on the market.

Garraty also analyzed how diversity scores and obsidian blade concentrations change as the distance from the potential marketplace at El Sauce increased. To infer the radius served by a single market center Garraty (2009) compares changes in diversity scores with fall-off patterns by charting obsidian prismatic blade concentrations as concentric rings calculated by distance from El Sauce, the most likely candidate for a marketplace. The fall-off model states that as a result of "transportation costs, the abundance of any commodity falls off with increasing distance from the source," (Sidrys 1976:451). Garraty (2009) created thirteen 1-km ring buffer zones around El Sauce within which to evaluate heterogeneity scores and obsidian concentrations. The fall off of ceramics appears at about 9-km while the range for obsidian was smaller at only 6-km. The fact that imported ceramics were consumed a high frequency at a further distance implies that people were more willing to travel to a marketplace to purchase decorated ceramics than they were to purchase obsidian. These two lines of evidence working together provided evidence as to the size of the market area around El Sauce.

Leah Minc (2006) proposes a similar approach to Hirth, but takes a wider, regional look at markets. She purports that on a regional level, a market system contains several "market centers" that act as the locus of exchange. Each region contains "market zones", which she defines as the area served by the market center. Market centers are the equivalent of marketplaces since they are places where producers and consumers consistently come together to exchange goods and/or services. Smaller market centers often only provide subsistence items, while larger market centers that serve a greater area provide long-distance exchange items and other, more labor intensive commodities in markets. Because long-distance exchange items are more costly and the not necessary for survival, demand in smaller centers was not high enough for them to exchanged in marketplaces (Minc 2006).

According to Minc, identifying the extent of a market zone is done by analyzing the regional distribution of artifacts and raw materials from specific producers. Communities within the same market zone will primarily have goods from the same producers. Minc (2006) agrees that the use of trace-element analysis, such as XRF, on long-distance trade items, such as obsidian, has been useful at a regional scale to define market zones, but she questions its efficacy at the intrasite scale since the number of sources may not be variable enough to show patterning.

This project will incorporate a combination of methods described above. Following Garraty (2009) and Hirth (1998), a comparison will be made between the concentrations of imported items at residences of differing rank at Actuncan. The socio-economic rank of Actuncan's households will be independently determined by the size and location of houses within the site. Large houses near to the civic core are considered more elite than those smaller households on the periphery. Further, sourcing of obsidian will determine where imported items were obtained, whether elites controlled access to high-valued sources, the number of exchange relations, and shifting access to these sources by household. However, my study is not a synchronic study like Hirth's; rather I take a diachronic approach. Since a regional approach could not be executed, exploring the change in artifact distribution over time allows for a comparative measure of exchange modes over time at Actuncan. These results will be viewed against a backdrop of changing political authority over time to determine if elites administered the public buying and selling of obsidian during the Late and Terminal Classic periods, or whether they maintained strict control over obsidian through redistribution and reciprocity.

Why obsidian?

Obsidian is a long-distance import that was widely used for utilitarian and ritual purposes and is an excellent artifact to study exchange networks because of its unique role in ancient Mesoamerica society (Braswell 2004). As Raymond Sidrys (1976) once said, "one commodity is not representative of the entire diversified exchange system", but it does appear that obsidian was unique in that it is the only long distance, non-perishable good imported in large enough quantities to function as a utilitarian item, mainly used as knives and prismatic blades for ritual bloodletting, woodworking, shaving, and cleaning hides. Because it was so widely used, it may have become a commodity bought and sold in markets in the Late and Terminal Classic periods.

Obsidian has been the focus of the majority of exchange studies in southern Mesoamerica for a number of reasons (Aoyama 2001; Braswell 2002, 2003, and 2004; Dreiss 1988; Dreiss and Brown 1989; Feinman et al. 2006; Fowler 1991; Hammond 1972 and 1976; Hirth 1998 and 2008; Johnson 1976; Joyce et al 1995; Knight and Glascock 2009; Levine et al 2011; Nelson 1985; Nelson and Clark 1998; Nelson et al. 1978; Rebnegger 2010; Sidrys 1976; Spence 1996). It is found throughout the Maya area in relatively high quantities and appears to have been used for both ritual and utilitarian purposes because it is easily made into sharp cutting tools or projectile points. Obsidian is almost indestructible so the quantity excavated is likely the quantity present upon abandonment of the site (Braswell 2004). During production, it behaves predictably, therefore manufacture and usage studies can be done on replicas, and it absorbs water at a constant rate making it easy to date using hydration dating (Dreiss 1988). Although its initial function was primarily utilitarian in the Preclassic period, during the Classic period ornaments and ceremonial items were also crafted from obsidian (Dreiss 1988; Moholy-Nagy 2003). Finally, obsidian is easily recognizable as a lithic import as it is visually distinct from local chert stone tools and debitage. Therefore, it is easily collected and initially studied using macroscopic analyses. Further, obsidian can be geochemically sourced using a number of different methods which is imperative in reconstructing trade routes (Braswell 2004, Dreiss 1988; Sidrys 1976).

There are two primary geologic zones in Mesoamerica: volcanic highlands that contain multiple obsidian outcroppings and centrally located lowlands with sedimentary limestone geology that lack obsidian (Hammond 1972). The Guatemalan highlands and central Mexico are the nearest known sources of obsidian to the Maya lowlands which means it must have been transported great distances to have obtained such widespread distribution (Dreiss 1988; Hammond 1982; Nelson 1985).

Three primary sources of obsidian are recognized in the Maya lowlands: El Chayal, San Martin Jilotepeque, and Ixtepeque. El Chayal is located near Guatemala City and the prehistoric Maya site called Kaminaljuyu. Within an area of around 100 square kilometers, this source is made up of seven to eight lava-flows with at least 58 documented outcroppings (Asaro et al. 1978; Dreiss 1988; Ley 2011). The quarries at El Chayal are located along the pathway connecting the Pacific Piedmont, the Motaqua Valley and the upper Chixoy-Salinas River, which may have been a determining factor in its control and widespread distribution by Kaminaljuyu (Dreiss 1988). San Martin Jilotepeque is located in the southern Guatemalan highlands and is made up of several complex geologic deposits that are chemically homogenous (Dreiss 1988). Ixtepeque is located in eastern Guatemala near El Salvador, it was the closest of the three to the Caribbean. It was purportedly traded via sea routes (Dreiss 1988, Hammond 1976; Nelson 1985). Ixtepeque would likely have been the most easily accessible source for sites in modern day Belize because of the efficiency of sea routes. In addition to these sources, a variety of outcrops in Central and Western Mexico were also traded by the ancient Maya, but only arrived in very small quantities to the lowlands. The most popular of these is Pachuca obsidian which is known for is characteristic green hue. It is said to be of superior quality and was controlled and distributed by Teotihuacan which is located nearby (Dreiss 1988; Spence 1996).

Obsidian in the Maya lowlands

Long-distance import of obsidian into the Lowlands began as early as 1300 B.C. (Hammond 1982). As a result of high transportation costs, it is likely that obsidian arrived in the lowlands as preformed cores, which would have eliminated any unnecessary weight (Hirth and Andrews 2002). Thompson (1970) suggests that is was likely traded over water routes since that would have been the most efficient means of transport, although some foot travel was surely necessary. Hammond (1972) reiterates this point when he points out that water routes appear to distribute the obsidian further than land routes, which he also attributes to canoe transport being more economical.

In the Maya lowlands, obsidian is found in the majority of residential units, but in much lower quantities than it is found in highland Maya areas or in central Mexico (Ford 2004). Maya lowland sites are located a minimum of 300 km from any obsidian source, yet prismatic blades requiring special production are found at nearly every lowland Maya site in both residential and ceremonial contexts (Ford 2004). With the exception of ceremonial centers, little evidence of blade production exists in the lowlands.

As early as the Preclassic period, blade technology in the Belize River valley was highly developed (Healy 2006). Research by Jaime Awe and Paul Healy (1994) shows that blade technology in the upper Belize River valley began as flakes in the early Middle Formative period (1000-850 B. C.) before shifting to prismatic blade production in the late Middle Formative. Their data were based on obsidian collected a Cahal Pech, but this trend was verified at Pacbitun, Barton Ramie, Seibal, Altar de Sacrificios and even as far as the Pacific coast of Guatemala. Source analysis of samples from Cahal Pech and Pacbitun showed that at least three obsidian sources, all located in the Guatemalan highlands, were used by the Preclassic Maya (Healy 2006).

In the Belize River valley, 56 percent of residences tested during the Belize River Archaeological Settlement Survey (BRASS) contained obsidian (Ford 1991). Ford (1991) asserts that the distribution of obsidian in this region was restricted since this frequency much lower than that found in highland Mexican sites. Unlike the core Maya area where access to obsidian was open to all, some individuals in the Belize River valley were not allowed access to this valuable import. At nearby Xunantunich, obsidian makes up almost 40 percent of the formed stone artifacts (Keller 2006).

Obsidian is normally found in the form of beautifully carved eccentrics, personal adornments, mortuary goods, and prismatic blades used for bloodletting and utilitarian purposes, and occasionally projectile points. While there are several potential ways to use obsidian, in the lowlands the prismatic blade is the most common artifact. A blade has parallel edges and is at least twice as long as it is wide (Trachman 2002).

Figure 2.1. Proximal end (right) of a prismatic blade collected at Actuncan.

Obsidian prismatic blade production has been well documented by both ethnohistoric accounts and contemporary lithic studies (Lubbock 1865; McKillop 1995; Sheets and Muto 1972). Polyhedral cores are formed from large cores of raw obsidian by removing small blades through percussion leaving behind flakes from the removal of cortex. Larger blades from the outer core were primarily removed using percussion flaking, while smaller prismatic blades required only pressure flaking (McKillop 1995). Often times the platform was prepared and varying sizes of blades and flakes were removed to form the ideal polyhedral core (Hirth 2008). Prismatic blades, rather than prismatic cores, are the most common obsidian item found in the Maya lowlands (see Figure 2.1). In making these prismatic blades, a blade is removed from a polyhedral core by applying pressure with a wooden implement placed between the sternum and the core (Lubbock 1865; Sidrys 1983). The resulting blade has a bulb of percussion on the proximal end with medial ridges along the dorsal side giving the blade a triangular or trapezoidal shape (Sidrys 1983).

Elite control of obsidian

Sidrys' (1976 and 1983) studies showed an increase in the use of obsidian from the Classic to Postclassic periods. His studies in north-central Belize uncovered two massive ritual obsidian deposits that overturned notions that obsidian was simply utilitarian. At El Pozito, 4,993 obsidian artifacts were found in a Late Classic elite tomb, while only 60 obsidian pieces were found in the 50 test pits excavated at Late Classic house mounds. He found that elite residential contexts had much more obsidian artifacts than non-elite residences when standardized by the number of stratigraphic levels. Similarly, a seventh century offering of 1,025 obsidian cores and 7,503 blades and chips was found at Lamanai in elite contexts (Sidrys 1983). This abundance of obsidian is never seen in non-elite contexts.

Similarly, Aoyama (2011) conducted a regional analysis of over 123,000 lithic artifacts from Copán, Honduras and Aguateca, Guatemala in order to understand socioeconomic and political aspects of obsidian procurement and exchange. He used a combination of visual and chemical sourcing to conclude that 98.5 percent of the obsidian at Copán was from Ixtepeque, while more than 96 percent of all obsidian in the Aguateca region comes from El Chayal (Aoyama 2011). The known political boundary between these two polities appears to be dramatically affecting access to obsidian sources. If political authorities were not controlling how obsidian was accessed by their subjects, then we would expect to see more variation in source use at these sites.

Ixtepeque was the primary source utilized at Copán, although early on, they were simply importing large flake spalls (Aoyama 2011). It was not until the Early Classic that they began producing large quantities of prismatic blades (Aoyama 2011). At Copán, Ixtepeque obsidian was primarily used for utilitarian purposes, and prismatic blades are found in all portions of the site (Aoyama 2011). Only urban elites at Copán appear to have been producing blades and controlling access to prismatic cores, since rural obsidian manufacture was dominated by casual flake industry. While a small amount of prismatic blades are found in rural areas, they are finished products with no evidence of production (Aoyama 2011). Aoyama (2011) suggests that the cores were allocated by the ruling dynasty at Copán to local nobles in the Copán valley as part of the political economy. Perhaps the elite administered the distribution of Ixtepeque prismatic blade cores that helped create the power and prestige afforded to this group. This assertion is also supported by the decreased quantity of obsidian observed near the end of the Late Classic period when the ruling class began to lose control of intra- and inter- regional exchange systems, which was likely a factor in the collapse of the Maya ruling class (Aoyama 2011).

Braswell and Glascock (2011) come to different conclusions about the control of obsidian at Tikal and Calakmul. They suggest that Classic period administered market exchange was the mechanism for obsidian distribution at these sites. Since the quantity of obsidian found at Tikal is at least four times that found at Calakmul, the distribution system must have been bounded, meaning that while trade was free within this arbitrary zone, goods were not exchanged across the boundary (Braswell and Glasock 2011). Evidence for an administered market at Calakmul is bolstered by the tentative identification of a marketplace adjacent to the central plaza where it could be easily overseen by rulers. It seems that depending on the size and political organization of the site, obsidian was procured and allotted through varying mechanisms.

Sourcing of Obsidian

Using trace elements to identify the geological source of obsidian has been common practice in the Mesoamerican for approximately 50 years (Braswell 2004; Sheets 1976; Sidrys 1979). Obsidian is a silicate glass that contains trace elements useful for determining the location of the source. The relative proportion of specific trace elements are unique making it simple to correlate source locations with obsidian excavated at archaeological sites (Dreiss 1988; Hammond 1982). Early research emphasized the link between individual sites and the geological sources of the obsidian found there but made little attempt to reconstruct trade routes or observe how source use may have changed over time (Cobean et al. 1971; Heizer et al. 1965; Hester et al. 1971; Jack and Heizer 1968; Sheets 1976). In more recent times, trade routes have been reconstructed in the Maya lowlands and changes in source use over time have been analyzed (Aoyama 2011; Braswell 2002; Braswell and Glascock 2011; Dreiss 1988; Hammond 1982; Nelson 1985).

As described above, three sources dominate the archaeological record in the Maya lowlands: El Chayal, Ixtepeque, and San Martin Jilotepeque. In addition, small quantities of obsidian from Central Mexico including Pachuca and Ucareo are found, but most commonly in elite or ceremonial contexts. El Chayal and Ixtepeque are easily distinguished using their trace elements, despite their close proximity. El Chayal contains higher concentrations of manganese (Mn), cesium (Cs), uranium (U), antimony (Sb), thorium (Th), tantalum (Ta), and rubidium (Rb).

Ixtepteque's proportions of iron (Fe), cobalt (Co), and hafnium (Hf) are much higher. These trace elements are consistent within each outcropping (Hammond 1982). San Martin Jilotepeque has higher levels of barium (Ba) and strontium (Sr) (McKillop et al. 1988:242-243). Ucareo is noted to have very low levels of barium (Ba) and strontium (Sr) and high levels of zirconium (Zr) (McKillop et al. 1988:242-243).

There are several different methods commonly used by geologists and archaeologists to match stone artifacts to their natural sources. Neutron activation analysis (NAA) and x-ray fluorescence analysis (XRF) are most commonly used by archaeologists (Braswell et al. 2000; De Francesco et al. 2011; Nazaroff et al. 2010). NAA involves the removal of approximately 100 mg from each artifact to be irradiated. After decaying, the piece is placed before a high-purity germanium detector that measure the gamma-ray emissions used to determine the concentration of the following elements: aluminum (Al), barium (Ba), chlorine (Cl), dysprosium (Dy), potassium (K), manganese (Mn), and sodium (Na)(Glascock et al. 1994; Smith et al. 2007). In XRF, the specimen is irradiated with x-rays inducing displacement of atomic electrons (Glascock et al. 1998:19). Inner energy levels are left empty, so electrons from outer levels move into this vacant space which emits fluorescent x-rays. Identification of each element is possible since each element has a different energy level which is observable in the fluorescent x-ray. To determine obsidian source, the elemental composition of sodium (Na), potassium (K), titanium (Ti), manganese (Mn), iron (Fe), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), and barium (Ba) are frequently measured (Glascock et al. 1998).

While NAA is highly accurate, it is expensive and requires radioactive analysis, both of which are shortcomings of this process. In addition, NAA is unable to measure barium (Ba), strontium (Sr), and zirconium (Zr) as accurately as XRF (Nazaroff et al. 2010). X-ray fluorescence analysis is widely used in both research and industry, and it is preferred over other methods because it is non-destructive (Shackley 2011). It has been shown to be accurate in both non-destructive and portable modes, especially when applied to obsidian which is easily sourced and highly homogenous (Liritzis and Zacharias 2011; Moholy-Nagy and Nelson 1990; Nazaroff et al. 2010).Unfortunately, it is nearly impossible to chemically analyze each piece of obsidian for source information because these techniques are expensive. Therefore, archaeologists also use visual sourcing as a means of determining source location.

Visual sourcing is a technique that entails close evaluation of the visual characteristics of obsidian such as refracted color (what you see when the piece is held up to the light), reflected color (what you see when piece is on white backdrop), and texture. Once these attributes are characterized they are compared to expected characteristics determined from geological outcroppings or comparative geological collections. Many obsidian researchers such as Aoyama (2011) and Braswell and colleagues (2000) argue that this method is highly accurate when conducted by a trained lithicist using a reference collection (Aoyama 2011; Braswell 2011; Braswell et al. 2001; Chavarria 2011; Jackson and Love 1991). In fact a test was conducted by several lithicists in which each individual visually sourced a lithic assemblage with approximately 98 percent accuracy (Braswell et al. 2000). Others have argued visual sourcing is not consistently accurate and overlooks variability in the assemblages by often missing unexpected sources (Moholy-Nagy and Nelson 1990; Moholy-Nagy 2003). While the practice has become quite widespread, it is important for the researcher to be frank about his or her limitations (Braswell et al. 2010; Levine et al. 2011, Redbegger 2010). There are other advantages to exploring color. Describing the color categories present in a collection and their contexts can also be revealing since color is a visible characteristic, unlike geological source, that probably affected use in ancient societies.

Reconstructing Trade Routes and Availability of Sources

Norman Hammond (1972, 1976, 1982) was one of the first to look at obsidian trade routes. He proposed a few different scenarios for how El Chayal and Ixtepeque were distributed throughout the Maya area. He proposed that obsidian from El Chayal was distributed down river valleys. If headed northwest, then the merchants followed the Río Negro and Río de la Pasión to the Chixoy-Salinas-Usumacinta valleys. If headed toward the Caribbean, they would follow the Río Matagua, Río Sarstun, Río Grande, Belize River, New River, or Río Hondo. He proposed a different and competing route for Ixtepeque obsidian which would have followed the Río Motagua to the Caribbean and then moved north along the coast by canoe to coastal sites in Belize and Yucatan (See Figure 2.2) (Dreiss and Brown 1989; Hammond 1982). He later suggested that coastal routes probably extended up river valleys to distribute the obsidian inland, which offered an explanation for why Ixtepeque was found in relatively high frequencies at inland sites. After more than 30 year of additional research, these routes are still the basis for our current understanding of trade routes, but small adjustments have been made. Hammond's routes were too generalized and exclusive. It seems that many sites were accessing both sources simultaneously; perhaps efficiency in travel was not the only concern (Hammond 1972; Johnson 1976).

Nelson (1985) compiled obsidian source studies from throughout the lowlands to develop his distribution model which takes into account the chronological changes in source usage. He suggests that San Martin Jilotepeque (also referred to as Río Pixcaya) was the primary source in the Middle Preclassic before a shift toward El Chayal in the Late Preclassic period. He proposes that this shift occurred when Olmec power began to subside and they lost control of the El Chayal source (Nelson 1985). El Chayal dominated during the Classic period, but over time Ixtepeque slowly gained popularity, especially at southern sites along the Caribbean coast during the Late and Terminal Classic periods. In the Postclassic period, dependency on Ixtepeque obsidian sources and trade networks was almost complete (Nelson 1985; Nelson and Clark 1998; Sidrys and Kimberlin 1979). Many interior sites had been abandoned by this time, but those along the Caribbean coast used Ixtepeque almost exclusively along with a small proportion of Mexican obsidians. It appears that inland trade routes had probably dissipated due to lack of population and popularity of coastal trade (Nelson 1985).

Additional research has shown that archaeologists are just scratching the surface of the complexity of the Maya exchange system. Research at sites like Wild Cane Caye, a coastal trading post, and Paso de la Amada, a site which imported larger quantities of El Chayal obsidian despite its location 100 km nearer to San Martin Jilotepeque, has revealed that efficiency of travel is not always the most important factor regulating trade routes (Clark and Lee 1984; Fowler 1991; McKillop et al. 1988). McKillop and colleagues (1988) assert that Wild Cane Caye directly participated in long-distance coastal trade since seven different obsidian sources are represented on this small island. The obsidian source data also provided evidence that Wild Cane Caye fit the pattern seen at other lowland Maya sites of changing source use over time. A study by Dreiss and Brown (1989) looked at obsidian distribution on a regional scale in the Belize River valley and examined source attribution at 38 southern lowland Maya sites. This study showed that during the Late and Terminal Classic period, 5 percent of obsidian came from San Martin Jilotepeque, 69 percent from El Chayal, and 22 percent from Ixtepeque. The remaining 4 percent originated at Mexican sources (Dreiss and Brown 1989). The numbers correlate nicely to what Nelson would have expected to see at inland sites during this time, but it would be more revealing to see the proportion of obsidian from these varying sources during the Early Classic and Postclassic periods for a comparative measure against Actuncan to see how source use was changing over time.

Alternatively, Brown and colleagues (2004) explored obsidian procurement at Colha, famous for its chert production, and were surprised to find that over half of the obsidian during the Classic period was chemically sourced to Ixtepeque. During the Late Preclassic, 25 percent of the sample at Colha was sourced to Ixtepeque (Brown et al. 2004).This informs us that Nelson's (1985) descriptions of changing source use over time may not have been universal.

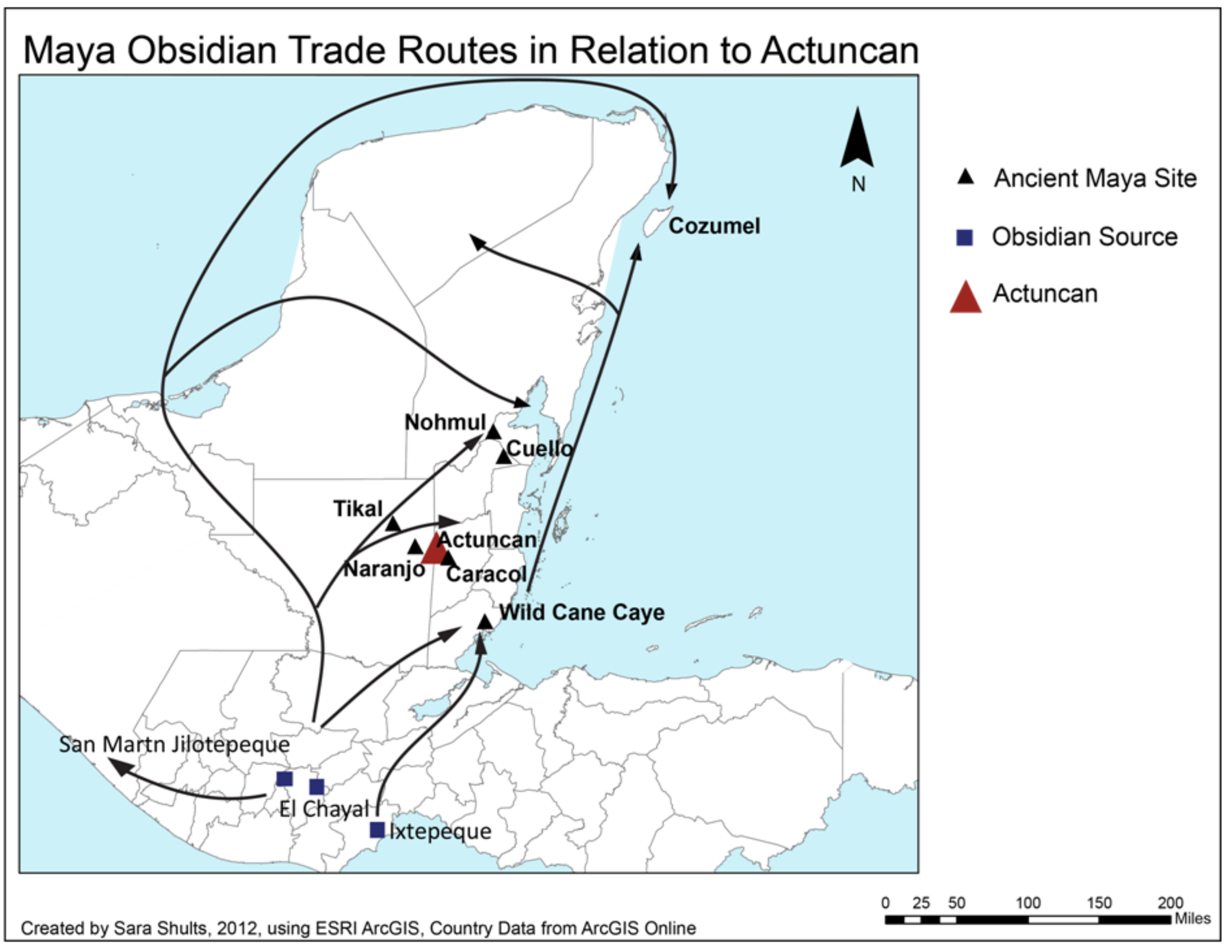

Figure 2.2. Potential obsidian trade routes in relation to Actuncan.

Elite Control of Obsidian

While many archaeologists argue for the existence of marketplaces, none would deny that elites controlled obsidian at one point in time. It is likely that elite control shifted over time. Earlier, it was import for elites to institutionalize their authority, and the control of resources was an effective way of doing this. There are many arguments for which stage of production and distribution the elites were most involved, and it is possible that elite involvement varied on a site to site basis (Aoyama 2011; Braswell and Glascock 2011; Ford 2004). Investigations at the rural community of Laton found evidence that a large elite residence was highly involved in obsidian production due to the high concentration of production by-products throughout the residence (Ford 2004). The minimum quantity of obsidian found at the residence was 3,000 pieces per m^3. Ford (2004) asserts this evidence demonstrates that while there may have been centralized control of the distribution of obsidian, production of obsidian was not centralized. Elites at rural centers may have used the production of obsidian as a way to demonstrate their connection to larger centers (Ford 2004). Alternatively, the elites may have placed these producers on the outskirts as a way to protect the resource and maintain control.

Evidence at Uaxactun and Barton Ramie suggests that during the Early Classic period, rare imported items like jade and obsidian were open for access by anyone in society (Hammond 1982). By the Late Classic period such items were relegated mainly to elite contexts, mainly found in large buildings near the ceremonial center (Hammond 1982).

While there is ample use of obsidian from El Chayal, San Martin Jilotepeque and El Chayal during the Preclassic at Colha, contextual evidence suggests that elite Colha households were controlling obsidian during the Classic period. Ixtepeque appears to have shifted from utilitarian use to ceremonial use during the Terminal Classic period, which shows a shift from open to restricted access (Brown et al. 2004; Dreiss et al. 1993).

Alternatively, Aoyama's (2011) study found evidence from the Copán region that suggests that royalty initially gained power through the control of obsidian, and presumably other valuable imported commodities, but later lost that power along with the control of resources. Evidence of blade production in the form of cores is only found in elite contexts, which shows that they were in control of production. While obsidian from the Ixtepeque source is found at households of all ranks, higher quantities are found in elite contexts. By the end of the Late Classic period, evidence suggests they lost control of this valuable resource (Aoyama 2011). The rulers were no longer regulating exchange at Copán or the surrounding region during the last half of the Late Classic period. By the Postclassic period, the procurement and exchange of obsidian cores from Ixtepeque had declined, resulting in a decline of obsidian prismatic blade production (Aoyama 2011). These studies provide solid evidence for elite control of obsidian, but when and how they controlled obsidian seems to vary in different areas. Inomata and Aoyama (1996: 307-308) suggest that certain aspects of Maya society operated on different scales, both spatially and politically. They argue that making generalizations about how the elite managed economic relationships is difficult since polities were variable in size and status (Aoyama 2011). In addition, the collapse of Classic Maya society occurred at different times in different places. Some areas were affected more than others, which makes it difficult to compare elite control based solely on time periods.

Obsidian Research at Actuncan

This study seeks to document the ways in which obsidian was exchanged at Actuncan and how that may have changed over time. I hypothesize the exchange of obsidian at Actuncan shifted over time and there will be evidence in changing artifact distributions at households. I anticipate that there will be a greater difference between elites and non-elites in the Early Classic period, with distributions evening over time with the rise of market exchange. In addition, I hypothesize that access to particular obsidian sources changed over time, as suggested by Nelson (1985). There should be higher quantities of El Chayal in the Early Classic period, with incrementally more Ixtepeque added until the Postclassic period when the majority should be Ixtepeque.

Chapter 3: Actuncan, The Setting and Sample Contexts

Actuncan sits almost 50 meters above the Rio Mopán, a tributary to the Belize River that flows from the West, looking out over lush bottomlands. The site was occupied for nearly two-thousand years and held shifting levels of influence during this time (McGovern 2004:55). Its initial occupation began in the Middle Preclassic period (1000-300 B.C.) and persisted until its abandonment during the Terminal Classic period (A.D. 800 to 1000) (McGovern 2004). It has been suggested that Actuncan, like other sites in the Belize River valley were settled as people moved inland from the coast looking for farm land along river valleys. Initial occupation in the Belize River valley began around 1000 B. C. (Garber 2004). Actuncan's location in the Petén periphery allowed it to stay in close cultural, political, and social contact with Tikal and other Early Classic centers (LeCount and Blitz 2002).

James McGovern (2004) divided the site into two sectors: Actuncan South marked by its Preclassic triadic structure and Actuncan North, a Classic center. McGovern (2004) asserts that while Actuncan showed a great deal of political autonomy and power in the Early Classic period, a time when it shared links with a handful of other developing sites in the Belize River Valley. The city's power was lost when large political centers outside the valley, like Naranjo in Guatemala, rose to power and wielded influence over smaller centers throughout the Maya lowlands during the Late Classic period (A. D. 600-850). In addition, nearby centers gained power which greatly limited the political autonomy once present at Actuncan.

In 2001, Lisa LeCount initiated excavations at Actuncan North, an area containing ritual, administrative, elite-residential, nonresidential domestic, and special purpose structures. Over the course of four field seasons, the project has focused on excavating royal, elite and commoner households A noble residence (structure 19 and 20), three elite households (structures 73, 41, 40 and 29), and six non-elite residential *plazuelas* have been tested or excavated (see Table 3.1). *Plazuelas* are groupings of small domestic structures around a patio, most of which are associated with commoner households (LeCount et al. 2005:15). Elite structures are larger pyramidal buildings surrounded by terraces and smaller platforms. LeCount suggests that we may not only be looking at the difference between elite and common people at Actuncan but the difference between agrarian and urban families (LeCount et al. 2005).

Table 3.1. List of structures and plazuela groups excavated at Actuncan.

Elite	Non-elite	
Structure ID	*Groups*	*Structure ID*
73	1	59, 60, 61, 62
41	2	51, 52
40	3	45, 46, 47
29	5	63, 64, 65, 66
20	6	53, 54
19	7	55, 56, 57,58

The main goal of the AAP is to use households as means of determining the processes that encouraged the rise of kingship and state-level society during the Late Preclassic and Early Classic periods (400 B. C to A. D. 500). Rather than examining how the rise of state-level society is seen in royal tombs and civic architecture, LeCount examines statecraft from the perspective of households. Long-established households held kin-based power as a result of their claim to ancestral authority, as well as their control over land and labor (LeCount and Blitz 2012). The institutionalization of kingship likely had a profound effect on the organization of households as some households may have chosen loyalty to the king rather than their lineage groups. Long-established families were likely resisted this directive in favor of maintaining control of their own resources. If kingly power was ascertained, then large households established through kin-based power probably fragmented, while other new households may have gained unprecedented wealth (LeCount et al. 2005). LeCount and Blitz (2012) accept that an alternative was possible at smaller cities like Actuncan, which were founded upon kin-based authority. They suggest that rulers may have been unable to override kin-based authority; therefore, residential structures would indicate a consistent growth in size and wealth over time, largely unaffected by the establishment of kingship.

Angela Keller has initiated a research program to study plaza space at Actuncan. The close proximity of Actuncan to Xunantunich makes it probable that residents at Actuncan also participated in the market at Xunantunich or possibly Actuncan (Keller and Craiker 2012). Keller tested a broad, flat area west of the royal residence for physical evidence of a market at Actuncan known as the West Plaza. The West Plaza is similar to a purported market at Xunantunich, located 2 km south of Actuncan (Keller 2006). After reviewing the soil and artifacts for 364 postholes distributed at 5m intervals across the plaza for ceramics, lithics, phosphorus, and microartifacts, Keller has not confirmed the exact function of the West Plaza during the Classic period (Keller and Craiker 2012). By combining her artifact and soil samples with the magnetometer study conducted by Chet Walker, Keller has created several nice distributional maps of the plaza and may have identified a lithic workshop, but evidence is slim for obsidian production. This workshop yielded only one piece of obsidian in its minimal testing. It will be interesting to see what future excavations can reveal about this plaza, but Keller has provided a nice baseline for areas that require further attention (LeCount and Blitz 2012).

My research on the rise of marketplaces in the Classic period can lend evidence to address both of these research projects. If influential households maintained authority through time despite the rise of kingly authority, then obsidian quantities would likely remain consistent through time. On the other hand, if the institution of kingship managed to dominate kin-based power then a decrease in access to obsidian at commoner households, and other imported or luxury items, would likely be seen as elites and royals harnessed control of trade. My study will also lend support for Keller's research program concerning the presence of a marketplace within one of Actuncan's plaza, since the current evidence is not sufficient to identify a marketplace. Indirect evidence from this study should elucidate whether marketplace exchange was taking place at Actuncan.

Sample Contexts

Since this study attempts to understand exchange patterns at Actuncan based on household access and consumption, all the data under investigation come from domestic contexts. Both elite and non-elite context were analyzed since it is necessary to understand how access to the obsidian by the two socioeconomic groups may have changed over time as political and economic conditions changed.

Group 1, Operation 1

The first household excavated by the Actuncan Archaeological Project was Group 1. It consisted of four platforms made up of Structures 59, 60, 61, and 62 and oriented on a north-south axis and centered on a raised patio. This group measures 26.5m north-south and 25.5 m east-west. Structure 59 reaches the maximum height above ground surface at this group at 2.5 m.

Over the course of four field seasons, 128 units across two operations (Ops.1 and 12) have been excavated totaling 54.5 m^3 of matrix. Operation 1 consists of Structures 59, 60, and 62 as well as a few units in the plaza. In 2011, Operation 12 was opened on Structure 61 because there were too many units in Operation 1 to organize easily.

Occupation at this household began in the Middle Preclassic period and ended during the Terminal Classic period. There appear to have been three major construction episodes as evidenced by three thick plaster patio floors. There are a number of burials, many of impressive size and adorned with rich burial goods, in the patio of this household. The ornamentation in the burials lead LeCount and Blitz (2002) to believe that this family was the most influential commoner family during the transition from Terminal Formative to Early Classic periods, but later lost some of their authority. A large group of burials was found in front of Structure 60 containing ten individuals and a few burial goods such as cave pearls and speleothem. Two Early Classic period caches, one containing a bird skeleton, two greenstone pebbles, and one greenstone bead, were excavated in an Early Classic context of Structure 61.

Due to the location of this household near the center of Actuncan north, the significant size of the structures, and wealth related goods found during early time periods it seems likely that the members of this household, at least early on, were important players at Actuncan. While they were not elite like those at Structure 41, these people were not poor. Excavation data suggest that Group 1 was occupied for many centuries, but it is unlikely that over those 1000 years only a single patronage occupied this space. Later in time it is possible that families made themselves ritual descendants of the original patrons.

Group 2

Excavated during the 2001 field season, this three mound group (Group 2) is centered on a patio and located on the southern periphery of Plaza G. Group 2 is made up of Structures 50, 51, and 52. It measures 19 by 19.5 m, and the tallest structure, Structure 52, stands 2.5 m above the ground surface (LeCount 2002). A total of 3.93 m^3 of matrix was excavated in a single test unit straddling the patio, called Operation 2. The patio opens to the south and faces the largest pyramidal-range structure complex in Actuncan north. Although occupation appears to have begun during the Early Classic period, building construction did not begin until the Late Classic period (Lecount 2002).

Group 3

Excavated during the 2001 field season, this northwest to southwest trending patio group is located on the northeastern periphery of Plaza G and consists of three low mounds, Structures 45, 46, and 47. The tallest mound (Structure 47) measures 1.4 m above ground surface. The *plazuela* measures 20 by 15 m. A total of 2.54 m^3 of matrix was excavated in a 1-by-2 m test pit located on the patio, called Operation 3. There is evidence of occupation as early as the Late Preclassic period extending at least until Late Classic II period. Unfortunately, the surface is highly disturbed, so the terminal occupation is unknown.

Group 4

Located on the eastern side of the civic center, Group 4 is composed of three structures (Structures 33, 34, and 35) set on a large platform. The large platform supporting these structures is approximately 1,278 m^3 in area. An axial line of 1-by-1 m units were excavated atop the platform and near the western edge of Structure 34 along with an additional 6 units on Structure

35. A total of 53 units were excavated resulting in 15.8 m^3 of matrix and are referred to as Operation 8 (Units A-AAA).

This group's placement and orientation away from the plaza is atypical of Classic-period architecture and seems to be placed in an odd location in the center of Plaza C. Initial excavations were conducted to determine if this group was a Terminal or Postclassic C-shaped structure (LeCount and Keller 2011). While the construction of Structure 34 did not take place until the Terminal Classic period, there is evidence of an Early Classic period building below Structure 34 which may be the reason this location was chosen for this civic building.

Group 5

Group 5 is a patio-focused household located northwest of the city center that contains at least four structures (Structures 63, 64, 65, 66). The architecture at Group 5 is smaller than at other nearby residential groups, so the initial assumption was that its residents were of lower status. Excavations consisting of 2 m wide trenches (totaling 45 1- by-1 m units) were conducted at Structures 64 and 65, the easternmost and westernmost structures at the group, during the 2011 field season. These excavations resulted in 23.85 m^3 of matrix across two operations (Op 9A-V and Op11A-V) (Hahn 2012).

Because of its close proximity to Group 1, it has been suggested that the residents of these two groups had a close relationship, but artifactual evidence supporting this hypothesis has not been found. It appears that construction took place as early at the Terminal Late Preclassic period, and possibly as early at the Middle Preclassic period. Building and occupation continued until well into the Terminal Classic period at this group (Hahn 2012).

Group 6

Located 30 m north of Group 1, Group 6 is comprised of Structure 53 and 54 with a patio to the south and open land to the north. Measuring 20 by 10 m, it is small relative to other patio groups at Actuncan. Artifacts recovered at this group, including and jade and shell tinkler beads, suggest this group held ritual significance. A total of four 1-by- 1 m excavation units were opened at this group resulting in 26.73 m^3 of matrix. Two units (Op 13A and B) were located in the plaza while the other two crosscut Structure 53 (Op 13 C and D). The simple stratigraphy found at the group led Simova (2012) to conclude it was not occupied for long in the Late Classic period.

Group 7

With four structures, Structures 55, 56, 57, and 58, widely spaced around its patio, Group 7 is one of the largest *plazuelas* at Actuncan. Located at the northwest corner of the site, approximately 180 m northwest of Group 1, Group 7 measures 30 m in length. A 2-by-1 m trench was placed on the western façade of Structure 57 (Op16A-B), but most of the matrix derived from patio occupation and fill contexts. A 3-by-1m trench (Op 16 D, C, K) was placed perpendicular to the previously mentioned trench in an attempt to locate a structure wall. Another 3-by-1 m unit was placed into the façade of Structure 58 (Op 16 H, I, J). Finally, three 1-by-1 m units were placed across Structure 56 (Op 16 E, F, G). A total of 14.76 m^3 of matrix was excavated during the 2011 field season.

Structure 56 shows evidence of Early Classic period occupation followed by a Late Classic period construction episode. Structure 57 may contain multiple platforms and appears to have been occupied longer than the other structures since it dates from the Terminal Late Preclassic period to the later part of the Late Classic period. A child burial dedicated the construction of the house, which dates to the Terminal Late Preclassic period. These ritual deposits indicate that the initial group was founded in the Terminal Late Preclassic period (Simova 2012).

Structure 18

Located at the edge of Plaza C in a ravine below Structure 15, a pyramidal structure, Structure 18 is built atop a 60-cm deep Early Classic period trash deposit. Two 2- by-2 m units (Op 5A-B) were excavated totaling 8.43 m^3 of matrix. Beneath the large trash deposit, two individuals buried side-by-side were uncovered (LeCount et al. 2005). Researchers suggest that the Early Classic material is trash that originated from modification of the civic plaza or monument.

Structures 19 and 20

Located on the northern boundary of Plaza C, Group 4 is comprised of one structure and a courtyard group that was likely a noble palace complex. During 2004, only Structure 20 and the courtyard in front of Structure 19 were excavated, but the palace likely consisted of Structures 19, 20, 21, and 22. A total of 12.89 m^3 of matrix were excavated in a combination of one 2-by-1 m unit (Op 4, Unit A) in front of Structure 19 and a shallow 2-by-8 m trench across Structure 20 in2004 (Op 4, Units B-E). More recent excavations have been conducted in the winter of 2012, but materials from these excavations are not included in this analysis

Structure 19 has a high, long substructure that at other sites has been known to support rooms typical of a royal or noble residence. The courtyard was excavated in order to understand construction phases. The latest construction occurred during the Samal Phase (A.D. 600-670), while the lowest and earliest floors date to the Late Preclassic period. LeCount (2004) feels certain that occupation was continuous, despite the lack of evidence for an Early Classic floor.

Excavations at Structure 20 showed its terminal construction took place during the Late Classic Hats' Chaak phase (A.D. 660-780).

Structures 40 and 41

Structure 41 is a large, multi-tiered and terraced elite structure. It is located on the eastern edge of Plaza D. Over the course of three field seasons, 109 units were excavated resulting in 63.05 m^3 of matrix (Op 6A – FFFFF) and a 4-by-4m unit resulting in 0.927 m^3 of matrix (Op 19A, B, E, F). Structure 40 is a two-tiered mound measuring 11 by 7m. The lower tier measures 1 m in height, while the upper tier is approximately 1.5m tall. It is located just south of Structure 41 on the same plaza and faces north toward Structure 41 (Mixter 2012). While the structures are related, their axial orientations are slightly off. Excavation began at Structure 40 during the 2011 field season when 20 1-by- 1 m units resulted in 11.88 m^3 of matrix (Op 10A-T).

Excavations in 2011 at Structure 41 found evidence of occupation as early as the Cunil Phase in the Terminal Early Preclassic period in the form of a ritual deposit and a platform resting on sterile soil. This is the earliest occupation uncovered thus far at the site. However, construction of the large pyramidal structure visible today began in the Terminal Preclassic period and continued through the Terminal Classic period. The pinnacle of power at Actuncan is estimated to be during the Late and Terminal Preclassic, so it makes sense that this large elite structure was constructed during that time (Mixter 2012). While interpretations as to the function of this large structure are still unclear, Mixter (2012) feels the construction layout suggests domestic rather than public use. Domestic artifacts provide evidence that it functioned as a big house (Mixter 2012).

Structure 40 was constructed during the Early Classic period and modification occurred until the Terminal Classic period. Initially Structure 40 was expected to have served as an ancestral shrine, but extensive excavations in 2011 debunked that hypothesis. No burials were found, but a bench found in one construction episode indicates that it likely functioned as a semi-public meeting place. Unfortunately, benches are found in a wide variety of structures, so this is not functionally diagnostic (Mixter 2012).

Structure 29

Located north of Structure 41 on the eastern edge of the site, Structure 29 is an elite residence (LeCount et al. 2005). Measuring only 2.6 m above ground surface at the rear of the building, the front view is more striking since it is atop a natural hill. The structure's staircase is oriented toward Actuncan South, the ritual center. Four 2-by-2 m units were excavated on and around Structure 29 resulting in 3.89 m^3 of matrix (Op 7A-E). One located on the northeast corner of the eastern terrace was placed there to look for trash, while the remaining three were located on the northern edge of the eastern medial terrace of the structure (LeCount et al. 2005)

The eastern terrace was constructed during the Early Classic period, and a platform buried beneath it that could be evidence of Preclassic period occupation. It is possible that Structures 29 and 41 were family homes for *nouveaux riches* (LeCount et al. 2005).

Structure 73

Structure 73 is a medium-sized pyramidal platform much like other elite structures, including Structures 41 and 29. Centrally located just west of the *sacbe* leading to Actuncan South, this elite residence is located near the Preclassic temple group (Simova 2012). Six 1-by-1 m units were excavated resulting in 2.38 m^3 of matrix (Op A-F).

The terminal façade of this building was never penetrated, therefore excavation was limited. Nonetheless, it appears that a complex construction technique was used to build this structure. It was terminated in the Early Classic period with no evidence of later occupation.

More excavation is necessary to determine whether the building functioned at an elite residence of ritual structure (Simova 2012).

The Obsidian Assemblage

At the time of my summer research, the obsidian assemblage at Actuncan was comprised of 594 pieces of obsidian, but the final count at the end of the 2011 field season was 795. The initial 594 pieces were analyzed for form and color, while the final count of 795 was used in my distributional analysis. As seen in Table 3.2, obsidian was found in every operation at the site showing that its use was widespread.

In order to view change over time, I divided the data into broad temporal units: Middle Preclassic, Late Preclassic, Early Classic, Late Classic, Terminal Classic, and Postclassic periods. After much consideration, a small number of lots remained difficult to date so they were assigned to the even broader time periods, either Preclassic or Classic, based on stratigraphic positioning. The earliest context yet observed to contain obsidian is the Late Preclassic period from which 35 artifacts were recovered.

Table 3.2. Count of obsidian by temporal and household context.

Context by Period	*Late Preclassic*	*Early Classic*	*Late Classic*	*Terminal Classic*	*Postclassic*	*Not Established*	*Total*
Group 1	16	73	75	95	-	5	264
Group 2	-	1	4	-	-	-	5
Group 3	-	6	3	-	-	-	9
Group 4	1	2	-	1	-	1	5
Group 5	-	-	42	36	-	13	91
Group 6	1	19	9	7	-	-	36
Group 7	1	7	18	1	-	15	42
Structure 18	-	41	26	-	-	-	67
Structure 19	1	-	-	-	-	-	1
Structure 20	-	-	5	-	-	-	5
Structure 29	-	-	1	-	-	-	1
Structure 40	-	4	19	7	-	9	39
Structure 41	15	13	61	75	36	5	205
Structure 73	-	20	-	-	-	5	25
Total	35	186	263	222	36	53	

Chapter 4: Methodology

This study encompasses three very different types of obsidian analyses. First, I analyzed all 594 obsidian artifacts to better understand the type of tools used at the site and how they were produced. Second, Hirth's distributional approach was applied to the data described in the previous chapter by analyzing the distribution of obsidian across households, both elite and non-elite at Actuncan. Third, I sought to understand the sources of obsidian present at the site at varying points in time using both visual and chemical sourcing of obsidian. Understanding the sources of obsidian informs my research on markets because it possible that some sources were more restricted than other. In addition, it is widely accepted that Ixtepeque and El Chayal, the two most common sources, moved along different trade routes that shifted over time. Ixtepeque was traded east to the Caribbean Sea, then north along the coastline, while El Chayal was traded on overland and riverine routes, and in some instances, along the Gulf of Mexico and Caribbean Sea. There is evidence from varying sites that source access changed over time; therefore, sourcing of obsidian will also provide data on changing trade relationships through time (Dreiss and Brown 1993; McKillop 1994; McKillop et al 1988).

I maintain two separate databases for this research: the distributional database and the obsidian database. Both databases have fields for the provenience, time period assigned, structure number, and socioeconomic status of the household (elite or non-elite). The distributional database contained the artifact counts, weights, and volume of dirt of each lot excavated at Actuncan since 2001. If I was unable to obtain all the information needed, these lots were eliminated from the analysis. While the distributional database contained information on all excavations conducted at Actuncan, only household excavation data were used in the analysis, so Operations 14 and 15 were eliminated from the dataset since they were test units in a plaza. In the obsidian database, I recorded every piece of obsidian that had been excavated and catalogued by July 7, 2011. In this database I recorded the physical characteristics of the obsidian and categorized it into visual groups that were later used as a basis for visual sourcing.

Descriptive Lithic Analysis

In July of 2011, I traveled to Actuncan, Belize and spent 10 days cataloguing and analyzing all 594 obsidian artifacts that had been excavated up until that point. I attempted to record as much information as possible for this lithic analysis by recording variables most often seen in lithic studies (Chavarria 2011). I recorded the type (prismatic blade, flake, core), condition (proximal, medial, distal), the percent of cortex, presence of retouch, platform preparation, the number of dorsal ridges, amount of usewear (light or heavy), mass (g), length (mm), width (mm), thickness (mm), and specific color/texture categories that I used to visually source the obsidian (See Appendices A and B for raw data).

Examining the blade length, width and mass offers insights into how efficiently the producers were using obsidian. When obsidian is a high value import travelling hundreds of kilometers, it is expected that the producers would use the obsidian as efficiently as possible without sacrificing quality. A method for measuring production efficiency was presented by Sheets and Muto (1972) called "cutting edge to mass ratio" (CE/M). It is figured by taking the cutting edge length in centimeters for both sides of blade (basically length multiplied by two), then dividing it by the mass in grams. Sidrys (1979) measured CE/M in his study of 38 Classic period Maya sites that examined the supply theory that producers, like blade makers, will be more efficient in their production when the cost of importation is higher. A higher ratio implies more efficient use of obsidian. In order to test this Sidrys (1979) measured the CE/M ratio at 14 highland and 24 lowland Maya sites, and then compared that to their distance from the source. He found that on average sites farther to the source were more efficient with their use of obsidian. This pattern follows a steady linear trajectory until it reaches 350 km from the source at which point it becomes erratic. He estimated that sites above 300 linear kilometers from an obsidian source would see highly efficient CE/M ratios ranging from 5-7 (Sidrys 1979).

De León et al. (2009) examined three different methods of obsidian blade exchange: "whole-blade trade", "processed-blade trade", and "local-blade production." Processing of blades generally consisted of breaking them into smaller more easily used pieces (De León et al. 2009). If blades were being exported whole, then the archaeological record should show a proximal-distal ratio of 1:1 because each blade should have both one proximal and one distal end. It is possible with whole blade production to have a medial-distal ratio of 2:1 or 3:1, since multiple medial fragments could come out of one blade (De León et al. 2009). In addition, some whole blades should be found. Similar ratios would be found if the blades were being produced at the site, since it not possible to simply produce medial portions of blade. The whole blade must be produced then processed into smaller, more workable pieces (De León et al. 2009).

Distributional Database and Analyses

For the distributional analysis, I compared the distribution of obsidian in elite and non-elite household contexts to determine whether these two groups had similar access to obsidian and whether their access was changing over time. In order to do this I compiled all the records and databases from previous field seasons, including 2001, 2004, 2010, and 2011. The Actuncan Archaeological Project maintains an inventory of all artifact classes excavated within lots, with some exceptions. Over the years, many different individuals, some highly skilled and other less so, have entered data into this inventory. It was clear that in the early seasons of the project many of the Belizean workers were unable to decipher local *jute* shell from marine shell, so the counts of marine shell were greatly skewed. During the winter 2012 season, LeCount sorted through the "marine shell" bags and created a new, accurate marine shell inventory. I replaced previous counts and weights with these more accurate data. In addition, different levels of precision were used in different field seasons. At one time, the only scale available measured only to the nearest gram, therefore weights of artifacts with little mass were often rounded up. The weights of obsidian and marine shell were corrected in the database when these artifact classes were measured for more detailed analyses. In addition to errors in data collection, there were also errors in data entry. Most labeling errors were corrected through discussions with team members and review of field notes. As with any large database, especially one that involves input from several individuals, there were many discrepancies. While I did my best to search out the answers, there are still some gaps. Any lot that I was unsure of the context, I omitted from the analysis. Based on these data, I created a master inventory with counts and weights of ceramics, lithics, bone, obsidian, marine shell, groundstone, slate, and plaster. While I only used data concerning ceramics, lithics, obsidian, and marine shell in my analysis, it was more helpful to the project as a whole to keep the full database organized.

Actuncan Archaeological Project Recording Procedure and Definitions

The Actuncan Archaeological Project (AAP) categorized proveniences by context across three levels. The broadest category is the "operation" which defines a large area, generally within a household group. It can be as expansive as a large plaza or as small as one structure. Operations are named with numbers starting at 1, for example Operation 1 at Group 1. Each excavation is organized horizontally by "units", normally one-by-one meter in size, which are labeled sequentially by letters (eg. A, B, C, D, etc). Vertical control within each unit is maintained by "lots" that are defined by changes in cultural context, and occasionally defined arbitrarily. Lot numbers signify order of excavation, which do not necessarily reflect cultural stratigraphy.

I assigned dates to lots based on analytical units (a culturally defined unit that many encompass one or more lots or units; it is assumed that all features within an analytical unit were used at the same time). In the final report from each field season each excavator creates a Harris matrix and chart showing analytical units and their phase designation. The phase designations for analytical units came from LeCount's ceramic analysis of each lot. Many of the dates are published in the reports, but some were parsed out in face-to-face meetings with LeCount. I consolidated the data on a unit by unit basis by combining each lot that fell into the same time period. For example, if one unit had three lots that fell into the Late Classic period, the counts and weights for those lots were summed and a new analytical unit referred to as by its operation, unit, and time period was created. These units have names like "10C_Late Classic", which means all lots that date to the Late Classic period from Operation 10 and Unit C. The result of this organization is that I was able look at how the data changed at a one-meter scale across each group and structure over time.

Standardizing Data

While it may seem logical to compare raw counts from different households at different time periods, this does not allow for potential differences in household size, length of occupation, or excavation strategies and could certainly skew the results. When comparing households or sites, most archaeologists choose a ratio that standardizes the data by comparing the object of interest with a constant. For instance, an imported item can be standardized by a locally made item or by dirt excavated. Table 4.1 describes the three ratios I used in my analyses.

Table 4.1. Description of ratios used to standardize obsidian quantities and weights.

Ratio	**What does this ratio measure?**	**What does this reveal?**
Obsidian / Ceramics	Weight of obsidian by the weight of ceramics.	Since ceramics are indicative of household activities and population, this reveals how much obsidian there was relative to normal household waste.
Obsidian / Lithics	Weight obsidian by the weight of local lithics. This offers archaeologists an understanding of access to stone resources and stone preferences.	This offers archaeologists an understanding of access to stone resources and stone preferences. When documented diachronically this ratio can reveal how access changed over time and whether increase in exchange allowed for obsidian to be used preferentially over local stone.
Obsidian / Volume of Dirt	Weight of obsidian by the volume of dirt.	Volume of dirt is a common ratio because it should represent the depositional history. It is problematic in that Maya architecture is often made of stone which is not tracked in this measure. Volume is tied to the amount of construction, not necessarily amount of occupation.

While each of these ratios has inherent issues, I chose to display all three in order to gain an overall understanding of obsidian distribution across households at any one point in time and diachronically over time at Actuncan. Using the Statistical Package for Social Sciences (SPSS) software, I ran frequencies of each of these variables by phase, as well as calculate their sums. I created ratios from these sums for each group to track change over time. While charts were the clearest way of displaying the data, a line graph was more successful at revealing the trend. I ran t-tests by rank for each time period on the obsidian to sherd ratio to determine whether or not there was a significant difference between the two groups.

In order to display the data, I used Environmental Systems Research Institute, Inc's (ESRI) ArcMap software. I joined the excel database inventory to a shapefile, a vector data storage format storing the location, shape, and attributes of geographic features, containing the 1-by-1 m units mapped in the field using a total station. This procedure allowed for the spatial representation of obsidian distribution at the site. I represented each household with graduated symbols to show the quantity of obsidian at each time period.

Source Analysis

In my study, I use the sourcing of obsidian as means of understanding how different kinds of obsidian were exchanged at Actuncan. High-valued obsidian, especially Pachuca green obsidian, may have been exchanged differently than gray obsidian from Guatemala. It is known that Maya elites preferred Mexican Pachuca green obsidian for its color and sociopolitical significance. If they withheld this source from the marketplace, then green obsidian would not be found evenly across households at Actuncan. However, if each different source of obsidian displays an even distribution across households, then marketplace exchange was the mode of obsidian circulation at Actuncan.

First, I macroscopically characterized each obsidian artifact to create visual color groups. When defining visual groups several characteristics are taken into account, refracted color, reflected color, texture, type and quantity of inclusions, and clarity. These characteristics are seen as most important by those people who practice visual sourcing (Braswell et al. 2000; Jackson and Love 1991; McKillop 1995). Based on my analysis of color in the field, I then created nine visual groups which are shown in Figure 4.2. While some archaeologists (Braswell et al. 2000; Dreiss 1988; Levine et al. 2011) argue that visual sourcing can be quite accurate, others (Moholy-Nagy 2003) insist that results are inconsistent and often misattribute rare sources to one of the more popular sources. When I ventured into the world of visual sourcing, it was my first time analyzing obsidian, and I worked without a reference collection. While I feel quite confident in my attribution of Pachuca obsidian because of its characteristic green color, I feel less confident when it comes to the expansive shades of gray. Nonetheless, I followed known descriptions of obsidian.

Ixtepeque obsidian has a tan hue and is clear like glass, but can be banded. Geoffrey Braswell often describes Ixtepeque obsidian as having a similar appearance to glass from a Coca-Cola bottle (Braswell, personal communication; Braswell et al. 2000). El Chayal is usually gray with translucency varying from clear to murky or speckled but can be found in wide variety of hues including, black, gray, reddish-brown, and mixtures of these colors (Ley 2011; McKillop 1995). San Martin Jilotepeque is gray with large sand-like particles (Braswell and Glascock 1998; McKillop 1995). Pachuca obsidian is easily identified by its distinct green color and is often found in elite contexts. Another common Mexican source, Ucareo, is known for its dark black color with bluish undertones (Spence 1996).

Next I pulled an informed stratified, random sample of 27 pieces of obsidian from the visual groups established during visual sourcing in order to confirm through XRF analysis whether my distinct visual groups corresponded to distinct chemical groups. Braswell (2011:121), a proponent of visual sourcing and obsidian analyst, asserts that this form of sampling reduces the risk of missing underrepresented sources. When I pulled my sample, I was planning to limit the scope of my project to the Late and Terminal Classic periods, so I only sampled specimen from those periods. Three specimens were selected from all groups with the exception of Groups eight and nine from which only two samples were taken. Group nine (categorized by opaque black color) had only two specimens, and Group eight (characterized by opaque grey color) had only four. Therefore, these color categories may be overrepresented in the sample. No green obsidian (Group 6) was sampled because it is widely accepted to be from the Pachuca source in Central Mexico. For Groups 1 through 5, I used Statistical Package for the Social Sciences (SPSS) to randomly sample three specimens from each group. Since the budget allowed for a few more samples, I went back and selected additional specimens for visual Groups 1, 2, 3, 4, and 5 since they contained the highest proportion of artifacts.

Table 4.2. List of specimen selected for chemical sample from each visual type.

Visual Category	*ID of Specimen Sampled for XRF Analysis*
1 = Cloudy Gray	57, 81, 151, 284
2 = Cloudy Gray with Striations	118, 137, 228, 259
3 = Clear Gray or Tan	179, 220, 372, 379
4 = Grainy Gray	41, 61, 98, 176
5= Grainy Gray with Striations	123, 276, 361, 363
6 = Green	None selected
7 = White and Black with Striations	147, 289, 375
8 = Opaque gray	43, 367
9 = Black	62, 230

The chemical characterization using x-ray fluorescence (XRF) analysis was carried out by the Institute for Integrative Research in Materials, Environments, and Society (IIRMES) at California State University Long Beach under the supervision of Hector Neff. A Bruker AXS Tracer III-V hand-held x-ray fluorescence (PXRF) spectrometer was used to perform the analysis. Artifacts and source materials were exposed to three minutes of x-ray emissions using 50 kV (voltage) 21 micro amps (current) using an obsidian filter composed of aluminum, copper, and titanium. Concentrations of elements calibrated against numerous obsidian samples from various places on earth. Elements measured during this procedure were Mn, Fe, Zn, Th, Rb, Sr, Y, Zr, and Nb. A dataset was created from these concentrations and plotted in a bivariate scatterplot to allow the visualization of source groups. Comparative samples from 12 sources were used in the analysis. Items from the following outcroppings were used: Cofre de Perote, Guadelupe, Victoria, Otumba, Oyameles/Zaragoza, Paredon, Pachuca, Tulancingo, Urcareo, Zacualtipan, El Chayal, Ixtepeque, and San Martin Jilotepeque.

Chapter 5: Results

I will begin by discussing the results of my lithic analysis as a way to describe the nature of obsidian available to the households of Actuncan and to better understand how it was being used at the site in varying contexts. Besides source determination and reconstruction of trade routes, standard analysis of obsidian weight, number, and formal characteristics can tell us about exchange among the prehistoric Maya. Through analysis of blade length, fragment type, and processing techniques it is possible to gain information on production techniques and the form in which obsidian arrived at Actuncan.

Obsidian Attribute Analysis

Actuncan's obsidian collection is largely composed of prismatic blades with only 6.5 percent of the assemblage representing flakes and production refuse (e.g. cores). Two of the cores were found in Group 1 and the other two were found at Structure 41, but the flakes were distributed across multiple households, both elite and non-elite. This suggests no correlation between socioeconomic status and blade production. While the four cores found at Actuncan technically should have been enough to produce the almost 600 blades found at the site since Clark (1997) states that around 180 blades could be produced per core, the blades are very narrow with largest ones around 2 cm wide which does not seem to reflect the presence of first series blades (De Leon et al. 2009). In addition, it is unlikely that a skilled knapper lived at Actuncan since such a small amount of obsidian has been found spread out over 2000 years. It seems doubtful that people at Actuncan were receiving one core everyone 300-500 years and someone local was skilled enough to knap it. These factors suggest that the blades were not being produced at Actuncan, or at least not at any of the structures excavated thus far.

The majority of the blades are fragmented with proximal ends making up 22 percent of the assemblage, medial fragments making up 68 percent, and the remaining 3 percent are distal ends (see Table 5.1). The proximal-distal ratio is just under 6:1, and the medial-distal ratio is 17:1. While is possible that a few distal ends were misidentified during analysis, an error De Leon and colleagues (2009) warn to avoid, it is unlikely that so many were misidentified. This implies that blades were being imported already processed.

Table 5.1. Frequency of each type of obsidian artifact found at Actuncan.

Cores	*Flakes*	*Proximal Blades*	*Medial Blades*	*Distal Blades*	*Reworked Flakes or Blades*	*Total*
4	33	128	402	20	4	591
(0.6%)	(5.6%)	(22%)	(68%)	(3.4%)	(0.6%)	(100%)

Table 5.2. Means and ranges of prismatic blade fragment measurements.

	Dorsal Ridges	*Mass (g)*	*Length (mm)*	*Width (mm)*	*Thickness (mm)*
Mean	*1.98*	.68	*18.9*	10.7	2.6
Range	*(0-5)*	*(.004-2.48)*	*(3.39-51.88)*	(3.07-49.96)	(0.92-14.16)

Early in my analysis, it was clear that the blades were all very narrow and most were short fragments of blades (see Table 5.2). Not only were the blades small, but there were no large tools or eccentrics made from obsidian and four cores. Since Actuncan is located approximately 300 km from the nearest source, access was limited and each piece was used to its full extent. When a resource is scarce, individuals will likely take care to use it as efficiently as possible (Fowler 1991).

Sidrys (1979) found that on average sites farther from the source were more efficient with their use of obsidian. He estimated that sites beyond 300 linear km from an obsidian source would have highly efficient CE/M ratios ranging from 5 to 7. If Actuncan falls into the same pattern as the sites in Sidrys' study, then a ratio of between 5 and 7 is expected since Actuncan, when measured linearly, is located 294 km from El Chayal and 315 km from Ixtepeque. The data shown in Table 5.3 make it quite clear that at Actuncan, blades were being produced and consumed highly efficiently. Even more efficiently than at any site Sidrys analyzed. The mean CE/M ratio at Actuncan for the entire occupation was 7.84, the mean width was 10.58 mm, and the mean thickness was 2.74 mm.

Table 5.3. Mean CE/M ratio, width, and thickness by time period.

Variables by Period	Late Preclassic	Early Classic	Late Classic	Terminal Classic	Postclassic
CE/M ratio	7.04	8.89	7.44	7.56	8.5
Mean Width (mm)	10.95	10.6	10.58	10.43	10.96
Mean Thickness (mm)	2.61	2.77	2.71	2.79	2.71

It might be the case that prismatic blades were not being produced at Actuncan from cores, nor were whole prismatic blades imported to the site. Instead they could have been produced and processed into smaller pieces at another site. Since the upper Belize River valley is located 300 linear kilometers from the nearest source, and even further when one accounts for topography, it seems logical that the long-distance traders from the highlands (i.e. *pochteca)* would have transported the obsidian in the most energy efficient manner to the area. This would mean leaving behind all excess material and transporting only processed prismatic blades into the lowlands. Local middle men or merchants then processed pieces from whole prismatic blades or simply distributes processed pieces. Processing might have happened at a larger center nearby, or perhaps at an elite residence, such as Laton, before middlemen distributed them to mid-sized centers such as Actuncan.

Distributional Study

The distributional study was the primary emphasis of this research. Excavations at Actuncan were undertaken at a household level; therefore, that is how I categorized my data. Although synchronic data are most often used to analyze exchange modes, I argue that the diachronic approach led to more interesting and interpretable results because, based on Hirth's model, a historical development of markets should homogenize the distribution of obsidian across households. As shown in Table 5.4, I used several different ratios to standardize the distribution of obsidian. I summed the weight of obsidian, weight of ceramics, weight of lithics, and volume of dirt for all units during each time period. I did not standardize based on individual households, but rather aggregated all elite into one group and all non-elite into another group.

Each ratio provided a different picture of obsidian consumption at Actuncan. Both obsidian-to-sherd and obsidian-to-lithic ratios standardize the sum of obsidian within elite and non-elite households by local materials, therefore the resulting indices should be a good measure of how much obsidian was available to individual households. Alternatively, the obsidian-to-volume ratio is standardizes obsidian based on the volume of dirt excavated, which should be an indicator of occupation, but it severely affected by construction episodes. In addition, I standardized marine shell by the weight of ceramics to make a comparison about how another imported item's use changed over time.

Interpreting the results of these ratios is difficult, because each ratio shows different trends. One reason this might occur is that sherd, lithic, and soil deposition are affected by social processes such as the timing of construction, household craft specialization, depositional patterns and termination rituals that result in the smashing of pottery. Because households engage in these activities differentially, the variables used as "standards" are, in fact, not constant and cause artificial spikes in the data. The obsidian-to-sherd ratio lends evidence to suggest that access to obsidian does not appear to be equalizing over time, rather elites gained tighter control of this resource over time starting the Late Classic period (Table 5.4 and Figure 5.1). Before the Late Classic period, elites and commoners appear to have relatively equal access to obsidian. Relatively even distribution across status in earlier time periods may mean that obsidian was initially circulated through 1) reciprocal relations or 2) markets. I suggest the more parsimonious explanation is reciprocal relations because there is little evidence for markets prior to the Terminal Classic period (Cap 2011; Dahlin 2009; Dahlin et al. 2007; Garcia 2008).

I prefer this ratio because it is not as affected by the drastically different amounts of dirt deposited due to construction at elite and non-elite households. On the other hand, this variable is affected depositional processes like termination rituals.

Table 5.4. Standardized obsidian weight by status across time. Red letters signify a statistically significant difference between groups (p <.001). Lots without ceramic and lithic weights were eliminated.

	Late Preclassic		**Early Classic**		**Late Classic**		**Terminal Classic**	
Variable Weight (g)	*Elite*	*Non-elite*	*Elite*	*Non-elite*	*Elite*	*Non-elite*	*Elite*	*Non-elite*
Obsidian	8.24	9.66	36.27	63.24	69.57	107.86	56.93	116
Ceramics	66925	115827	162936	209238	253344	711589	94700	669181
Lithics	11630	26967	24680	50589	63844	186957	25856	264079
Marine Shell	5	11	9	13	10	1	18	33
Volume	10.25	8.96	11.52	9.65	38.42	23.62	13.93	29.70
Obs/Sherd Ratio x 1000	.123	.083	.222	.302	.275	.152	.601	.173
Obs/Lithic Ratio x1000	.709	.358	1.47	1.25	1.09	.577	2.2	.439
Shell/Sherd x1000	.075	.095	.055	.062	.039	.001	.190	.049
Obs/Volume	.80	1.07	3.14	6.55	1.41	4.57	4.09	3.91

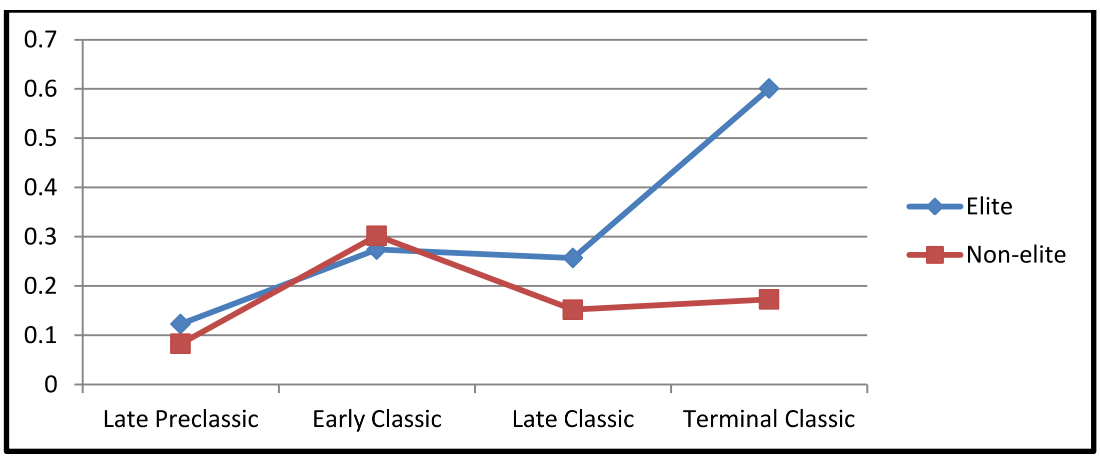

Figure 5.1**.** Line graph documenting elite and non-elite obsidian-to-sherd ratio over time.

Alternatively the obsidian-to-volume ratio appears to show similar changes in obsidian access in elite and non-elite residences (Table 5.4 and Figure 5.2). In fact, the line graph of this ratio appears to show that non-elites are accessing greater amounts of obsidian throughout the Preclassic and Classic periods, except for the Terminal Classic period. However, this patterning might be greatly skewed by the differential amount of household construction at elite and commoner households. Household construction fill consists mostly of cobbles, therefore this ratio is largely driven by the great amount of construction in elite households during the Classic period. This pattern is particularly true for Structure 41, which has a current collapsed height of around 9 m. Comparatively, Group 1's tallest structure is under 2 m.

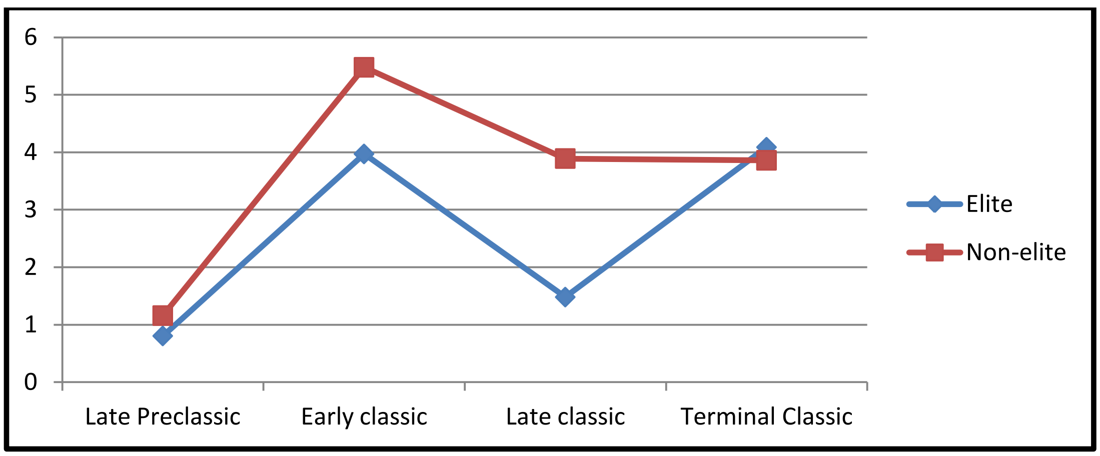

Figure 5.2. Line graph documenting elite and non-elite obsidian-to-volume ratio.

As a result of these inconsistencies, I decided to look at the mean weight of obsidian per each 1-by-1 m unit during each time period (see Figure 5.3). This is a form of spatial standardization similar to that used by Sidrys (1976), but his looked at cubic meters. I used time periods to determine the depth of the 1x1m unit, while Sidrys simply standardized the weight of obsidian by each cubic meter. With my method, the volume of each unit may vary, but the area is equal and comprised of only one time period. The results of this analysis (Figure 5.3) appears similar to those for the obsidian-to-volume ratio (Figure 5.2), which is understandable since the artifact content of either area of volume is still skewed by nature of construction fill. Further, construction sequences that have more analytical units with no obsidian skew the mean obsidian weight per unit.

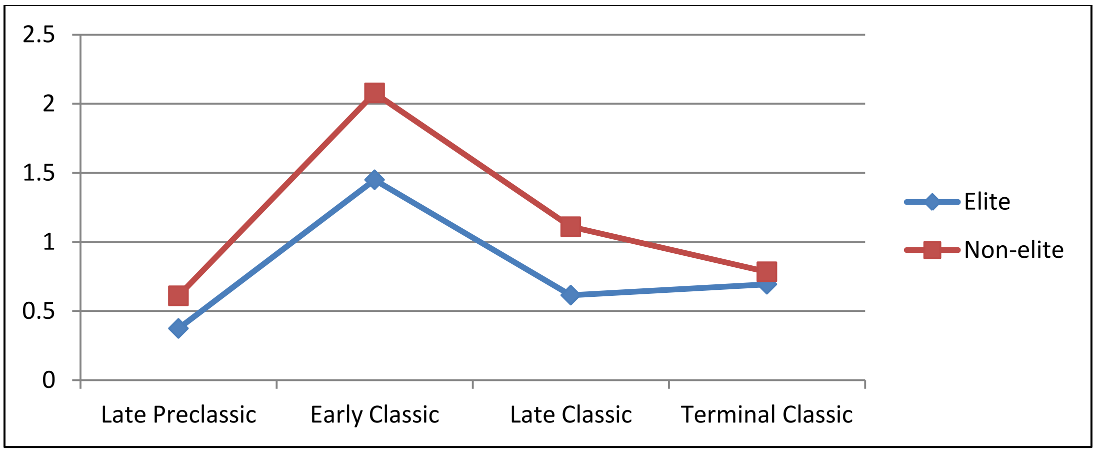

Figure 5.3. Line graph documenting the mean weight (g) of obsidian per 1-by-1 m unit in elite and non-elite contexts over time.

In both the area and volume ratios, the results showed an even distribution of obsidian in elite and non-elite contexts over time. Therefore, according to Hirth's model, this suggests that market exchange was the cause for this distribution since the Late Preclassic period. This interpretation is highly unlikely and unprecedented among the ancient Maya. Perhaps there is no good way to standardize artifacts from all contexts without leaving the results subject to the effects of cultural processes that may affect some artifact classes differently than others.

To give a better visual of where obsidian is concentrated at Actuncan, I will now look at the distribution of obsidian by household. This is important because certain households may be skewing the results of the analysis when only socioeconomic status is considered. In addition, certain households may have had changing access to obsidian over time and this may provide clues about changing political and social relationships at Actuncan. I felt that maps of the changing densities over time would be the best way to portray these changes. The maps can be seen below in Figure 5.4 through 5.7, and the numerical data underlying these charts can be seen in Appendix C.

The following maps display the total weight of obsidian standardized by ceramics weights for particular households. Since initial excavations in Group 1, 2, and 3 did not record the counts and weights of ceramics and lithics, the following units were excluded from the analysis since proper standardization could not occur: 1A, 1B, 2A, and 3A. Unfortunately, Units 2A and 3A were the only units excavated at these households, so they were eliminated from this analysis. In addition, Structure 34, a long, narrow building located on the east side of the civic plaza, appears to have been a civic structure, not a household, but I included it in the maps for comparative purposes. Structure 34 was eliminated from the distributional table so as not to skew the results of the household study. Lastly, during the Early Classic period it appears that the area later occupied as Structure 18 was used as a refuse pile. Data collected from Structure 18 during the Late Classic period was also eliminated from the analysis since it does not represent household occupation.

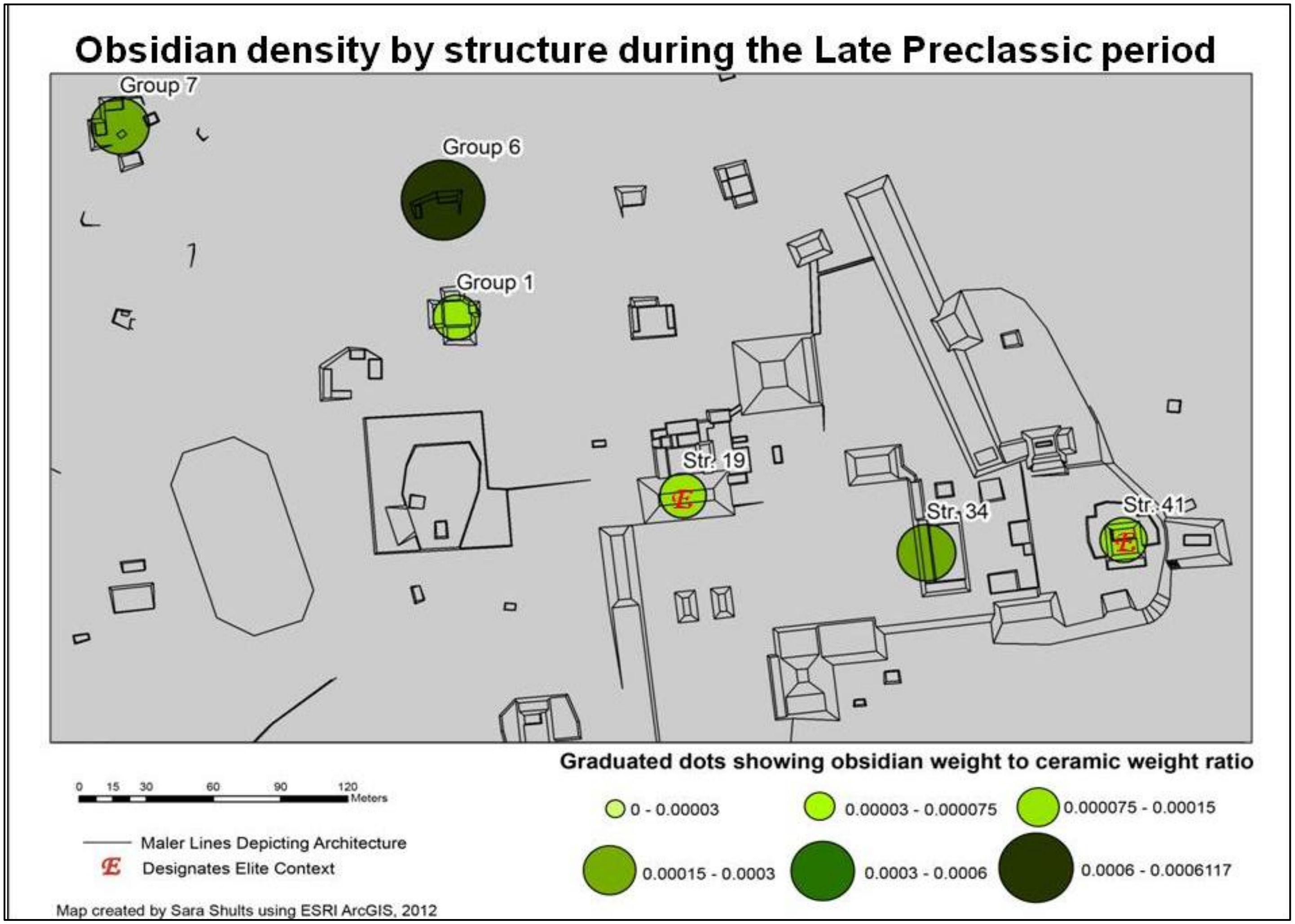

Figure 5.4. Dot density map showing concentration of obsidian in household at Actuncan during the Late Preclassic period.

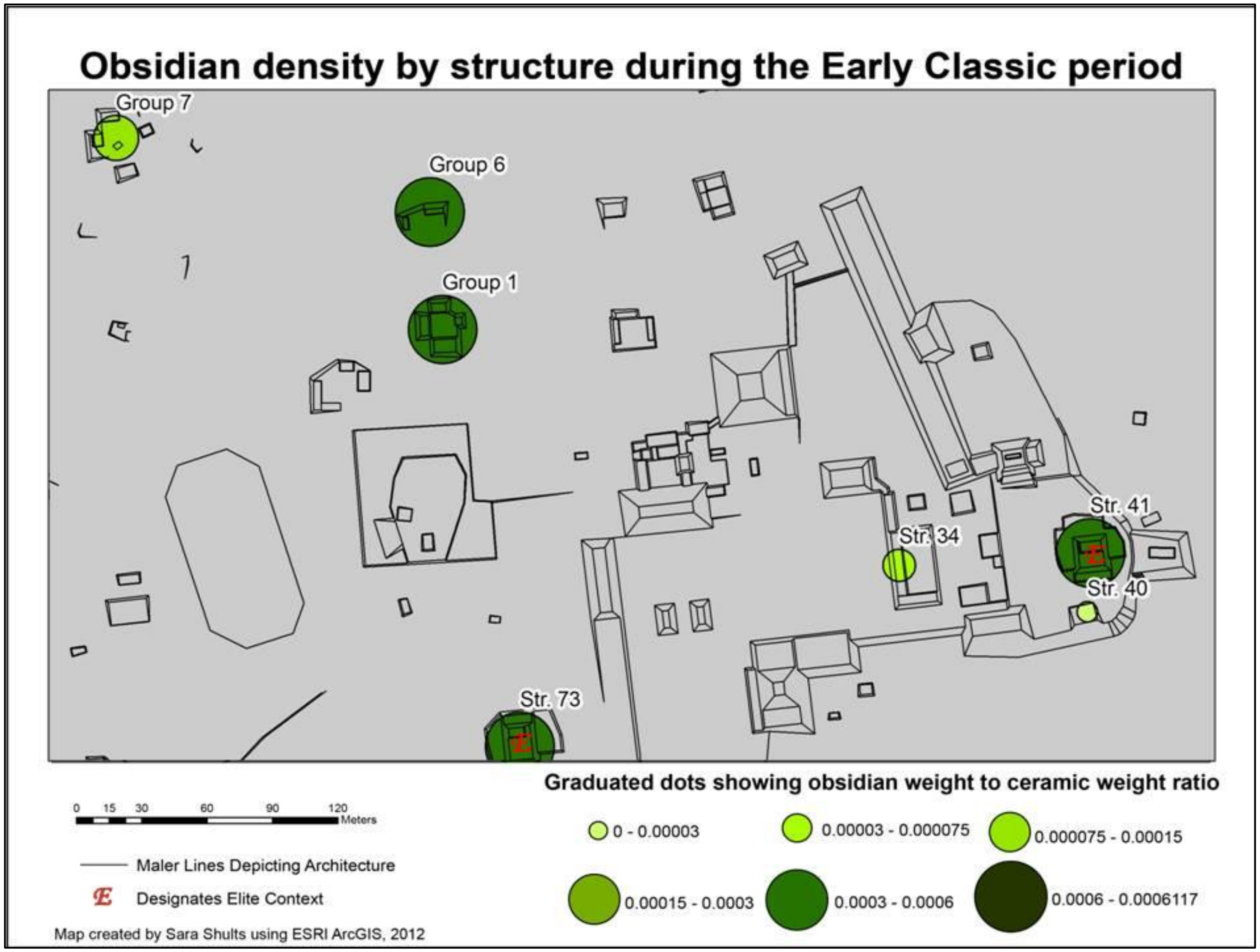

Figure 5.5. Dot density map showing concentration of obsidian in household at Actuncan during the Early Classic period.

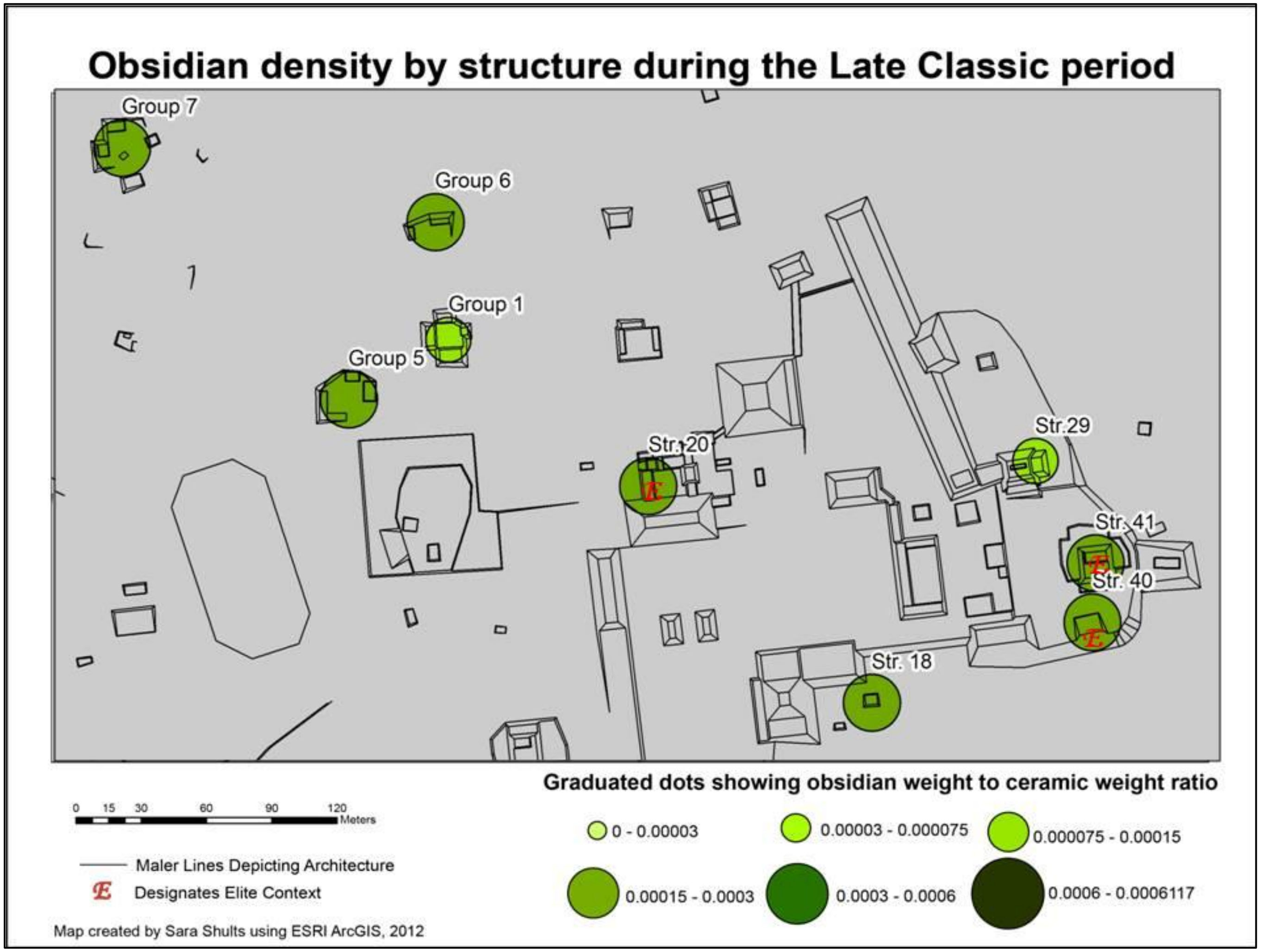

Figure 5.6. Dot density map showing concentration of obsidian in household at Actuncan during the Late Classic period.

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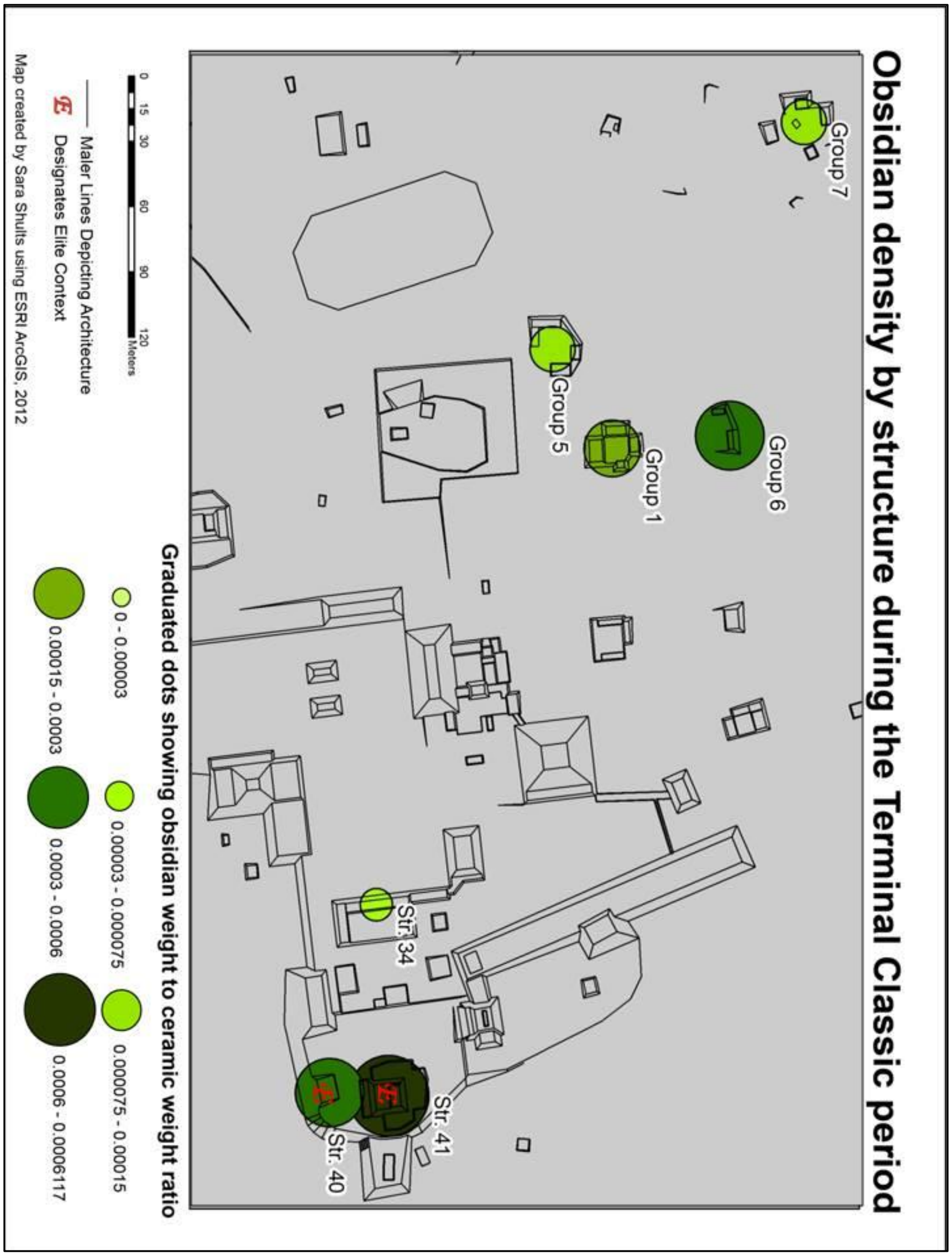

Figure 5.7. Dot density map showing concentration of obsidian in household at Actuncan during the Terminal Classic period.

When examining the trends seen in the maps, it is easy to track occupation and abandonment of certain households, like Structure 73. In addition, it appears that in the Late Preclassic period most of the households had similar access to obsidian. In the Early Classic period, more elite households had access to obsidian than non-elites, but many of them have relatively low quantities. In the Late Classic period, the distribution of obsidian across household appears similar across households of differing rank in the map, which contradicts evidence shown in the tabulated data showing obsidian-to-ceramic ratios in elite and non-elite households based on the lumped sum of all variables by status (Table 5.4). This inconsistency arises because dots for households with no obsidian are not displayed on the map since there is no density to measure. But these households with no obsidian were included in the previous ratios that summed variables by status.

Some interesting patterns emerge in this analysis. First, in the Terminal Classic period, the higher concentration of obsidian in elite contexts can be clearly seen, particularly in Structures 40 and 41. This coincides with the data shown in Table 5.4 and Figure 5.1 that suggest the elite took greatest control of obsidian during the Terminal Classic period. Also, Group 6 stands out in the dot density map because it has the highest ratio of obsidian-to-ceramic weight during the Late Preclassic period. Interestingly, it also maintains a high ratio of obsidian-to-ceramics for all other time periods despite its location farther from the civic core. It has been suggested that Group 6 may have been associated with Group 1since the two groups appear to have been connected by a low *sacbe* (walkway). The presence of other imports like a jade bead and shell tinkler at Group 6 led to suggestions that it may have been a shrine for Group 1 residents which would explain the high incidence of obsidian, especially when compared to ceramics which would have been less in a ceremonial context (Simova 2012).

Like the ratio of obsidian-to-ceramics lumped by status, these density maps are affected by the deposition of ceramics, but do show a clearer picture of which households were consuming the most obsidian. What is interesting is that certain elite and non-elite households consumed more obsidian than others, which may be influenced by a number of factors, including exchange networks and domestic activities.

Results of Visual and Chemical Sourcing

In this section I will discuss the results of the chemical and visual sourcing analyses. I will begin with the visual sourcing dataset since it includes the entire obsidian collection. The chemical sourcing is certainly more accurate, but unfortunately only 5 percent of the assemblage was sourced therefore results had to be interpolated across the visually identified categories.

The majority of obsidian at Actuncan was gray in color, as is the norm in this region (Table 5.5). There are numerous shades of gray, but the texture and striation patterns vary. The most common category was "Cloudy Light Gray" which comprised 23.1 percent of the assemblage. I infer that all pieces in this category are from El Chayal. The next most common is "Clear Gray or Tan" which made up 20.7 percent of the assemblage. I infer that the "Clear Gray or Tan" category correlated to Ixtepeque obsidian since it is described as a clear brown color, like a coke bottle, differing from other grays in its sharp refraction of light (Braswell et al. 2000). The third most common was "Grainy Gray" which included 18 percent of the sample. With the exception of a few pieces that I noted had extremely large grains, a characteristic unique to San Martin Jilotepeque, I inferred that most pieces in this category were from El Chayal. Comprising 16.8 percent of the assemblage is "Grainy Gray with Striations" obsidian pieces, which I also inferred to be from El Chayal. Making up 15 percent of the sample, "Cloudy Light Gray with Striations" was inferred to be from El Chayal. The remaining four categories each represent 2 percent or less of the assemblage. White and Black with Striations", "Opaque Gray" and "Black" were all inferred to be from El Chayal based on the results of chemical analyses, although I separated them out initially thinking they may have been from a rarer source like Ucareo. Finally, the "Green" obsidian made up only 1.2 percent of the assemblage and was inferred to be from Pachuca, Hidalgo, Mexico.

Table 5.5. Frequency and percent of obsidian in elite and non-elite contexts.

Color Category	Count of Obsidian		Percent by Status		Percent of Total
	Elite	*Non-elite*	*Elite*	*Non-elite*	
Cloudy Light Gray	56	81	*19.9 %*	*26.0 %*	*23.1%*
Cloudy Light Gray w/ Striations	40	49	*14.2 %*	*15.8 %*	*15.1%*
Clear Gray or Tan	59	63	*20.9 %*	*20.3 %*	*20.7%*
Grainy Gray	57	50	*20.2 %*	*16.1 %*	*18.1%*
Grainy Gray with Striations	48	52	*17 %*	*16.7 %*	*16.8%*
Green	4	3	*1.4 %*	*1.0 %*	*1.2%*
White and Black Striations	10	2	*3.5 %*	*0.6 %*	*2.1%*
Opaque Gray	3	4	*1.1 %*	*1.3 %*	*1.2%*
Black	3	7	*1.1 %*	*2.3 %*	*1.7%*
Total	280	311	*100%*	*100%*	*100%*

While Pachuca green obsidian from Hidalgo, Mexico is very rare at Actuncan, it provides an interesting glimpse into Actuncan's relationship with Teotihuacan, the site likely controlling this source. It is unlikely that Teotihuacan had a direct relationship with Actuncan since it is a medium size center located very far from central Mexico. Therefore, Pachuca obsidian likely made its way to Actuncan via down-the-line trade, probably though elite gift exchange. Oddly, only four pieces (57 %) are found in elite contexts while the other three (43%) are found in non-elite contexts. All four elite pieces were found at Structure 41 (two during Early Classic period and two during Terminal Classic period), the largest and most thoroughly excavated elite structure. Two of the three pieces found in non-elite contexts were found at Structure 65, in Group 5 and they date to the Terminal Classic period. The one remaining piece of Pachuca obsidian was found at Group 1, the largest and most excavated non-elite household group, and it dates to the Early Classic time period. Perhaps, the elites were rewarding these households or trying to win their support with this valuable import. The color group "White and Black Striations" is also found primarily in elite contexts (3.5%, opposed to 0.6% in non-elite) and may have been treated similarly to Pachuca obsidian based on visual preference.

Chemical Sourcing

Chemical sourcing of Actuncan's obsidian using XRF is a relatively simple procedure. Attribution to sources was conducted by Hector Neff who is knowledgeable of current standards for elemental proportions within each source (see Appendix D for chemical data). Figures 5.8 and 5.9 show the distribution of each piece of obsidian on bivariate plots of diagnostics elements (iron, rubidium, zirconium). They clearly fall into groups because the proportion of these elements is highly homogenous within each volcanic flow, but variable between sources. Since elements from each geological source have been measured repeatedly and are used as standards, there is little room for error in this analysis.

Overall, my visual color groups correlate well to the chemical sources determined using XRF. As seen in Table 5.6, 20 out of 27 were correctly sourced by visual characteristics. Chemical sourcing of obsidian based on color show that 21 (78%) derive from El Chayal, Guatemala, three derive from Ixtepeque (11%) and two (7%) derive from San Martin Jilotepeque. The source of one piece (ACT062) failed to be determined using XRF, because it appears to be basaltic glass. Since we decided to do no further chemical analysis on this piece, its source location cannot be determined at this point. My sampling strategy biased these results since I picked equal amount from each color group and El Chayal, being widely variable in color, is the primary chemical source for seven of the nine visual groups.

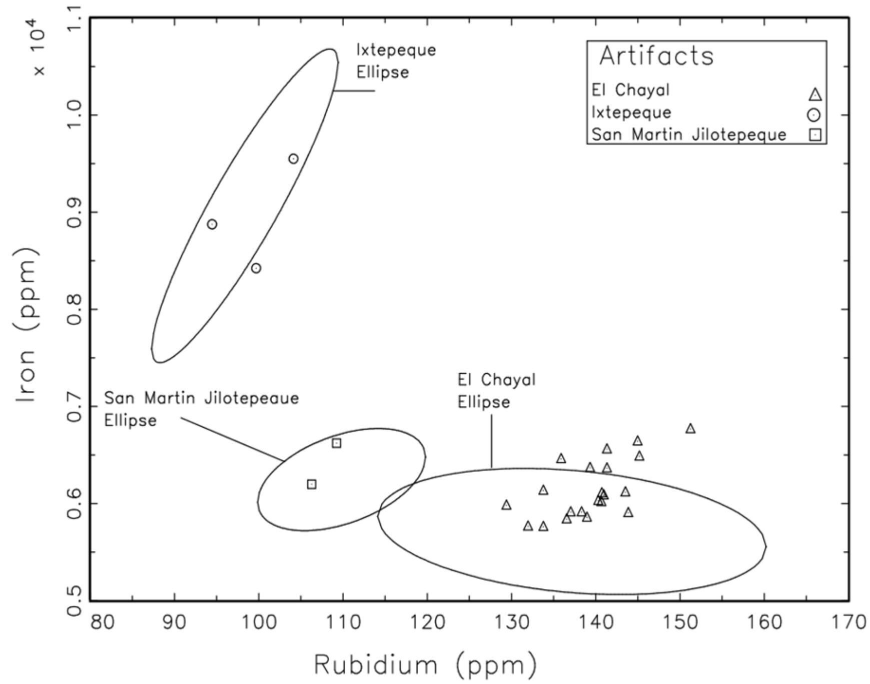

Figure 5.8. Rubidium-Iron bivarate plot illustrating the probable sources (ellipses) of Actuncan obsidian artifacts

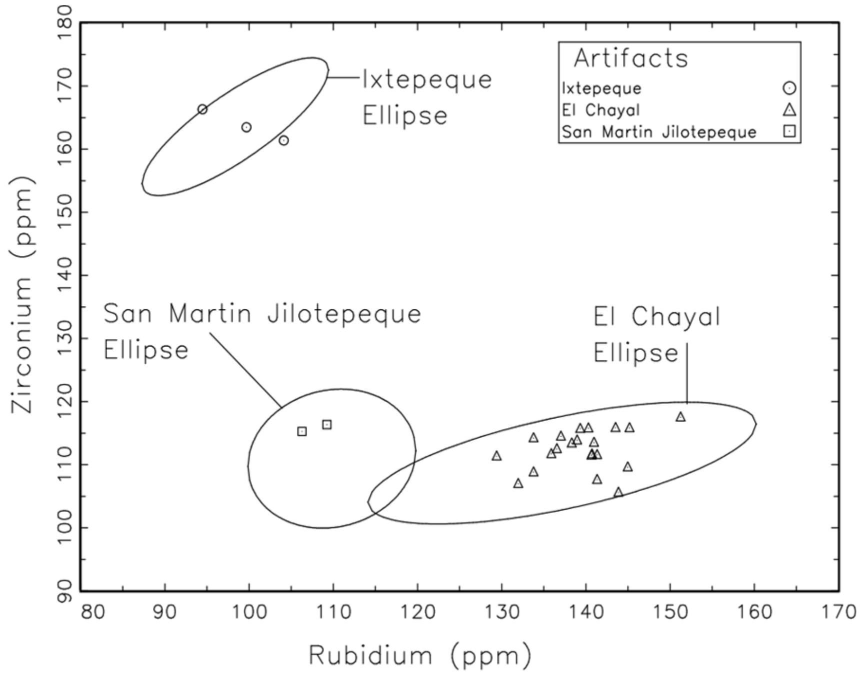

Figure 5.9. Rubidium-Zirconium bivarate plot illustrating the probable sources (ellipses) of Actuncan obsidian artifacts

In some cases my color categories were not unanimously attributed to one source. The problematic groups included "Grainy Gray", "Grainy Gray with Striations", "Black", and "Clear Tan or Gray" (see Table 5.6 for individual visual source attribution). Initially I assumed that "black" obsidian was from the Ucareo source in central Mexico, but when the chemical analysis of three pieces all came back as El Chayal I changed any other pieces I assigned to the color "Black" to El Chayal in my database. In other instances, the error was not as easily addressed. My "Grainy Gray" category sourced to El Chayal in three cases, but San Martin Jilotepeque in another case. Similarly, the "Grainy Gray with Striations" category sourced to El Chayal once and San Martin Jilotepeque once. Even the "Clear Tan or Gray" category that I felt sure was Ixtepeque returned inconsistent results. One of the four pieces sourced from this group was attributed to El Chayal rather than Ixtepeque.

Table 5.5. List of each sample, its color, estimated visual source, and actual chemical source

Specimen	Provenience	Color	Visual Source	Chemical Source
41	1D13	*Grainy Gray*	El Chayal	El Chayal
43	1D15	*Opaque Gray*	El Chayal	El Chayal
57	1I2	*Cloudy Light Gray*	El Chayal	El Chayal
61	1L2	*Grainy Gray*	El Chayal	El Chayal
62	1M1	*Black*	**Ucareo**	**Unknown**
81	1FF2	*Cloudy Light Gray*	El Chayal	El Chayal
98	1PP2	*Grainy Gray*	El Chayal	El Chayal
118	1KKK4	*Cloudy Light Gray w/Striations*	El Chayal	El Chayal
123	1SSS3	*Black*	**Ucareo**	**El Chayal**
137	3A3	*Cloudy Light Gray w/Striations*	El Chayal	El Chayal
147	4C5	*White and Black Striations*	El Chayal	El Chayal
151	5A1	*Cloudy Light Gray*	El Chayal	El Chayal
176	5B1	*Grainy Gray*	**El Chayal**	**San Martin Jilotepeque**
179	5B3	*Clear Gray or Tan*	Ixtepeque	Ixtepeque
220	4C1	*Clear Gray or Tan*	**Ixtepeque**	**El Chayal**
229	6C1	*Cloudy Light Gray w/Striations*	El Chayal	El Chayal
230	6C1	*Black*	**Ucareo**	**El Chayal**
259	6O4	*Cloudy Light Gray w/Striations*	El Chayal	El Chayal
276	6T3	*Grainy Gray w/Striations*	**El Chayal**	**San Martin Jilotepeque**
284	6U3	*Cloudy Light Gray*	El Chayal	El Chayal
289	6V3	*White and Black Striations*	El Chayal	El Chayal
357	6AAAA2	*Clear Gray or Tan*	Ixtepeque	Ixtepeque
361	6BBBB2	*Grainy Gray w/Striations*	El Chayal	El Chayal
363	6CCCC2	*Black*	**Ucareo**	**El Chayal**
367	6GGGG2	*Opaque Gray*	El Chayal	El Chayal
375	6PPPP1	*White and Black Striations*	El Chayal	El Chayal
379	6TTTT1	*Clear Gray or Tan*	Ixtepeque	Ixtepeque

Overall, I feel that the visual source analysis gave me a good basis upon which to assign sources to my collection, but with the understanding that sometimes it is difficult to visually discern the difference between Guatemalan sources. After seeing the chemical results, I revised my inferred sources for the entire collection. Currently, I suggest that El Chayal represents 77 percent of the assemblage, Ixtepeque represents 20 percent of the total, and a little over 1 percent is from Pachuca. The remaining 2 percent are from San Martin Jilotepeque and potentially other Mexican sources that were not identified.

Obsidian Use across Time at Actuncan

The distribution of the chemically sourced sample over time agrees with Nelson's model for shifting trade routes. While my chemically sourced sample did not include any obsidian from the Preclassic or Early Classic periods when San Martin Jilotepeque obsidian is expected to be more common in lowland sites, a shift from primary use of El Chayal to Ixtepeque in the Terminal Classic can be seen in the chemically sourced sample (Table 5.6). In the Late Classic period, El Chayal makes up 81 percent of the sample and 9 percent was sourced to both Ixtepeque and San Martin Jilotepeque. By the Terminal Classic period, San Martin Jilotepeque is no longer present, and there is 50 percent Ixtepeque and 50 percent El Chayal in households at Actuncan (Table 5.6). Due to sampling methods, these results are likely skewed since I did not perform a random sample, but rather a stratified random sample based on color.

Table 5.7. Chemical sources of 27 piece sample shown over time.

	Late Classic	**Terminal Classic**	**Postclassic**
El Chayal	9	10	2
Ixtepeque	1	0	2
San Martin Jilotepeque	1	1	0

When the results of chemical analyses are applied to the assigned visual categories, the results are not as clear. As seen in Table 5.8, access to different sources does not appear to be changing much over time. If the results of the visual sourcing are accurate, then Nelson's (1985) hypothesis that Ixtepeque obsidian did not reach inland sites until the Terminal Classic period is not confirmed at Actuncan. Others have noted this trend at Classic period sites like Nohmul and Colha (Dreiss et al. 1993; McKillop 1995). In addition, it seems that Actuncan was receiving a very minimal amount of San Martin Jilotepeque obsidian, but this may be an error in visual sourcing. When comparing elite and non-elite contexts, access to different sources looks very similar over time as well. Pachuca is the only source that appears to have been accessed differently (Figure 5.10 and 5.11).

Table 5.8. Inferred visual source results shown diachronically at Actuncan.

Obsidian source	Late Preclassic		Early Classic		Late Classic		Terminal Classic		Postclassic	
	No.	%	No.	%	No.	%	No.	%	No.	%
El Chayal	20	*83*	100	*73*	170	*79*	126	*77*	27	*82*
Ixtepeque	4	*17*	35	*26*	43	*20*	31	*20*	6	*18*
San Martin Jilotepeque	-	-	-	-	2	*1*	1	*1*	-	-
Pachuca	-	-	2	*1*	-	-	4	*2*	-	-
Total	24		137		215		164		33	

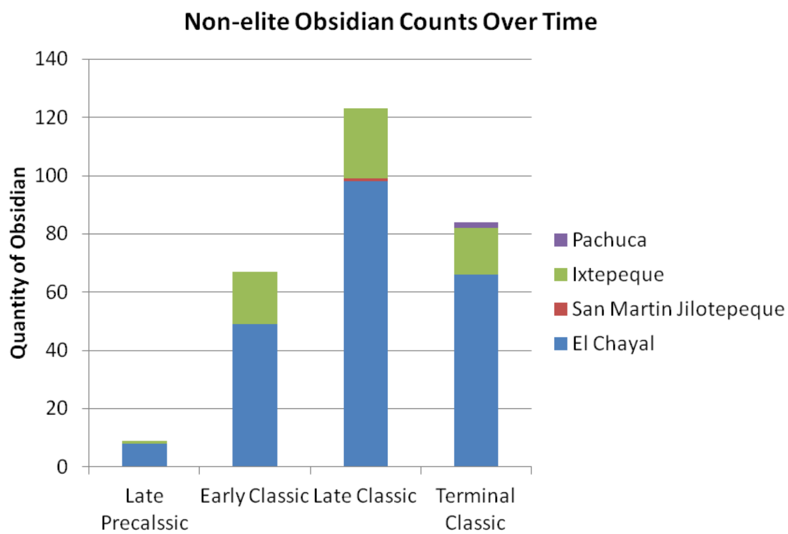

Figure 5.10. Inferred source use in non-elite contexts over time at Actuncan.

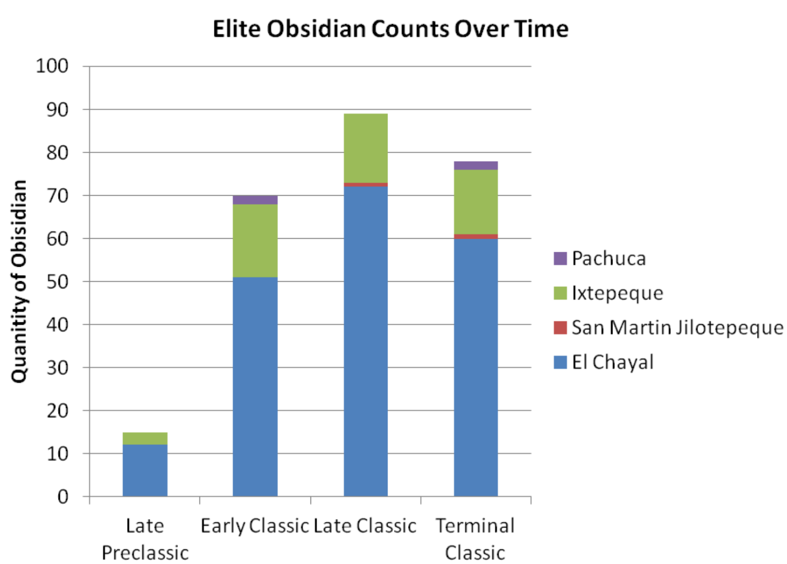

Figure 5.11. Inferred source use in elite contexts over time at Actuncan.

Chapter 6: Conclusions

When I began this study, my knowledge of obsidian trade in the Maya area was largely based on Kenneth Hirth's (1998) article "The Distributional Approach: A New Way to Identify Marketplace Exchange in the Archaeological Record". After reading this article and deciding I would use his model to conduct my study, I felt quite sure that my results would mimic his and that there would be evidence of marketplace exchange in the Terminal Classic period at Actuncan. Upon further reading, I began to realize that markets and marketplaces were not as easy to distinguish as I initially thought. Many archaeologists deny the existence of marketplaces at such an early time, while others suggest that Hirth's method is not the best way of identifying them (Garraty 2009; Smith 1998; Wilk 1998).

This study was conducted not only to determine the type of exchange at work at Actuncan, but also to determine whether or not Hirth's distributional approach is effective in identifying marketplace exchange in the eastern Maya lowlands. While the methods I employed in applying Hirth's approach revealed much about obsidian at Actuncan, I feel there are a number of reasons his approach does not work in the eastern Maya Lowlands the way that it did in central Mexico. For example, the eastern Maya lowlands are located much further from the geological source of obsidian than Xochicalco, Mexico. In addition, there are few sites with the type of depositional preservation seen at Xochicalco. Hirth was able to look at actual household deposition on floors of buildings since the site was rapidly abandoned during the Postclassic period. Nonetheless, the organization of data suggested by his model offered a clear path and method under which to conduct my study.

My analysis provided evidence that obsidian was not being produced at Actuncan since there only a miniscule amount of production debris has been excavated. In addition, the amount of obsidian present at the site along with the small size of the blades shows that Actuncan was only receiving what was left over after a long journey from the Guatemalan highlands, the location of the three primary sources identified through chemical sourcing. Only seven pieces are known to have originated at a geological sources outside of Guatemala, and they are all Pachuca green obsidian from central Mexico. Four of these pieces were found in elite Structure 41, but the other three were found in non-elite Groups 1 and 5. While Pachuca obsidian is generally considered a prestige item used to show ties to Teotihuacan, at Actuncan the sample is too small to say much about whether it was particularly confined to ritual or elite spaces. Although the obsidian was clearly being imported and used in households at Actuncan, it is still unclear what means of exchange brought the obsidian to Actuncan.

While all the households currently excavated at Actuncan contain obsidian, the amount of obsidian they have varies. Unfortunately, it is difficult to determine whether there is a significant difference between elite and non-elites because of the many cultural factors affecting the standardization of the obsidian data. When standardizing by ceramics, a primarily utilitarian product that should be indicative of the number of people supported by the household, it appears that elites have much greater access to obsidian in the Terminal Classic period than non-elites. Alternatively, when I standardize by the volume of dirt excavated, the trend shows that elites and non-elites have relatively equal access to obsidian over time at Actuncan. In my opinion, the results of the obsidian-to-ceramic ratios provide the most consistent patterning. Before the Late Classic period, elites and commoners appear to have relatively equal access to obsidian that lends evidence to suggest that obsidian was circulated through reciprocal relations. However, afterward, elites appear to control the distribution of obsidian because by the Terminal Classic period elite households have as much as three times that of commoners.

After seeing the discrepancy in my initial forms of standardization, I conducted a spatial form of standardization and found that the mean weight of obsidian per1-by-1 m unit for elite and non-elite contexts in each time period is similar. Much like the obsidian-to-volume ratio, it appears that the consumption of obsidian was similar in elite and non-elite contexts during all time periods examined. This pattern suggests that perhaps obsidian was relatively easily available and not considered a prestige item. Rather, obsidian was a scare but necessary domestic item. While I do not believe that this long-term homogeneity was the result of market exchange, I do think it is possible that reciprocal exchanges and potentially redistribution between elites and commoners were acting to circulate obsidian relatively evenly across households. This idea in itself goes against Hirth’s model that suggests market exchange is the primary leveling mechanism for the circulation of imported goods.

Still, after careful inspection of the data, I do not find clear evidence as to whether obsidian was exchanged as a commodity, nor is there evidence for a marketplace at Actuncan currently since the results of this study were inconclusive. While marketplaces were likely present in other sites in the Belize River valley as suggested by numerous archaeologists, it is unclear whether or not obsidian was traded in these markets based on market principles of supply and demand (Cap 2011; Chase and Chase 2001; Keller 2006).

In the following closing paragraphs I briefly outline some of the differences between the lowland Maya and central Mexican cases and present some ideas to strengthen the distributional approach when it is used in lowland Maya archaeology. In Hirth’s (1998) study, he applied the distributional approach to Xochicalco, a regional center from A.D. 650-900 located in central

Mexico. Xochicalco is located near several well known obsidian outcroppings. While Hirth considers obsidian an import, it is a regional import at best when compared to the exceedingly long distances obsidian had to travel to reach the eastern Maya lowlands. In addition, Hirth (1998) refers to obsidian as a "commodity". While it may have been a commodity in central Mexico since it was easily accessible through numerous middlemen or merchants operating within a short supply chain from source to consumer, it does not appear that obsidian functioned as a commodity in the upper Belize River valley where it trickled down through many hands to the end of the supply chain. When a resource is as scarce as obsidian was in the Belize River valley, it is easily susceptible to elite administration. Even if it were sold in marketplaces, I suggest that the amount released into the marketplace was determined by the elite who gained prestige based on their ability to furnish obsidian.

After applying my data to Hirth's model, it seems to me that obsidian may not be the best artifact to use in the eastern Maya lowlands to investigate markets since it is easily controlled by elites. Perhaps marine shell, a regional import from the Gulf of Mexico, would be more suitable for the application of Hirth's approach, but marine shell is found in smaller quantities in Classic contexts than obsidian which suggests it was not a commodity either. The biggest issue when exploring exchange among the ancient Maya is that it is difficult to standardize one artifact in a way that is not greatly affected by other depositional processes, like construction and termination rituals. In the future, a ubiquity or diversity measure like Garraty (2009) used would be a better measure of access to high value or imported items. In addition, it is also possible that limiting the sample to occupation context only might produce better results. However, the sample sizes might be too small to produce statistically significant results.

Of course, the distributional approach is not the only method for testing the presence of markets. Angela Keller (2006; 2012) has also been searching for a marketplace at Actuncan using a *configurational* approach. While Actuncan is located on the Mopan River, a main trade route, there is no evidence that it was a noteworthy stopping place, at least for obsidian trade. Like most Maya sites, Actuncan has an open plaza near the civic center, the West Plaza, but in this plaza there is little evidence for market stalls. In addition, Keller's soil chemistry and microartifact analysis did not reveal any substantial evidence for a marketplace in the West Plaza. While there is one area of the plaza with a higher concentration of lithic debitage, its location seems oddly placed and the evidence does not form a pattern. Therefore, the data are inconclusive (Keller 2012). From a *contextual* perspective, Actuncan has little evidence of market provisioning in the form of workshops or full-time craft specialists. Garcia's (2008) research on local ceramics was inconclusive in demonstrating that local ceramics were being mass produced since there was no increase in standardization of paste recipes or stylistic elements through the Late and Terminal Classic periods. Lastly, from a *spatial* point of view analysis of chipped stone tool production in the Xunantunich polity, which included Actuncan, shows that participation in the chipped-stone economy was not uniform, or homogenous, but rather it varied at a household and settlement scale (Vandenbosch et al. 2010). If these tools had been distributed in a marketplace, then the settlements closer to the center of the Xunantunich polity should have had more uniform assemblages, while those further from the capital would show greater variability (Vandenbosch et al. 2010). But according to Vandenbosch's lithic chert data, this was not the case.

Some of the evidence provided by this study indicates that obsidian was not exchanged in a commercial market during the Classic period. Based on the obsidian-to-ceramic ratio, it can be suggested that Actuncan elites had greater access to the resource, likely through preferred trade partnerships, redistribution from paramount capitals, or buying power at an administered market at another site nearby. While other nearby sites like Buenavista del Cayo and Caracol are purported to have had marketplaces, it is unclear whether the obsidian was exchanged the same way as local and perishable items that have been identified in market contexts (Cap 2011; Chase and Chase 2001). Evidence of an obsidian workshop at Laton near El Pilar is not convincing evidence in favor of a marketplace in the region either. Elites could, and likely did, control the production and exchange of obsidian (Ford 2004). Even if obsidian was exchanged in the marketplace, it is likely that the elite administered the amount in circulation.

However, if we look at the ratios of obsidian-to-volume and obsidian per unit, then this research provides some evidence to suggest that obsidian was distributed evenly across households of differing rank at Actuncan in all time periods. It is unclear at this point in time what exactly that means, but does imply that obsidian was used and exchanged similarly from the Late Preclassic period forward. Further research and other forms of analysis will shed light on whether elite were controlling obsidian distribution or if it was primarily a utilitarian item open to access by all. The fact that there have been no eccentric or decorative items made from obsidian excavated at the site suggests that it was used primarily for domestic purposes.

At Actuncan, research at households will continue. Data collected in the spring 2012 field season will contribute to our knowledge of the relationships between commoner, elite and noble groups and shed more light on exchange at Actuncan. Further chemical sourcing of obsidian at the site will surely reveal more in the way of changing source use over time.

As with all archaeology, the continuation of research molds and shapes theoretical ideas and assertions, and as archaeologists it is important to always be willing to change our interpretations when the data demands it rather than changing the data to our demands. This study did not result in the conclusion I anticipated at the outset, but nevertheless it has provided a new perspective on marketplaces from the Belize River Valley and aided in the creating the cultural history at Actuncan.

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Appendix A: Obsidian Attributes

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
1	1	A	1	Prismatic blade	medial	0.86	21.03	13.1	1.97
2	1	A	1	Prismatic blade	medial	0.33	15.97	7.51	2.19
3	1	A	3	Prismatic blade	medial	0.18	9.98	6.99	2.15
4	1	A	5	Reworked blade fragment	medial	0.39	11.19	12.11	3.33
5	1	A	5	Prismatic blade	medial	0.68	16.77	12.6	2.23
6	1	A	5	Prismatic blade	medial	0.28	12.07	8.78	3.03
7	1	A	5	Prismatic blade	medial	0.73	19.75	12.21	2.51
8	1	A	5	Prismatic blade	medial	0.66	20.25	10.79	2.44
9	1	A	8	Prismatic blade	medial	0.25	13.35	9.32	1.33
10	1	A	9	Reworked blade fragment	proximal	0.55	13.2	15.11	3.91
11	1	A	12	Prismatic blade	proximal	1.15	26.42	11.4	3.23
12	1	B	2	Prismatic blade	medial	0.15	11.06	8.57	1.79
13	1	B	2	Prismatic blade	medial	0.21	9.21	8.25	2.55
14	1	B	2	Prismatic blade	medial	0.57	16.45	11.63	2.54
15	1	B	3	Prismatic blade	medial	0.72	21.28	10.06	2.6
16	1	B	3	Prismatic blade	medial	0.69	15.8	13.95	2.82
17	1	B	4	Prismatic blade	medial	0.34	18.99	8.48	1.6
18	1	B	5	Prismatic blade	medial	0.81	26.49	10.86	2.33
19	1	B	15	Prismatic blade	proximal	1.82	39.73	12.18	3.84
20	1	C	1	Prismatic blade	medial	0.36	8.28	12.11	3.52
21	1	C	8	Prismatic blade	medial	0.34	16.64	7.61	2
22	1	C	8	Prismatic blade	medial	0.5	16.41	11.95	2.53
23	1	C	8	Prismatic blade	proximal	0.33	10.86	11.74	2.34
24	1	C	8	Prismatic blade	medial	0.58	16.59	12.76	1.91
25	1	C	9	Prismatic blade	medial	0.48	19.55	9.7	2.27
26	1	C	9	Prismatic blade	medial	0.59	17.48	13.55	2.34
27	1	C	12	Prismatic blade	proximal	0.33	11.94	9.99	2.28
28	1	D	0	Prismatic blade	medial	0.74	21.73	9.88	2.7
29	1	D	2	Prismatic blade	medial	0.96	24.06	9.14	3.71
30	1	D	4	Prismatic blade	proximal	2.08	37.6	13.89	4.03
31	1	D	4	Prismatic blade	medial	1.27	26.65	12.49	2.86
32	1	D	4	Prismatic blade	medial	0.49	17.67	9.83	2.55
33	1	D	7	Prismatic blade	distal	2.48	46.89	11.55	4.29
34	1	D	7	Prismatic blade	medial	0.67	17.58	9.53	3.38

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
35	1	D	7	Prismatic blade	medial	0.52	11.68	9.7	3.38
36	1	D	7	Prismatic blade	medial	0.35	10.69	10.81	2.45
37	1	D	9	Prismatic blade	proximal	1.27	33.66	10.79	2.45
38	1	D	9	Prismatic blade	medial	0.37	19.1	7.78	2.35
39	1	D	11	Prismatic blade	proximal	1.72	28.45	12.81	4.36
40	1	D	12	Prismatic blade	distal	0.98	27.25	10.31	3.39
41	1	D	13	Prismatic blade	medial	1.23	20.46	10.95	5.48
42	1	D	14	Prismatic blade	proximal	0.86	24.77	9.61	3.86
43	1	D	15	Prismatic blade	medial	0.76	18.28	11.19	3
44	1	D	15	Prismatic blade	medial	0.39	14.93	8.51	3.02
45	1	D	17	Core (polyhedral)	distal	2.73	18.4	13.19	8.86
46	1	D	17	Prismatic blade	proximal	1.23	26.08	13.48	3.68
47	1	D	18	Core Reduction Flake	medial	0.88	10.46	22.63	4.25
48	1	D	18	Prismatic blade	medial	0.82	23.17	10.68	2.33
49	1	D	18	Prismatic blade	medial	0.42	20.13	7.58	2.04
50	1	D	18	Core	distal	2.93	25.36	13.19	11.52
51	1	D	18	Flake		0.95	22.02	12.98	4.03
52	1	D	19	Prismatic blade	medial	0.58	24.23	7.55	2.83
53	1	D	25	Prismatic blade	medial	0.21	12.07	6.86	2.12
54	1	E	2	Prismatic blade	medial	0.43	13.34	9.89	2.54
55	1	F	1	Flake	proximal	0.32	14.2	9.63	2.4
56	1	G	1	Flake	complete	0.28	14.78	8.2	3.1
57	1	I	2	Prismatic blade	proximal	1.21	28.36	9.7	4.32
58	1	J	2	Prismatic blade	medial	0.82	20.43	13.18	2.63
59	1	J	2	Prismatic blade	proximal	0.46	16.61	9.24	2.64
60	1	J	2	Flake	complete	0.15	10.12	7.57	2.89
61	1	L	2	Prismatic blade	medial	0.61	14.93	12.27	2.83
62	1	M	1	Flake	complete	0.89	19.51	15.81	3.21
63	1	M	2	Prismatic blade	medial	0.72	27.58	8.22	2.38
64	1	M	2	Prismatic blade	medial	0.36	16.28	7.27	2.7
65	1	M	3	Prismatic blade	medial	0.17	19.14	5.39	1.46
66	1	N	2	Prismatic blade	medial	0.26	8.36	8.65	2.25
67	1	O	1	Prismatic blade	medial	0.71	20.02	11.37	2.38
68	1	O	2	Prismatic blade	distal	0.38	18.82	8.62	2.7

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
69	1	P	1	Prismatic blade	medial	0.85	31.67	11.05	2.13
70	1	Q	1	Prismatic blade	medial	0.28	13.62	9.96	1.88
71	1	R	1	Prismatic blade	proximal	0.63	16.79	9.91	3.32
72	1	T	1	Prismatic blade	medial	0.37	10.72	13.05	2.23
73	1	X	2	Prismatic blade	medial	0.27	14.79	7.86	2.4
74	1	T	2	Prismatic blade	medial	0.18	9.31	10.68	1.96
75	1	T	2	Prismatic blade	medial	0.09	11.63	5.51	1.34
76	1	EE	1	Flake		0.07	8.47	5.26	1.84
77	1	EE	5	Prismatic blade	medial	0.75	18.6	8.99	3.65
78	1	EE	5	Prismatic blade	proximal	0.58	15.68	10.62	3.34
79	1	EE	5	Prismatic blade	medial	0.2	13.82	7.7	1.91
80	1	EE	6	Prismatic blade	medial	0.69	17.23	11.97	3.23
81	1	FF	2	Prismatic blade	proximal	1.06	31.13	11.1	3.09
82	1	FF	4	Prismatic blade	proximal	0.99	25.2	11.8	3.22
83	1	FF	4	Prismatic blade	proximal	0.54	20.93	9.01	2.46
84	1	FF	4	Prismatic blade	medial	0.69	15.93	15.09	3.56
85	1	FF	4	Prismatic blade	medial	0.24	7.85	11.77	2.28
86	1	HH	3	Prismatic blade	medial	0.19	5.44	9.7	3.42
87	1	HH	4	Prismatic blade	medial	0.65	13.78	14.08	2.62
88	1	HH	4	Flake	proximal	0.45	11.21	11.69	4.57
89	1	HH	4	Prismatic blade	medial	0.8	16.03	14.46	2.87
90	1	HH	8	Prismatic blade	proximal	0.82	16.34	11.47	3.96
91	1	KK	2	Prismatic blade	proximal	0.55	11.85	12.07	3.43
92	1	KK	2	Prismatic blade	medial	0.31	11.36	9.29	2.68
93	1	MM	3	Prismatic blade	medial	0.45	21.51	9.21	2.22
94	1	MM	3	Prismatic blade	medial	0.68	18.6	10.8	3.02
95	1	NN	3	Prismatic blade	medial	0.59	16.22	11.91	2.25
96	1	OO	2	Prismatic blade	proximal	0.99	29.94	10.98	2.72
97	1	PP	2	Prismatic blade	proximal	1.42	44.67	10.01	2.73
98	1	PP	2	Prismatic blade	medial	0.36	11.07	10.71	2.63
99	1	PP	2	Prismatic blade	medial	0.36	20.59	9.14	2.77
100	1	PP	2	Prismatic blade	medial	0.27	19.4	7.92	2.64
101	1	PP	4	Flake	proximal	0.38	14.49	10.14	2.48
102	1	RR	3	Reworked blade fragment	medial	0.64	17.47	15.18	3.49

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
103	1	RR	3	Prismatic blade	proximal	1.31	30.2	11.84	2.79
104	1	TT	3	Prismatic blade	medial	0.96	20.22	11.93	3.02
105	1	VV	3	Prismatic blade	medial	0.2	11.41	8.29	2.59
106	1	XX	4	Prismatic blade	distal	0.62	19.53	10.93	2.04
107	1	ZZ	2	Prismatic blade	medial	0.25	14.34	11.72	1.96
108	1	ZZ	3	Prismatic blade	medial	0.52	16.46	9.42	2.58
109	1	AAA	3	Prismatic blade	proximal	0.21	12.93	6.7	2.01
110	1	BBB	2	Prismatic blade	medial	0.99	13.65	16.2	14.16
111	1	GGG	1	Prismatic blade	medial	0.44	10.85	14.25	2.31
112	1	GGG	1	Prismatic blade	medial	0.25	6.88	12.76	3.15
113	1	HHH	2	Prismatic blade	proximal	0.58	20.92	10.92	2.52
114	1	III	3	Prismatic blade	distal	0.39	18.74	7.45	2.37
115	1	JJJ	3	Prismatic blade	medial	0.46	10.15	12.84	3.1
116	1	JJJ	5	Prismatic blade	medial	0.19	14.45	5.72	1.9
117	1	KKK	2	Prismatic blade	medial	0.5	18.42	8.66	2.42
118	1	KKK	4	Prismatic blade	medial	0.22	9.68	8.18	2.78
119	1	KKK	4	Prismatic blade	proximal	1.16	23.95	13.67	4.06
120	1	RRR	2	Prismatic blade	medial	1.06	20.46	13.85	3.14
121	1	RRR	2	Prismatic blade	medial	0.52	10.72	12.84	2.84
122	1	SSS	3	Prismatic blade	Proximal	2.06	38.16	14.56	3.27
123	1	SSS	3	Prismatic blade	medial	1.23	26.6	11.38	3.38
124	1	SSS	3	Flake	proximal	0.43	11.6	9.69	3.77
125	1	SSS	3	Prismatic blade	medial	0.22	18.06	5.99	1.69
126	1	SSS	3	Prismatic blade	edial fragme	0.08	11.43	3.9	1.95
127	1	TTT	2	Prismatic blade	medial	0.92	27.32	11.75	2.55
128	1	TTT	2	Prismatic blade	medial	0.87	22.71	12.41	2.52
129	1	UUU	3	Prismatic blade	medial	0.34	14.59	9.88	1.85
130	1	UUU	4	Prismatic blade	medial	0.82	25.82	9.31	2.73
131	1	YYY	1	Prismatic blade	medial	0.24	12.27	7.75	1.81
132	1	DDDD	3	Prismatic blade	medial	0.53	17.23	8.49	3.76
133	1	DDDD	3	Flake	proximal	0.35	10.06	11.85	3.67
134	1	FFFF	1	Prismatic blade	medial	0.23	11.74	12.13	1.6
135	1	GGGG	4	Prismatic blade	proximal	1.74	40.01	11.19	3.19
136	2	A	9	Prismatic blade	medial	0.43	10.66	11.09	3.57

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
137	3	A	3	Prismatic blade	medial	0.51	15.75	10.39	2.39
138	3	A	2	Prismatic blade	medial	0.52	21.52	7.83	2.77
139	3	A	4	Prismatic blade	proximal	1.03	24.5	12.85	3.53
140	3	A	4	Prismatic blade	proximal	0.62	18.91	11.54	2.9
141	3	A	4	Prismatic blade	proximal	0.51	18.26	10.75	3.19
142	3	A	4	Prismatic blade	edial fragme	0.6	15.5	8.01	4.05
143	3	A	4	Reworked flake	medial	0.85	21.15	8.07	4.66
144	3	A	1	Prismatic blade	medial	0.22	13.08	8.39	1.97
145	3	A	5	Prismatic blade	medial	0.64	16.11	12.33	2.15
146	4	A	9	Prismatic blade	proximal	0.8	15.07	13.8	3.69
147	4	C	5	Prismatic blade	medial	0.6	13.18	12.8	2.94
148	4	D	1	Prismatic blade	proximal	0.43	14.7	9.8	3.06
149	4	E	3	Prismatic blade	medial	0.9	19.97	13.59	2.39
150	4	E	3	Prismatic blade	proximal	0.8	22.21	11.09	3.6
151	5	A	1	Prismatic blade	proximal	1.83	39.66	12.85	3.55
152	5	A	1	Prismatic blade	proximal	1.32	29.21	12.03	3.02
153	5	A	1	Prismatic blade	medial	0.45	17.16	7.81	2.8
154	5	A	1	Prismatic blade	medial	0.43	14.35	9.99	3.21
155	5	A	2	Prismatic blade	proximal	0.97	32.76	10.59	2.82
156	5	A	2	Prismatic blade	medial	0.25	10.15	9.91	2.07
157	5	A	3	Prismatic blade	medial	0.31	14.85	8.64	1.99
158	5	A	3	Prismatic blade	proximal	0.71	37.28	7.62	2.38
159	5	A	3	Prismatic blade	distal	0.48	16.53	9.63	2.91
160	5	A	5	Prismatic blade	proximal	1.01	32.65	9.79	2.86
161	5	A	5	Prismatic blade	medial	1.03	29.36	11.2	2.41
162	5	A	5	Prismatic blade	medial	0.66	19.18	12.68	2.24
163	5	A	5	Prismatic blade	medial	0.37	18.39	8.36	1.88
164	5	A	5	Prismatic blade	medial	0.59	18.92	9.51	2.49
165	5	A	7	Prismatic blade	medial	0.1	11.27	5.5	1.29
166	5	A	7	Prismatic blade	medial	0.09	10.53	7.38	1.59
167	5	A	8	Prismatic blade	proximal	0.89	26.74	11.91	2.89
168	5	A	9	Prismatic blade	medial	1.44	24.95	12.58	3.56
169	5	A	10	Prismatic blade	medial	0.26	11.87	8.84	2.04
170	5	A	10	Prismatic blade	medial	0.57	15.87	10.35	2.71

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
171	5	A	10	Prismatic blade	distal	0.2	11.83	8.92	1.47
172	5	A	10	Prismatic blade	medial	1.38	25.64	13.37	3.17
173	5	A	10	Prismatic blade	medial	0.3	11.88	9.54	2.76
174	5	A	10	Prismatic blade	medial	0.45	13.38	15.28	2.1
175	5	A	11	Prismatic blade	medial	0.73	20.13	13.18	2.55
176	5	B	1	Prismatic blade	medial	0.77	22.4	10.08	3.21
177	5	B	1	Prismatic blade	medial	0.55	18.22	12.1	1.91
178	5	B	3	Prismatic blade	medial	0.84	30.01	11.16	1.82
179	5	B	3	Prismatic blade	medial	0.23	10.13	8.69	2.37
180	5	B	5	Prismatic blade	medial	0.3	14.68	8.12	2.37
181	5	B	5	Prismatic blade	proximal	1.12	29.27	10.11	3.42
182	5	B	5	Prismatic blade	medial	0.22	13.78	7.08	1.76
183	5	B	7	Prismatic blade	medial	0.54	11.88	14.18	2.92
184	5	B	7	Prismatic blade	medial	1.43	23.04	13.19	3.89
185	5	B	7	Prismatic blade	medial	1.32	27.2	12.37	2.71
186	5	B	7	Prismatic blade	proximal	0.64	24.33	11.3	2.53
187	5	B	7	Prismatic blade	medial	0.65	14.36	9.07	5.56
188	5	B	7	Prismatic blade	distal	1.28	38.35	10.18	2.96
189	5	B	7	Prismatic blade	medial	1.1	26.26	11.83	3.17
190	5	B	7	Prismatic blade	medial	0.88	21.54	11.68	2.91
191	5	B	7	Prismatic blade	distal	0.91	23.08	10.91	2.62
192	5	B	7	Prismatic blade	distal	0.92	23.5	9.43	4.67
193	5	B	7	Prismatic blade	distal	0.42	14.51	9.91	2.22
194	5	B	8	Prismatic blade	medial	0.9	24.68	9.26	3.09
195	5	B	8	Prismatic blade	medial	0.33	15.09	10.46	1.63
196	5	B	8	Prismatic blade	medial	0.67	17.84	10.58	3.38
197	5	B	8	Prismatic blade	medial	0.4	13.39	10.06	2.05
198	5	B	8	Prismatic blade	medial	0.35	12.25	7.47	3.06
199	5	B	8	Prismatic blade	proximal	0.23	10.08	9.05	2.4
200	5	B	8	Prismatic blade	proximal	0.8	22.17	10.69	3.41
201	5	B	8	Prismatic blade	proximal	1.56	24.72	14.29	4.86
202	5	B	8	Prismatic blade	proximal	0.58	17.02	11.99	2.94
203	5	B	8	Prismatic blade	proximal	0.72	15.25	12.18	3.25
204	5	B	9	Prismatic blade	medial	1.25	41.53	12.07	2

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
205	5	B	9	Prismatic blade	medial	1.14	26.14	10.54	2.92
206	5	B	9	Prismatic blade	medial	1.49	24.89	13.2	3.88
207	5	B	9	Prismatic blade	proximal	0.45	14.28	10.89	2.67
208	5	B	9	Prismatic blade	medial	0.43	15.08	11.44	2.32
209	5	B	9	Prismatic blade	proximal	0.76	16.51	16.43	3.86
210	5	B	9	Prismatic blade	medial	1.36	24.24	13.34	3.17
211	5	B	9	Prismatic blade	medial	0.71	22.79	11.88	2.37
212	5	B	9	Prismatic blade	medial	0.61	18.22	9.73	2.75
213	5	B	9	Core Reduction Flake	proximal	2.75	22.08	14.09	8.36
214	5	B	10	Prismatic blade	proximal	0.91	24.7	11.32	2.49
215	5	B	10	Prismatic blade	proximal	1.01	20.87	13.86	3.7
216	5	B	10	Prismatic blade	proximal	0.69	15.02	12.86	4.02
217	5	B	10	Prismatic blade	medial	0.82	15.23	12.32	3.79
218	5	B	10	Prismatic blade	medial	0.16	11.27	6.47	1.68
219	1	D	20	Prismatic blade	medial	0.88	27.82	11.19	2.2
220	4	C	1	Prismatic blade	medial	0.33	20.08	7.32	1.78
221	6	A	1	Prismatic blade	medial	0.66	14.28	15.41	3.21
222	6	A	2	Prismatic blade	medial	0.48	18.95	9.06	2.02
223	6	A	2	Prismatic blade	medial	1.03	26.44	12.38	2.47
224	6	A	2	Multidirectional Core	distal	4.37	25.66	14.26	10.11
225	6	A	3	Prismatic blade	medial	0.71	16.68	12.08	2.51
226	6	B	2	Polished Core	unknown	7.24	37.13	13.2	13.49
227	6	B	3	Prismatic blade	proximal	1.11	23.68	12.27	3.51
228	6	B	3	Prismatic blade	medial	0.62	13.1	12.1	3.37
229	6	C	1	Prismatic blade	proximal	0.77	15.37	12.07	3.58
230	6	C	1	Prismatic blade	medial	0.46	20.49	9.22	2.33
231	6	C	1	Prismatic blade	medial	0.57	16.49	11.14	2.36
232	6	C	1	Prismatic blade	proximal	1.45	33.99	12.12	2.98
233	6	C	1	Prismatic blade	proximal	1.99	39.35	13.25	2.79
234	6	C	1	Projectile Point	complete	1.98	39.25	14.54	2.57
235	6	C	2	Prismatic blade	proximal	1.07	25.37	11.71	3.46
236	6	C	3	Prismatic blade	medial	0.83	20.99	11.21	2.67
237	6	C	3	Prismatic blade	medial	0.61	20.03	9.85	2.19
238	6	D	2	Prismatic blade	medial	0.72	29.4	8.67	2.17

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
239	6	D	2	Prismatic blade	distal	0.82	51.13	7.76	1.88
240	6	D	2	Prismatic blade	proximal	0.49	33.46	7.13	1.89
241	6	D	2	Prismatic blade	medial	0.61	31.99	7.94	2.56
242	6	D	2	Prismatic blade	medial	0.2	10	8.99	1.75
243	6	D	3	Prismatic blade	proximal	0.91	36.7	8.76	2.15
244	6	D	3	Prismatic blade	proximal	1.81	51.88	11.56	3.16
245	6	D	3	Prismatic blade	medial	0.31	11.69	9.8	2.49
246	6	D	3	Prismatic blade	proximal	1.97	37.14	13.18	3.74
247	6	D	3	Prismatic blade	medial	1.21	26.15	11.32	3.12
248	6	D	3	Prismatic blade	medial	0.98	45.66	9.03	1.84
249	6	E	1	Prismatic blade	proximal	0.65	15.28	49.96	3.31
250	6	E	1	Prismatic blade	medial	0.19	15.19	5.76	1.76
251	6	E	3	Prismatic blade	medial	0.75	27.07	9.08	3.51
252	6	F	1	Prismatic blade	proximal	0.28	11.27	10.39	2.53
253	6	F	2	Prismatic blade	medial	0.78	20.2	9.82	2.66
254	6	G	2	Prismatic blade	medial	0.22	9.46	13.26	2.03
255	6	I	1	Prismatic blade	proximal	0.8	29.47	8.6	2.85
256	6	I	1	Flake	proximal	0.46	13.37	12.95	3.52
257	6	J	1	Prismatic blade	medial	0.73	24.92	8.82	2.56
258	6	O	2	Prismatic blade	medial	0.09	12.43	6.94	1.21
259	6	O	4	Prismatic blade	proximal	0.4	19.57	7.26	2.14
260	6	O	5	Prismatic blade	proximal	1.58	29	18.31	3.84
261	6	P	3	Prismatic blade	proximal	1.62	28.98	13.22	3.27
262	6	P	14	Prismatic blade	medial	0.83	20.49	10.69	3.19
263	6	P	15	Prismatic blade	medial	0.38	15.71	10.56	2.59
264	6	P	15	Prismatic blade	medial	0.42	18.48	8.31	2.56
265	6	P	15	Prismatic blade	medial	0.45	15.7	9.47	2.25
266	6	Q	1	Prismatic blade	proximal	0.58	14.83	11.45	2.91
267	6	S	1	Prismatic blade	medial	0.45	11.85	12.42	2.82
268	6	S	1	Flake	medial	0.45	8.42	14.46	4.39
269	6	S	1	Prismatic blade	medial	0.17	12.38	6.33	1.46
270	6	S	2	Prismatic blade	medial	0.75	25.28	9.47	2.25
271	6	S	3	Prismatic blade	proximal	1.46	21.65	15.03	4.27
272	6	S	3	Prismatic blade	medial	1.05	29.67	10.94	2.55

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
273	6	T	3	Prismatic blade	proximal	0.57	18.19	9.07	3.17
274	6	T	3	Prismatic blade	proximal	0.66	32.62	7.56	2.44
275	6	T	3	Prismatic blade	medial	0.53	15.29	9.46	3.59
276	6	T	3	Prismatic blade	proximal	0.96	21	13.98	3.5
277	6	T	7	Prismatic blade	distal	0.7	20.86	9.44	3.53
278	6	T	11	Prismatic blade	medial	0.41	11.75	13.47	2.49
279	6	T	11	Prismatic blade	medial	0.74	10.65	20.79	4.14
280	6	U	1	Prismatic blade	proximal	1.44	32.74	12.4	3.45
281	6	U	2	Prismatic blade	medial	0.86	17.86	11.59	3.88
282	6	U	2	Flake	medial	2.11	19.88	24.05	5.9
283	6	U	3	Prismatic blade	medial	2.38	34.05	14.29	3.26
284	6	U	3	Prismatic blade	medial	0.78	17.95	11.5	3.34
285	6	U	3	Prismatic blade	medial	0.55	23.71	8.23	2.74
286	6	U	5	Prismatic blade	proximal	1.1	21.07	14.48	4.05
287	6	U	11	Prismatic blade	medial	0.73	23.68	8.3	2.5
288	6	V	1	Prismatic blade	medial	0.6	15.86	11.79	2.1
289	6	V	3	Prismatic blade	medial	1.76	28.01	14.27	3.68
290	6	V	3	Prismatic blade	medial	0.98	29.04	11.41	2.56
291	6	V	3	Prismatic blade	medial	0.31	19	6.8	2.24
292	6	V	6	Flake	proximal	0.37	19.81	8.25	2.97
293	6	V	6	Prismatic blade	medial	0.71	25.05	9.43	2.58
294	6	V	14	Prismatic blade	medial	0.31	13.85	7.88	2.53
295	6	W	6	Prismatic blade	medial	0.47	18.82	8.16	2.23
296	6	W	6	Prismatic blade	medial	0.09	10.84	6.74	1.4
297	6	X	5	Prismatic blade	medial	1.11	28.71	11.13	2.85
298	6	Y	5	Prismatic blade	proximal	1.65	33.9	11.75	4.03
299	6	Z	1	Prismatic blade	medial	0.97	16.07	15.06	3.17
300	6	Z	2	Prismatic blade	proximal	1.02	27.25	11.07	3.37
301	6	AA	3	Prismatic blade	proximal	1.32	23.8	14.06	2.98
302	6	EE	2	Prismatic blade	medial	0.25	13.42	8.53	1.53
303	6	FF	1	Prismatic blade	medial	0.5	13.96	14.98	2.44
304	6	FF	1	Prismatic blade	medial	0.25	10.69	8.97	2.45
305	6	FF	3	Prismatic blade	medial	0.6	11.8	12.6	4.21
306	6	FF	3	Prismatic blade	medial	0.27	15.41	9.9	1.8

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
307	6	HH	2	Prismatic blade	medial	0.29	13.39	10.07	1.77
308	6	LL	1	Prismatic blade	medial	0.98	20.21	13.26	3.14
309	6	LL	3	Prismatic blade	medial	0.23	14.22	6.09	2.67
310	6	MM	3	Unknown	medial	0.21	14.3	4.36	2.45
311	6	NN	3	Prismatic blade	medial	0.23	10.35	11.9	2.87
312	6	OO	1	Prismatic blade	medial	0.54	11.24	21.59	2.92
313	6	OO	1	Prismatic blade	medial	0.23	11.47	7.31	1.79
314	6	RR	1	Thinning flake	proximal	0.04	7.82	6.01	1.24
315	6	RR	2	Core Reduction Flake	proximal	0.72	11.65	13.45	6.91
316	6	SS	4	Prismatic blade	proximal	0.53	24.16	8.43	2.43
317	6	TT	2	Prismatic blade	medial	0.39	13.87	8.74	2.53
318	6	UU	3	Prismatic blade	medial	0.85	22.7	11.06	2.36
319	6	UU	3	Prismatic blade	medial	1.02	25.77	8.93	3.89
320	6	UU	3	Prismatic blade	medial	0.32	13.74	9.19	2.28
321	6	UU	4	Prismatic blade	medial	0.87	26.64	8.78	3.15
322	6	WW	3	Prismatic blade	medial	0.48	16.48	9.49	3.81
323	6	OO	3	Prismatic blade	medial	1	15.46	17.96	5.33
324	6	VV	4	Prismatic blade	medial	1.33	25.24	11.15	4.63
325	6	ZZ	1	Prismatic blade	proximal	1.06	26.34	11.87	3.35
326	6	AAAA	1	Prismatic blade	proximal	0.71	21.36	13.18	4.04
327	6	EEEE	1	Prismatic blade	medial	0.87	20.34	16.71	2.14
328	6	FFFF	1	Prismatic blade	medial	0.24	7.41	9.9	2.7
329	6	FFFF	1	Prismatic blade	medial	0.21	12.57	15.51	1.33
330	6	GGGG	2	Prismatic blade	medial	0.43	14.75	9.55	2.7
331	6	HHH	2	Prismatic blade	medial	0.32	11.03	11.83	2.89
332	6	III	1	Prismatic blade	medial	0.3	15.66	9.36	2.56
333	6	KKK	1	Prismatic blade	medial	0.25	11.19	7.82	2.47
334	6	MMM	1	Prismatic blade	proximal	0.94	31.55	9.44	2.38
335	6	MMM	3	Prismatic blade	medial	0.3	21.32	6.77	1.64
336	6	NNN	2	Prismatic blade	medial	1.62	28.37	12.17	3.78
337	6	OOO	1	Prismatic blade	medial	0.2	13.4	6.41	1.91
338	6	RRR	1	Prismatic blade	medial	0.22	13.43	5.7	2.67
339	6	TTT	1	Prismatic blade	medial	0.25	9.19	9.98	2.65
340	6	TTT	2	Prismatic blade	medial	0.78	17.75	13.48	2.7

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
341	6	UUU	3	Prismatic blade	medial	1.56	28.51	14.65	3.15
342	6	UUU	3	Prismatic blade	medial	1.39	26.15	10.64	3.73
343	6	UUU	3	Prismatic blade	medial	0.54	26.47	8.44	2.06
344	6	UUU	4	Prismatic blade	medial	0.78	28.89	10.72	2.96
345	6	UUU	4	Prismatic blade	medial	0.49	17.78	8.63	2.3
346	6	UUU	5	Prismatic blade	medial	1.06	22.79	11.83	2.62
347	6	UUU	7	Prismatic blade	medial	0.33	11.37	10.51	2.18
348	6	UUU	7	Prismatic blade	medial	0.45	16.84	11.22	1.72
349	6	UUU	9	Prismatic blade	proximal	0.24	14.63	7.43	2.52
350	6	VVV	1	Prismatic blade	medial	0.1	10	8.21	1.56
351	6	WWW	2	Prismatic blade	medial	0.37	20.4	5.92	2.72
352	6	WWW	5	Prismatic blade	medial	0.13	6.28	9.38	2.06
353	6	WWW	5	Prismatic blade	medial	0.64	22.08	10.17	1.97
354	6	WWW	5	Prismatic blade	medial	0.74	20.47	12.95	2.13
355	6	YYY	1	Prismatic blade	medial	0.33	13	8.69	2.02
356	6	AAAA	2	Prismatic blade	medial	1.05	25.8	12.28	2.71
357	6	AAAA	2	Prismatic blade	medial	0.97	20.73	12.17	2.71
358	6	AAAA	2	Prismatic blade	medial	0.25	16.65	7.42	1.87
359	6	AAAA	3	Prismatic blade	medial	0.71	23.44	11.59	1.95
360	6	AAAA	3	Prismatic blade	medial	0.09	6.84	6.06	1.48
361	6	BBBB	2	Prismatic blade	medial	0.22	9.36	8.21	2.81
362	6	BBBB	2	Flake	medial	0.14	11.11	9.93	1.94
363	6	CCCC	2	Prismatic blade	medial	0.84	15.39	13.82	3.31
364	6	EEEE	1	Prismatic blade	medial	0.91	25.2	11.28	2.46
365	6	FFFF	3	Prismatic blade	medial	0.22	3.39	15.2	3.72
366	6	GGGG	2	Prismatic blade	proximal	2.07	39.13	15.4	2.94
367	6	GGGG	2	Prismatic blade	proximal	1.73	37.02	11.4	3.6
368	6	GGGG	2	Prismatic blade	medial	0.24	21.57	10.23	6.72
369	6	GGGG	2	Flake	proximal	1.16	6.74	11.55	3.16
370	6	GGGG	3	Prismatic blade	medial	0.28	24.93	6.14	1.83
371	6	KKKK	1	Prismatic blade	proximal	0.9	22.41	12.09	2.98
372	6	KKKK	1	Prismatic blade	medial	0.05	7.51	7.36	0.92
373	6	LLLL	1	Prismatic blade	medial	0.37	10.64	13.2	2.43
374	6	MMMM	1	Prismatic blade	medial	0.59	21.84	8.27	2.5

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
375	6	PPPP	1	Prismatic blade	proximal	0.81	23.75	9.9	3.44
376	6	PPPP	1	Prismatic blade	medial	0.49	13.47	10.88	2.61
377	6	RRRR	1	Prismatic blade	medial	0.57	21.75	10.43	1.51
378	6	RRRR	2	Prismatic blade	proximal	1.21	23.78	16.93	3.23
379	6	TTTT	1	Prismatic blade	medial	1.96	42.45	11.06	3.6
380	6	WWWW	1	Prismatic blade	medial	0.35	15.65	8.91	2.54
381	6	XXXX	5	Prismatic blade	medial	0.47	13.59	10.27	2.44
382	6	XXXX	10	Prismatic blade	medial	0.57	16.5	10.44	2.29
383	6	YYYY	2	Prismatic blade	medial	1.58	30.07	12.51	3.48
384	6	YYYY	3	Prismatic blade	proximal	0.79	27.13	8.72	3.08
385	6	YYYY	14	Prismatic blade	medial	0.33	10.54	13.28	2.19
386	6	ZZZZ	3	Prismatic blade	proximal	0.55	20.3	8.16	2.53
387	6	ZZZZ	4	Prismatic blade	proximal	0.61	22.41	8.3	2.8
388	6	ZZZZ	4	Prismatic blade	medial	1.33	29.17	12.5	3.08
389	6	ZZZZ	7	Prismatic blade	medial	0.23	6.61	13.81	2.94
390	6	ZZZZ	9	Prismatic blade	medial	1.01	21.42	12.37	2.55
391	6	ZZZZ	11	Flake	complete	0.09	10.38	6.51	1.98
392	6	AAAA	1	Prismatic blade	medial	0.44	19.38	7.48	2.93
393	6	AAAA	2	Prismatic blade	medial	0.21	18.16	6.82	1.22
394	6	BBBB	1	Prismatic blade	medial	0.31	10.66	9.94	2.36
395	6	BBBB	1	Prismatic blade	medial	0.23	9.05	9.4	2.78
396	6	BBBB	1	Prismatic blade	medial	0.22	10.08	10.22	1.95
397	6	EEEEE	1	Prismatic blade	medial	0.69	16.37	13.97	2.62
398	6	EEEEE	2	Prismatic blade	medial	0.29	15.44	8.52	1.8
399	6	EEEEE	2	Flake	medial	0.19	10.49	11.93	1.63
400	6	EEEEE	6	Prismatic blade	medial	1.05	24.23	11.22	3.65
401	6	EEEEE	7	Prismatic blade	proximal	0.36	15.19	10.29	2.3
402	6	FFFFF	1	Prismatic blade	proximal	0.92	15.73	15.69	3.79
403	6	FFFFF	1	Prismatic blade	proximal	1.13	24.53	12.72	4.01
404	6	FFFFF	1	Prismatic blade	medial	0.34	18.35	6.71	2.15
405	6	FFFFF	2	Prismatic blade	medial	1.09	25.13	11.8	2.6
406	6	FFFFF	2	Prismatic blade	medial	1.02	19.16	12.4	3.35
407	6	FFFFF	2	Prismatic blade	proximal	0.55	12.57	12.74	3.3
408	1	RR	5	Prismatic blade	proximal	0.8	21.77	10.23	3.33

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
409	1	RR	5	Prismatic blade	medial	0.77	19.62	10.23	3.53
410	1	RR	5	Prismatic blade	medial	0.49	18.09	9.1	2.24
411	1	RR	5	Prismatic blade	proximal	0.46	12.51	12.5	2.67
412	1	RR	5	Prismatic blade	medial	0.42	21.27	9.07	1.83
413	1	RR	5	Prismatic blade	medial	0.35	14.92	7.38	2.45
414	1	PP	6	Prismatic blade	medial	1.24	24.42	11.05	4.22
415	1	PP	6	Prismatic blade	medial	0.82	31.94	9.62	2.55
416	1	PP	6	Prismatic blade	medial	0.3	11.16	10.34	1.9
417	1	PP	6	Prismatic blade	medial	0.41	21.01	7.03	2.28
418	1	PP	6	Prismatic blade	medial	0.45	11.53	9.77	3.22
419	1	PP	6	Prismatic blade	medial	0.61	16.82	8.37	3.45
420	1	LLL	2	Thinning Flake	proximal	0.75	13.44	16.65	3.5
421	7	B	1	Prismatic blade	proximal	0.75	19.99	13.27	2.4
422	8	E	8	Prismatic blade	proximal	0.79	27.01	8.91	2.66
423	8	E	12	Prismatic blade	medial	0.34	17.24	6.82	2.72
424	8	E	13	Prismatic blade	medial	0.46	12.3	12.48	3.64
425	8	E	14	Prismatic blade	proximal	0.59	18.9	11.85	2.24
426	8	E	17	Prismatic blade	medial	0.3	10.7	9.89	2.79
427	8	QQ	1	Prismatic blade	medial	0.21	9.16	9.64	2.58
428	9	A	4	Prismatic blade	proximal	0.61	25	10.35	2.17
429	9	A	4	Prismatic blade	proximal	0.43	15.48	10.25	2.53
430	9	A	4	Prismatic blade	medial	0.73	17.54	11.72	2.98
431	9	C	2	Prismatic blade	medial	0.28	13.21	11.16	1.66
432	9	C	2	Prismatic blade	medial	0.11	12.28	6.53	1.65
433	9	C	2	Prismatic blade	medial	0.65	9.11	6.99	1.57
434	9	F	1	Prismatic blade	medial	0.39	12.79	12.23	1.73
435	9	F	1	Prismatic blade	medial	0.17	14.73	5.51	1.55
436	9	G	1	Prismatic blade	medial	0.93	19.67	9.42	3.55
437	9	I	1	Prismatic blade	medial	0.81	25.46	11.19	2.2
438	9	I	1	Prismatic blade	medial	0.62	29.67	8.07	2.34
439	9	I	1	Prismatic blade	medial	0.67	13.46	14.25	3.42
440	9	I	1	Prismatic blade	medial	0.35	19.96	7.67	1.92
441	9	U	3	Prismatic blade	medial	1.15	31.41	10.77	2.4
442	9	U	3	Flake	distal	1.19	16.44	17.97	4.68

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
443	9	U	3	Core Maintance Flake	distal	3.08	32.6	21.68	6.53
444	9	Q	3	Prismatic blade	medial	0.36	13.03	8.5	2.46
445	9	V	3	Prismatic blade	proximal	0.6	19.81	11.19	2.56
446	9	V	3	Prismatic blade	medial	0.35	9.48	13.27	2.39
447	9	V	3	Prismatic blade	medial	0.17	12.4	6.5	1.65
448	10	A/D	1	Prismatic blade	proximal	1.03	21.66	12.44	2.81
449	10	A	4	Prismatic blade	medial	0.32	10.94	13.22	1.69
450	10	B	4	Prismatic blade	medial	0.5	23.05	8.6	2.6
451	10	C	1	Prismatic blade	distal	0.82	19.1	12.2	3.29
452	10	C	1	Flake	proximal	0.03	9.5	3.94	0.89
453	10	C	2	Prismatic blade	proximal	0.34	10.58	9.76	3.16
454	10	C	4	Prismatic blade	proximal	1.24	31.24	12.15	3.2
455	10	C	4	Prismatic blade	medial	0.22	15.08	8.06	2.12
456	10	D	4	Prismatic blade	medial	0.17	8.29	7.06	2.04
457	10	D	4	Flake	complete	0.004	5.46	4.75	0.43
458	10	D	5	Prismatic blade	proximal	0.73	22.1	9.75	3.22
459	10	E	2	Prismatic blade	proximal	0.86	24.63	11.28	3.05
460	10	G	6	Prismatic blade	medial	0.44	13.49	10.79	3.02
461	10	F	2	Prismatic blade	medial	0.27	16.9	9.4	1.6
462	10	F	2	Prismatic blade	medial	1.13	24.27	13.34	2.94
463	10	F	2	Prismatic blade	medial	0.71	21.93	11.03	2.98
464	10	F	4	Prismatic blade	medial	0.34	16.01	9.59	2.09
465	10	G	2	Prismatic blade	distal	1.01	18.36	14.19	3.97
466	10	H	3	Prismatic blade	medial	0.42	23.48	7.08	2.14
467	10	I	1	NOT OBSIDIAN	complete	0.37	17.54	13.59	2.04
468	10	I	1	Prismatic blade	medial	0.68	16.35	14.72	2.61
469	10	K	2	Prismatic blade	medial	0.33	11.39	12.22	2.3
470	10	Q	1	Prismatic blade	medial	0.77	19.87	9.7	3.55
471	10	Q	2	Prismatic blade	medial	0.81	26.11	10.38	3.1
472	10	Q	2	Prismatic blade	medial	0.32	15.6	8.24	2.32
473	10	R	2	Prismatic blade	medial	0.77	22.99	11.47	2.61
474	10	S	1	Prismatic blade	medial	0.69	15.33	12.11	3.29
475	10	S	1	Prismatic blade	medial	0.75	12.97	17.4	3.35
476	10	S	1	Prismatic blade	proximal	0.73	28.77	7.72	3.09

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
477	10	S	1	Prismatic blade	medial	0.34	13.14	9.95	2.28
478	10	T	1	Prismatic blade	proximal	0.7	19.12	9.13	3.41
479	10	T	1	Prismatic blade	proximal	0.35	18.41	6.46	2.51
480	10	T	1	Prismatic blade	proximal	0.34	15.71	7.72	2.99
481	10	T	1	Prismatic blade	medial	0.19	9.85	7.12	2.51
482	10	T	1	Prismatic blade	medial	0.25	12.01	8.62	2.08
483	11	A	3	Prismatic blade	medial	0.25	11.57	9.02	2.29
484	11	B	2	Prismatic blade	proximal	0.91	17.91	11.43	4.28
485	11	B	2	Prismatic blade	medial	0.74	23.05	10.52	2.52
486	11	B	2	Prismatic blade	proximal	0.78	22.53	9.6	3.28
487	11	E	2	Prismatic blade	medial	0.35	11.24	9.97	2.8
488	11	E	3	Prismatic blade	medial	0.71	28.78	8.08	2.61
489	11	E	7	Prismatic blade	medial	0.76	20.74	12.95	2.21
490	11	F	2	Prismatic blade	proximal	1.55	26.07	15.58	3.35
491	11	F	3	Prismatic blade	medial	0.38	12.65	9.9	2.55
492	11	F	7	Prismatic blade	medial	0.33	16.17	7.29	2.48
493	11	F	7	Prismatic blade	proximal	0.9	15.13	14.45	4.77
494	11	F	7	Prismatic blade	medial	0.16	10.15	8.52	1.94
495	11	H	2	Prismatic blade	medial	0.37	17.71	10.41	1.58
496	11	H	2	Prismatic blade	medial	0.68	18.05	10.73	2.84
497	11	I	8	Prismatic blade	medial	0.35	17.61	7.61	2.41
498	11	K	2	Prismatic blade	medial	0.54	16.75	9.31	3.34
499	11	N	2	Prismatic blade	medial	0.48	21.99	7.63	2.07
500	11	N	2	Prismatic blade	medial	0.26	11.3	9.55	1.94
501	11	S	1	Prismatic blade	medial	0.56	20.33	11.02	2.42
502	12	D	2	Prismatic blade	medial	0.82	22.45	11.94	2.31
503	12	E	1	Prismatic blade	medial	0.87	18.05	11.11	2.88
504	12	F	2	Prismatic blade	proximal	0.6	19.93	10.16	2.87
505	12	I	2	Core Maintance Flake	proximal	2.11	25.65	21.75	4.76
506	12	W	3	Prismatic blade	distal	1.13	23.87	13.91	3.85
507	12	W	3	Prismatic blade	proximal	0.46	18.53	7.54	2.52
508	12	W	3	Flake	proximal	0.11	9.17	8.51	1.79
509	12	X	2	Prismatic blade	medial	0.07	9.41	3.07	2.25
510	12	GG	2	Prismatic blade	medial	1.27	25.12	12.72	3.08

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
511	12	GG	2	Prismatic blade	medial	0.73	16.79	11.91	3.78
512	12	GG	2	Prismatic blade	medial	0.24	10.93	8.91	2.43
513	12	GG	2	Prismatic blade	medial	0.42	16.11	10.95	2.19
514	12	HH	2	Prismatic blade	medial	0.38	13.28	11.84	2.26
515	12	HH	2	Prismatic blade	proximal	0.13	11.94	6.75	1.65
516	12	HH	3	Prismatic blade	proximal	0.66	18.39	12.94	3.56
517	12	HH	3	Prismatic blade	medial	0.26	23.74	5.57	1.75
518	12	HH	3	Prismatic blade	medial	0.14	12.27	8.54	1.23
519	12	HH	3	Prismatic blade	medial	0.69	25.36	9.96	2.32
520	12	II	2	Prismatic blade	medial	0.19	13.64	6.38	1.8
521	12	II	4	Flake	medial	0.03	7.84	5.74	0.85
522	12	LL	2	Prismatic blade	medial	0.14	9.06	8.33	1.4
523	12	NN	2	Prismatic blade	medial	0.93	19.06	12.55	2.95
524	1	OOO	2	Prismatic blade	medial	0.37	13.95	10.41	2.5
525	6	YY	2	Flake	complete	0.11	10.65	6.88	1.35
526	9	U	2	Prismatic blade	medial	0.79	22.95	9.91	2.74
527	9	U	2	Prismatic blade	medial	0.95	16.5	14.46	3.78
528	11	U	1	Prismatic blade	proximal	0.83	23.02	12.19	3.57
529	11	I	4	Prismatic blade	medial	0.33	13.84	8.87	1.85
530	13	D	6	Prismatic blade	proximal	1.05	29.42	10.62	2.89
531	13	D	5	Prismatic blade	Distal	0.45	16.14	11.19	2.19
532	13	D	5	Prismatic blade	medial	0.19	8.75	7.75	2.56
533	13	D	5	Prismatic blade	medial	0.32	7.88	12.5	3.05
534	13	D	5	Prismatic blade	medial	0.38	10.57	11.23	4.42
535	13	D	5	Prismatic blade	medial	0.21	13.29	7.37	2.48
536	13	D	5	Prismatic blade	medial	0.23	9.05	10.98	2.65
537	13	D	5	Prismatic blade	medial	0.004	5.38	8.77	2.38
538	13	A	4	Prismatic blade	medial	0.63	14.23	11.15	2.98
539	13	A	5	Prismatic blade	medial	0.36	14.51	7.75	3.15
540	13	A	5	Prismatic blade	medial	0.44	17.8	9.45	2.62
541	13	A	5	Prismatic blade	medial	0.18	12.31	7.88	1.64
542	16	A	8	Prismatic blade	medial	2.18	35.49	14.49	3.85
543	13	B	1	Prismatic blade	medial	0.67	13.26	11.47	3.46
544	13	B	3	Prismatic blade	medial	0.76	19.31	12.01	2.54

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
545	13	B	6	Prismatic blade	proximal	0.65	29.11	8.65	2.57
546	13	B	6	Prismatic blade	medial	0.82	24.75	9.95	2.89
547	13	B	6	Prismatic blade	proximal	1.33	24.01	15.85	3.75
548	13	B	6	Prismatic blade	medial	0.41	12.58	12.38	3.09
549	13	B	7	Prismatic blade	medial	0.83	15.48	17.13	2.94
550	13	C	1	Prismatic blade	medial	0.52	19.17	9.65	2.75
551	13	C	2	Prismatic blade	medial	0.58	27.43	8.84	2.57
552	13	C	4	Prismatic blade	medial	0.76	17.74	12.64	2
553	13	C	4	Prismatic blade	medial	0.77	19.91	12.96	2.23
554	13	C	5	Prismatic blade	medial	0.29	18.59	7.48	1.53
555	13	C	5	Prismatic blade	proximal	0.61	14.7	11.33	2.75
556	13	C	5	Prismatic blade	medial	0.66	24.07	9.18	2.61
557	13	C	5	Prismatic blade	medial	0.52	16.01	8.83	2.71
558	13	C	5	Core Maintance Flake	distal	1.43	18.79	10.21	6.49
559	13	C	5	Prismatic blade	medial	0.31	13.39	11.54	1.51
560	13	D	3	Prismatic blade	medial	0.66	22.16	10.34	2.52
561	13	D	3	Prismatic blade	medial	0.32	13.09	11.17	1.72
562	13	D	4	Prismatic blade	medial	0.45	24.39	6.13	2.16
563	13	D	2	Prismatic blade	medial	1.62	34.54	9.49	3.95
564	13	D	2	Prismatic blade	medial	0.53	25.35	7.23	2.12
565	13	D	2	Prismatic blade	medial	0.39	15.79	8.54	2.06
566	13	D	2	Prismatic blade	Distal	1.09	35.11	9.65	9.39
567	14	B	2	Prismatic blade	proximal	0.4	12.88	11.21	2.54
568	14	B	2	Prismatic blade	medial	0.24	15.5	5.63	2.21
569	14	B	2	Prismatic blade	medial	0.36	10.79	12.1	3.08
570	14	B	3	Prismatic blade	proximal	0.88	20.84	12.2	3.08
571	14	B	3	Prismatic blade	medial	0.49	11.49	10.43	2.81
572	14	B	3	Prismatic blade	medial	0.62	19.62	10.68	2.49
573	1	MMMM	3	Prismatic blade	medial	0.17	9.07	8.6	1.8
574	16	B	1	Prismatic blade	medial	0.35	13.96	9.32	2.38
575	16	C	7	Prismatic blade	medial	0.55	15.29	12.21	3.11
576	16	C	7	Prismatic blade	medial	0.4	16.75	9.28	2.01
577	16	F	5	Prismatic blade	proximal	0.29	15.31	8.83	2.22
578	16	F	5	Prismatic blade	medial	0.4	11.1	10.35	2.43

ID	Op	Unit	Lot	Type	Condition	Mass (g)	Length (mm)	Width (mm)	Thickness (mm)
579	16	G	6	Prismatic blade	medial	0.73	18.88	16.18	2.22
580	16	G	7	Prismatic blade	medial	0.46	12.57	10.87	2.45
581	16	G	5	Prismatic blade	medial	0.13	19.75	5.9	1.14
582	16	G	5	Prismatic blade	medial	0.91	27.59	10.27	2.9
583	16	E	2	Core Maintance Flake	medial	0.85	23.64	5.05	4.87
584	16	E	2	Prismatic blade	medial	0.65	20.13	11.84	2.55
585	16	A	6	Prismatic blade	proximal	1.45	34.86	11.8	3.68
586	16	A	6	Prismatic blade	Distal	0.59	22.8	9.85	2.46
587	16	A	5	Prismatic blade	medial	0.52	16.39	10.19	2.21
588	16	A	12	Prismatic blade	proximal	0.42	18.05	10.06	2.21
589	16	E	4	Prismatic blade	medial	0.49	12.35	11.41	3.24
590	16	F	3	Prismatic blade	proximal	0.68	21.24	10.82	2.77
591	16	F	3	Prismatic blade	medial	0.48	13.41	12.92	2.07
592	16	H	2	Prismatic blade	medial	0.99	22.64	12.6	2.5
593	16	K	2	Prismatic blade	medial	1.22	22.9	13.57	2.73
594	16	K	2	Prismatic blade	Distal	0.29	16.93	7.76	1.83

Appendix B: Obsidian Source Attributes

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
1	1	A	1	62	Non-elite	Late Classic	Ixtepeque	
2	1	A	1	62	Non-elite	Late Classic	El Chayal	
3	1	A	3	62	Non-elite	Late Classic	El Chayal	
4	1	A	5	62	Non-elite	Late Classic	El Chayal	
5	1	A	5	62	Non-elite	Early Classic	El Chayal	
6	1	A	5	62	Non-elite	Early Classic	Ixtepeque	
7	1	A	5	62	Non-elite	Early Classic	Ixtepeque	
8	1	A	5	62	Non-elite	Early Classic	El Chayal	
9	1	A	8	62	Non-elite	Late Preclassic	El Chayal	
10	1	A	9	62	Non-elite	Late Preclassic	Ixtepeque	
11	1	A	12	62	Non-elite	Late Preclassic	El Chayal	
12	1	B	2	62	Non-elite	Late Classic	El Chayal	
13	1	B	2	62	Non-elite	Late Classic	El Chayal	
14	1	B	2	62	Non-elite	Late Classic	El Chayal	
15	1	B	3	62	Non-elite	Late Classic	El Chayal	
16	1	B	3	62	Non-elite	Late Classic	El Chayal	
17	1	B	4	62	Non-elite	Late Classic	El Chayal	
18	1	B	5	62	Non-elite	Late Classic	El Chayal	
19	1	B	15	62	Non-elite	Late Preclassic	El Chayal	
20	1	C	1	62	Non-elite	Late Classic	El Chayal	
21	1	C	8	62	Non-elite	Classic	Pachuca	
22	1	C	8	62	Non-elite	Classic	El Chayal	
23	1	C	8	62	Non-elite	Classic	El Chayal	
24	1	C	8	62	Non-elite	Classic	Ixtepeque	
25	1	C	9	62	Non-elite	Early Classic	El Chayal	
26	1	C	9	62	Non-elite	Early Classic	El Chayal	
27	1	C	12	62	Non-elite	Early Classic	El Chayal	
28	1	D	0	59	Non-elite		El Chayal	
29	1	D	2	59	Non-elite	Late Classic	El Chayal	
30	1	D	4	59	Non-elite	Late Classic	El Chayal	
31	1	D	4	59	Non-elite	Late Classic	El Chayal	
32	1	D	4	59	Non-elite	Late Classic	El Chayal	
33	1	D	7	59	Non-elite	Late Classic	Ixtepeque	
34	1	D	7	59	Non-elite	Late Classic	Ixtepeque	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
35	1	D	7	59	Non-elite	Late Classic	Ixtepeque	
36	1	D	7	59	Non-elite	Late Classic	El Chayal	
37	1	D	9	59	Non-elite	Late Classic	El Chayal	
38	1	D	9	59	Non-elite	Late Classic	El Chayal	
39	1	D	11	59	Non-elite	Late Classic	El Chayal	
40	1	D	12	59	Non-elite	Late Classic	Ixtepeque	
41	1	D	13	59	Non-elite	Late Classic	El Chayal	El Chayal
42	1	D	14	59	Non-elite	Late Classic	El Chayal	
43	1	D	15	59	Non-elite	Late Classic	El Chayal	El Chayal
44	1	D	15	59	Non-elite	Late Classic	El Chayal	
45	1	D	17	59	Non-elite	Early Classic	El Chayal	
46	1	D	17	59	Non-elite	Early Classic	El Chayal	
47	1	D	18	59	Non-elite	Early Classic	El Chayal	
48	1	D	18	59	Non-elite	Early Classic	El Chayal	
49	1	D	18	59	Non-elite	Early Classic	El Chayal	
50	1	D	18	59	Non-elite	Early Classic	El Chayal	
51	1	D	18	59	Non-elite	Early Classic	Ixtepeque	
52	1	D	19	59	Non-elite	Late Preclassic	El Chayal	
53	1	D	25	59	Non-elite	Late Preclassic	El Chayal	
54	1	E	2	59	Non-elite	Terminal Classic	El Chayal	
55	1	F	1	62	Non-elite	Terminal Classic	El Chayal	
56	1	G	1	62	Non-elite	Terminal Classic	El Chayal	
57	1	I	2	62	Non-elite	Terminal Classic	El Chayal	El Chayal
58	1	J	2	62	Non-elite	Terminal Classic	El Chayal	
59	1	J	2	62	Non-elite	Terminal Classic	El Chayal	
60	1	J	2	62	Non-elite	Terminal Classic	El Chayal	
61	1	L	2	62	Non-elite	Terminal Classic	El Chayal	El Chayal
62	1	M	1	62	Non-elite	Terminal Classic	Unknown	UNK
63	1	M	2	62	Non-elite	Terminal Classic	El Chayal	
64	1	M	2	62	Non-elite	Terminal Classic	El Chayal	
65	1	M	3	62	Non-elite	Terminal Classic	Ixtepeque	
66	1	N	2	62	Non-elite	Terminal Classic	El Chayal	
67	1	O	1	62	Non-elite	Terminal Classic	El Chayal	
68	1	O	2	62	Non-elite	Terminal Classic	El Chayal	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
69	1	P	1	62	Non-elite	Late Classic	El Chayal	
70	1	Q	1	62	Non-elite	Terminal Classic	El Chayal	
71	1	R	1	62	Non-elite	Terminal Classic	El Chayal	
72	1	T	1	61	Non-elite	Terminal Classic	El Chayal	
73	1	X	2	62	Non-elite	Terminal Classic	El Chayal	
74	1	T	2	61	Non-elite	Terminal Classic	El Chayal	
75	1	T	2	61	Non-elite	Terminal Classic	El Chayal	
76	1	EE	1	61	Non-elite	Terminal Classic	El Chayal	
77	1	EE	5	61	Non-elite	Early Classic	El Chayal	
78	1	EE	5	61	Non-elite	Early Classic	El Chayal	
79	1	EE	5	61	Non-elite	Early Classic	El Chayal	
80	1	EE	6	61	Non-elite	Early Classic	Ixtepeque	
81	1	FF	2	61	Non-elite	Terminal Classic	El Chayal	El Chayal
82	1	FF	4	61	Non-elite	Late Classic	San Martin Jilotepeque	
83	1	FF	4	61	Non-elite	Late Classic	El Chayal	
84	1	FF	4	61	Non-elite	Late Classic	El Chayal	
85	1	FF	4	61	Non-elite	Late Classic	El Chayal	
86	1	HH	3	61	Non-elite	Terminal Classic	El Chayal	
87	1	HH	4	61	Non-elite	Late Classic	El Chayal	
88	1	HH	4	61	Non-elite	Late Classic	Ixtepeque	
89	1	HH	4	61	Non-elite	Late Classic	El Chayal	
90	1	HH	8	61	Non-elite	Early Classic	Ixtepeque	
91	1	KK	2	62	Non-elite	Late Classic	El Chayal	
92	1	KK	2	62	Non-elite	Late Classic	Ixtepeque	
93	1	MM	3	62	Non-elite	Late Classic	Ixtepeque	
94	1	MM	3	62	Non-elite	Late Classic	El Chayal	
95	1	NN	3	62	Non-elite	Terminal Classic	Ixtepeque	
96	1	OO	2	61	Non-elite	Late Classic	El Chayal	
97	1	PP	2	61	Non-elite	Late Classic	El Chayal	
98	1	PP	2	61	Non-elite	Late Classic	El Chayal	El Chayal
99	1	PP	2	61	Non-elite	Late Classic	El Chayal	
100	1	PP	2	61	Non-elite	Late Classic	El Chayal	
101	1	PP	4	61	Non-elite	Late Classic	El Chayal	
102	1	RR	3	61	Non-elite	Late Classic	Ixtepeque	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
103	1	RR	3	61	Non-elite	Late Classic	Ixtepeque	
104	1	TT	3	61	Non-elite	Late Classic	Ixtepeque	
105	1	VV	3	61	Non-elite	Terminal Classic	El Chayal	
106	1	XX	4	59	Non-elite	Terminal Classic	Ixtepeque	
107	1	ZZ	2	59	Non-elite	Terminal Classic	El Chayal	
108	1	ZZ	3	59	Non-elite	Terminal Classic	El Chayal	
109	1	AAA	3	59	Non-elite	Late Classic	El Chayal	
110	1	BBB	2	59	Non-elite	Terminal Classic	El Chayal	
111	1	GGG	1	59	Non-elite	Not established	El Chayal	
112	1	GGG	1	59	Non-elite	Not established	El Chayal	
113	1	HHH	2	59	Non-elite	Terminal Classic	El Chayal	
114	1	III	3	59	Non-elite	Terminal Classic	El Chayal	
115	1	JJJ	3	59	Non-elite	Terminal Classic	El Chayal	
116	1	JJJ	5	59	Non-elite	Late Classic	El Chayal	
117	1	KKK	2	59	Non-elite	Terminal Classic	El Chayal	
118	1	KKK	4	59	Non-elite	Terminal Classic	El Chayal	El Chayal
119	1	KKK	4	59	Non-elite	Terminal Classic	El Chayal	
120	1	RRR	2	61	Non-elite	Late Classic	El Chayal	
121	1	RRR	2	61	Non-elite	Late Classic	El Chayal	
122	1	SSS	3	61	Non-elite	Late Classic	El Chayal	
123	1	SSS	3	61	Non-elite	Late Classic	El Chayal	El Chayal
124	1	SSS	3	61	Non-elite	Late Classic	El Chayal	
125	1	SSS	3	61	Non-elite	Late Classic	El Chayal	
126	1	SSS	3	61	Non-elite	Late Classic	El Chayal	
127	1	TTT	2	61	Non-elite	Late Classic	El Chayal	
128	1	TTT	2	61	Non-elite	Late Classic	El Chayal	
129	1	UUU	3	61	Non-elite	Late Classic	El Chayal	
130	1	UUU	4	61	Non-elite	Late Classic	El Chayal	
131	1	YYY	1	59	Non-elite	Late Classic	El Chayal	
132	1	DDDD	3	62	Non-elite	Terminal Classic	El Chayal	
133	1	DDDD	3	62	Non-elite	Terminal Classic	El Chayal	
134	1	FFFF	1	62	Non-elite	Terminal Classic	El Chayal	
135	1	GGGG	4	62	Non-elite	Terminal Classic	Ixtepeque	
136	2	A	9	51	Elite	Early Classic	El Chayal	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
137	3	A	3	46	Non-elite	Late Classic	El Chayal	El Chayal
138	3	A	2	46	Non-elite	Late Classic	Ixtepeque	
139	3	A	4	46	Non-elite	Early Classic	El Chayal	
140	3	A	4	46	Non-elite	Early Classic	El Chayal	
141	3	A	4	46	Non-elite	Early Classic	El Chayal	
142	3	A	4	46	Non-elite	Early Classic	El Chayal	
143	3	A	4	46	Non-elite	Early Classic	El Chayal	
144	3	A	1	46	Non-elite	Late Classic	El Chayal	
145	3	A	5	46	Non-elite	Early Classic	El Chayal	
146	4	A	9	19	Elite	Late Preclassic	El Chayal	
147	4	C	5	20	Elite	Late Classic	El Chayal	El Chayal
148	4	D	1	20	Elite	Late Classic	El Chayal	
149	4	E	3	20	Elite	Late Classic	Ixtepeque	
150	4	E	3	20	Elite	Late Classic	El Chayal	
151	5	A	1	18	Elite	Late Classic	El Chayal	El Chayal
152	5	A	1	18	Elite	Late Classic	El Chayal	
153	5	A	1	18	Elite	Late Classic	El Chayal	
154	5	A	1	18	Elite	Late Classic	Ixtepeque	
155	5	A	2	18	Elite	Late Classic	El Chayal	
156	5	A	2	18	Elite	Late Classic	El Chayal	
157	5	A	3	18	Elite	Late Classic	El Chayal	
158	5	A	3	18	Elite	Late Classic	El Chayal	
159	5	A	3	18	Elite	Late Classic	El Chayal	
160	5	A	5	18	Elite	Early Classic	El Chayal	
161	5	A	5	18	Elite	Early Classic	El Chayal	
162	5	A	5	18	Elite	Early Classic	Ixtepeque	
163	5	A	5	18	Elite	Early Classic	Ixtepeque	
164	5	A	5	18	Elite	Early Classic	El Chayal	
165	5	A	7	18	Elite	Early Classic	El Chayal	
166	5	A	7	18	Elite	Early Classic	Ixtepeque	
167	5	A	8	18	Elite	Early Classic	El Chayal	
168	5	A	9	18	Elite	Early Classic	El Chayal	
169	5	A	10	18	Elite	Early Classic	El Chayal	
170	5	A	10	18	Elite	Early Classic	El Chayal	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
171	5	A	10	18	Elite	Early Classic	El Chayal	
172	5	A	10	18	Elite	Early Classic	Ixtepeque	
173	5	A	10	18	Elite	Early Classic	El Chayal	
174	5	A	10	18	Elite	Early Classic	El Chayal	
175	5	A	11	18	Elite	Early Classic	El Chayal	
176	5	B	1	18	Elite	Late Classic	San Martin Jilotepeque	San Martin Jilotepeque
177	5	B	1	18	Elite	Late Classic	El Chayal	
178	5	B	3	18	Elite	Late Classic	El Chayal	
179	5	B	3	18	Elite	Late Classic	Ixtepeque	Ixtepeque
180	5	B	5	18	Elite	Late Classic	El Chayal	
181	5	B	5	18	Elite	Late Classic	El Chayal	
182	5	B	5	18	Elite	Late Classic	El Chayal	
183	5	B	7	18	Elite	Early Classic	El Chayal	
184	5	B	7	18	Elite	Early Classic	Ixtepeque	
185	5	B	7	18	Elite	Early Classic	El Chayal	
186	5	B	7	18	Elite	Early Classic	El Chayal	
187	5	B	7	18	Elite	Early Classic	El Chayal	
188	5	B	7	18	Elite	Early Classic	El Chayal	
189	5	B	7	18	Elite	Early Classic	Ixtepeque	
190	5	B	7	18	Elite	Early Classic	El Chayal	
191	5	B	7	18	Elite	Early Classic	El Chayal	
192	5	B	7	18	Elite	Early Classic	El Chayal	
193	5	B	7	18	Elite	Early Classic	Ixtepeque	
194	5	B	8	18	Elite	Early Classic	El Chayal	
195	5	B	8	18	Elite	Early Classic	El Chayal	
196	5	B	8	18	Elite	Early Classic	Ixtepeque	
197	5	B	8	18	Elite	Early Classic	El Chayal	
198	5	B	8	18	Elite	Early Classic	El Chayal	
199	5	B	8	18	Elite	Early Classic	El Chayal	
200	5	B	8	18	Elite	Early Classic	El Chayal	
201	5	B	8	18	Elite	Early Classic	El Chayal	
202	5	B	8	18	Elite	Early Classic	El Chayal	
203	5	B	8	18	Elite	Early Classic	Ixtepeque	
204	5	B	9	18	Elite	Early Classic	Ixtepeque	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
205	5	B	9	18	Elite	Early Classic	Ixtepeque	
206	5	B	9	18	Elite	Early Classic	Ixtepeque	
207	5	B	9	18	Elite	Early Classic	El Chayal	
208	5	B	9	18	Elite	Early Classic	Ixtepeque	
209	5	B	9	18	Elite	Early Classic	Ixtepeque	
210	5	B	9	18	Elite	Early Classic	Ixtepeque	
211	5	B	9	18	Elite	Early Classic	El Chayal	
212	5	B	9	18	Elite	Early Classic	El Chayal	
213	5	B	9	18	Elite	Early Classic	El Chayal	
214	5	B	10	18	Elite	Early Classic	El Chayal	
215	5	B	10	18	Elite	Early Classic	Ixtepeque	
216	5	B	10	18	Elite	Early Classic	El Chayal	
217	5	B	10	18	Elite	Early Classic	El Chayal	
218	5	B	10	18	Elite	Early Classic	El Chayal	
219	1	D	20	59	Non-elite	Early Classic	El Chayal	
220	4	C	1	20	Elite	Late Classic	El Chayal	El Chayal
221	6	A	1	41	Elite	Late Classic	El Chayal	
222	6	A	2	41	Elite	Late Classic	El Chayal	
223	6	A	2	41	Elite	Late Classic	El Chayal	
224	6	A	2	41	Elite	Late Classic	El Chayal	
225	6	A	3	41	Elite	Classic	El Chayal	
226	6	B	2	41	Elite	Late Classic	Ixtepeque	
227	6	B	3	41	Elite	Late Classic	Ixtepeque	
228	6	B	3	41	Elite	Late Classic	Ixtepeque	
229	6	C	1	41	Elite	Terminal Classic	El Chayal	El Chayal
230	6	C	1	41	Elite	Terminal Classic	El Chayal	El Chayal
231	6	C	1	41	Elite	Terminal Classic	Ixtepeque	
232	6	C	1	41	Elite	Terminal Classic	El Chayal	
233	6	C	1	41	Elite	Terminal Classic	Ixtepeque	
234	6	C	1	41	Elite	Terminal Classic	El Chayal	
235	6	C	2	41	Elite	Early Classic	El Chayal	
236	6	C	3	41	Elite	Late Classic	Ixtepeque	
237	6	C	3	41	Elite	Late Classic	El Chayal	
238	6	D	2	41	Elite	Early Classic	Pachuca	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
239	6	D	2	41	Elite	Early Classic	El Chayal	
240	6	D	2	41	Elite	Early Classic	El Chayal	
241	6	D	2	41	Elite	Early Classic	El Chayal	
242	6	D	2	41	Elite	Early Classic	El Chayal	
243	6	D	3	41	Elite	Early Classic	Pachuca	
244	6	D	3	41	Elite	Early Classic	El Chayal	
245	6	D	3	41	Elite	Early Classic	El Chayal	
246	6	D	3	41	Elite	Early Classic	El Chayal	
247	6	D	3	41	Elite	Early Classic	El Chayal	
248	6	D	3	41	Elite	Early Classic	El Chayal	
249	6	E	1	41	Elite	Late Classic	El Chayal	
250	6	E	1	41	Elite	Late Classic	Ixtepeque	
251	6	E	3	41	Elite	Late Classic	El Chayal	
252	6	F	1	41	Elite	Postclassic	El Chayal	
253	6	F	2	41	Elite	Postclassic	Ixtepeque	
254	6	G	2	41	Elite	Postclassic	Ixtepeque	
255	6	I	1	41	Elite	Terminal Classic	El Chayal	
256	6	I	1	41	Elite	Terminal Classic	Ixtepeque	
257	6	J	1	41	Elite	Terminal Classic	El Chayal	
258	6	O	2	41	Elite	Postclassic	El Chayal	
259	6	O	4	41	Elite	Terminal Classic	El Chayal	El Chayal
260	6	O	5	41	Elite	Late Classic	El Chayal	
261	6	P	3	41	Elite	Postclassic	Ixtepeque	
262	6	P	14	41	Elite	Late Classic	El Chayal	
263	6	P	15	41	Elite	Late Preclassic	El Chayal	
264	6	P	15	41	Elite	Late Preclassic	El Chayal	
265	6	P	15	41	Elite	Late Preclassic	Ixtepeque	
266	6	Q	1	41	Elite	Terminal Classic	El Chayal	
267	6	S	1	41	Elite	Terminal Classic	Ixtepeque	
268	6	S	1	41	Elite	Terminal Classic	El Chayal	
269	6	S	1	41	Elite	Terminal Classic	El Chayal	
270	6	S	2	41	Elite	Late Classic	El Chayal	
271	6	S	3	41	Elite	Late Classic	El Chayal	
272	6	S	3	41	Elite	Late Classic	El Chayal	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
273	6	T	3	41	Elite	Terminal Classic	El Chayal	
274	6	T	3	41	Elite	Terminal Classic	El Chayal	
275	6	T	3	41	Elite	Terminal Classic	El Chayal	
276	6	T	3	41	Elite	Terminal Classic	San Martin Jilotepeque	San Martin Jilotepeque
277	6	T	7	41	Elite	Late Classic	Ixtepeque	
278	6	T	11	41	Elite	Late Preclassic	El Chayal	
279	6	T	11	41	Elite	Late Preclassic	El Chayal	
280	6	U	1	41	Elite	Terminal Classic	El Chayal	
281	6	U	2	41	Elite	Terminal Classic	Ixtepeque	
282	6	U	2	41	Elite	Terminal Classic	El Chayal	
283	6	U	3	41	Elite	Terminal Classic	El Chayal	
284	6	U	3	41	Elite	Terminal Classic	El Chayal	El Chayal
285	6	U	3	41	Elite	Terminal Classic	El Chayal	
286	6	U	5	41	Elite	Late Classic	El Chayal	
287	6	U	11	41	Elite	Late Preclassic	El Chayal	
288	6	V	1	41	Elite	Terminal Classic	El Chayal	
289	6	V	3	41	Elite	Terminal Classic	El Chayal	El Chayal
290	6	V	3	41	Elite	Terminal Classic	El Chayal	
291	6	V	3	41	Elite	Terminal Classic	El Chayal	
292	6	V	6	41	Elite	Late Classic	El Chayal	
293	6	V	6	41	Elite	Late Classic	El Chayal	
294	6	V	14	41	Elite	Late Preclassic	El Chayal	
295	6	W	6	41	Elite	Late Classic	El Chayal	
296	6	W	6	41	Elite	Late Classic	El Chayal	
297	6	X	5	41	Elite	Late Classic	El Chayal	
298	6	Y	5	41	Elite	Late Classic	El Chayal	
299	6	Z	1	41	Elite	Terminal Classic	El Chayal	
300	6	Z	2	41	Elite	Terminal Classic	El Chayal	
301	6	AA	3	41	Elite	Late Classic	El Chayal	
302	6	EE	2	41	Elite	Late Classic	Ixtepeque	
303	6	FF	1	41	Elite	Terminal Classic	El Chayal	
304	6	FF	1	41	Elite	Terminal Classic	El Chayal	
305	6	FF	3	41	Elite	Terminal Classic	El Chayal	
306	6	FF	3	41	Elite	Terminal Classic	Ixtepeque	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
307	6	HH	2	41	Elite	Postclassic	El Chayal	
308	6	LL	1	41	Elite	Postclassic	El Chayal	
309	6	LL	3	41	Elite	Terminal Classic	El Chayal	
310	6	MM	3	41	Elite	Late Classic	El Chayal	
311	6	NN	3	41	Elite	Late Classic	El Chayal	
312	6	OO	1	41	Elite	Terminal Classic	El Chayal	
313	6	OO	1	41	Elite	Terminal Classic	El Chayal	
314	6	RR	1	41	Elite	Postclassic	El Chayal	
315	6	RR	2	41	Elite	Late Classic	El Chayal	
316	6	SS	4	41	Elite	Late Classic	El Chayal	
317	6	TT	2	41	Elite	Late Classic	El Chayal	
318	6	UU	3	41	Elite	Late Classic	El Chayal	
319	6	UU	3	41	Elite	Late Classic	El Chayal	
320	6	UU	3	41	Elite	Late Classic	El Chayal	
321	6	UU	4	41	Elite	Late Classic	El Chayal	
322	6	WW	3	41	Elite	Late Classic	El Chayal	
323	6	OO	3	41	Elite	Late Classic	El Chayal	
324	6	VV	4	41	Elite	Early Classic	El Chayal	
325	6	ZZ	1	41	Elite	Terminal Classic	El Chayal	
326	6	AAAA	1	41	Elite	Postclassic	El Chayal	
327	6	EEEE	1	41	Elite	Postclassic	El Chayal	
328	6	FFFF	1	41	Elite	Terminal Classic	El Chayal	
329	6	FFFF	1	41	Elite	Terminal Classic	Ixtepeque	
330	6	GGGG	2	41	Elite	Late Classic	El Chayal	
331	6	HHH	2	41	Elite	Terminal Classic	Ixtepeque	
332	6	III	1	41	Elite	Postclassic	El Chayal	
333	6	KKK	1	41	Elite	Postclassic	El Chayal	
334	6	MMM	1	41	Elite	Terminal Classic	Ixtepeque	
335	6	MMM	3	41	Elite	Late Classic	Ixtepeque	
336	6	NNN	2	41	Elite	Late Classic	El Chayal	
337	6	OOO	1	41	Elite	Postclassic	El Chayal	
338	6	RRR	1	41	Elite	Postclassic	El Chayal	
339	6	TTT	1	41	Elite	Postclassic	El Chayal	
340	6	TTT	2	41	Elite	Postclassic	El Chayal	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
341	6	UUU	3	41	Elite	Terminal Classic	El Chayal	
342	6	UUU	3	41	Elite	Terminal Classic	El Chayal	
343	6	UUU	3	41	Elite	Terminal Classic	El Chayal	
344	6	UUU	4	41	Elite	Terminal Classic	El Chayal	
345	6	UUU	4	41	Elite	Terminal Classic	Pachuca	
346	6	UUU	5	41	Elite	Late Classic	El Chayal	
347	6	UUU	7	41	Elite	Late Preclassic	Ixtepeque	
348	6	UUU	7	41	Elite	Late Preclassic	El Chayal	
349	6	UUU	9	41	Elite	Late Preclassic	El Chayal	
350	6	VVV	1	41	Elite	Late Classic	El Chayal	
351	6	WWW	2	41	Elite	Late Classic	El Chayal	
352	6	WWW	5	41	Elite	Terminal Classic	Ixtepeque	
353	6	WWW	5	41	Elite	Terminal Classic	El Chayal	
354	6	WWW	5	41	Elite	Terminal Classic	El Chayal	
355	6	YYY	1	41	Elite	Terminal Classic	Ixtepeque	
356	6	AAAA	2	41	Elite	Postclassic	El Chayal	
357	6	AAAA	2	41	Elite	Postclassic	Ixtepeque	Ixtepeque
358	6	AAAA	2	41	Elite	Postclassic	El Chayal	
359	6	AAAA	3	41	Elite	Terminal Classic	El Chayal	
360	6	AAAA	3	41	Elite	Terminal Classic	Ixtepeque	
361	6	BBBB	2	41	Elite	Terminal Classic	El Chayal	El Chayal
362	6	BBBB	2	41	Elite	Terminal Classic	El Chayal	
363	6	CCCC	2	41	Elite	Late Classic	El Chayal	El Chayal
364	6	EEEE	1	41	Elite	Postclassic	El Chayal	
365	6	FFFF	3	41	Elite	Terminal Classic	El Chayal	
366	6	GGGG	2	41	Elite	Postclassic	El Chayal	
367	6	GGGG	2	41	Elite	Postclassic	El Chayal	El Chayal
368	6	GGGG	2	41	Elite	Postclassic	El Chayal	
369	6	GGGG	2	41	Elite	Postclassic	El Chayal	
370	6	GGGG	3	41	Elite	Terminal Classic	El Chayal	
371	6	KKKK	1	41	Elite	Postclassic	El Chayal	
372	6	KKKK	1	41	Elite	Postclassic	Ixtepeque	
373	6	LLLL	1	41	Elite	Postclassic	El Chayal	
374	6	MMMM	1	41	Elite	Postclassic	El Chayal	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
375	6	PPPP	1	41	Elite	Postclassic	El Chayal	El Chayal
376	6	PPPP	1	41	Elite	Postclassic	El Chayal	
377	6	RRRR	1	41	Elite	Postclassic	El Chayal	
378	6	RRRR	2	41	Elite	Postclassic	El Chayal	
379	6	TTTT	1	41	Elite	Postclassic	Ixtepeque	Ixtepeque
380	6	WWWW	1	41	Elite	Terminal Classic	El Chayal	
381	6	XXXX	5	41	Elite	Late Classic	El Chayal	
382	6	XXXX	10	41	Elite	Late Preclassic	El Chayal	
383	6	YYYY	2	41	Elite	Terminal Classic	El Chayal	
384	6	YYYY	3	41	Elite	Late Classic	El Chayal	
385	6	YYYY	14	41	Elite	Late Preclassic	El Chayal	
386	6	ZZZZ	3	41	Elite	Late Classic	El Chayal	
387	6	ZZZZ	4	41	Elite	Late Classic	El Chayal	
388	6	ZZZZ	4	41	Elite	Late Classic	El Chayal	
389	6	ZZZZ	7	41	Elite	Early Classic	El Chayal	
390	6	ZZZZ	9	41	Elite	Late Classic	El Chayal	
391	6	ZZZZ	11	41	Elite	Late Preclassic	Ixtepeque	
392	6	AAAAA	1	41	Elite	Terminal Classic	El Chayal	
393	6	AAAAA	2	41	Elite	Terminal Classic	El Chayal	
394	6	BBBBB	1	41	Elite	Terminal Classic	El Chayal	
395	6	BBBBB	1	41	Elite	Terminal Classic	El Chayal	
396	6	BBBBB	1	41	Elite	Terminal Classic	El Chayal	
397	6	EEEEE	1	41	Elite	Terminal Classic	El Chayal	
398	6	EEEEE	2	41	Elite	Terminal Classic	El Chayal	
399	6	EEEEE	2	41	Elite	Terminal Classic	El Chayal	
400	6	EEEEE	6	41	Elite	Late Classic	El Chayal	
401	6	EEEEE	7	41	Elite	Late Preclassic	El Chayal	
402	6	FFFFF	1	41	Elite	Terminal Classic	Ixtepeque	
403	6	FFFFF	1	41	Elite	Terminal Classic	El Chayal	
404	6	FFFFF	1	41	Elite	Terminal Classic	Pachuca	
405	6	FFFFF	2	41	Elite	Terminal Classic	El Chayal	
406	6	FFFFF	2	41	Elite	Terminal Classic	Ixtepeque	
407	6	FFFFF	2	41	Elite	Terminal Classic	Ixtepeque	
408	1	RR	5	61	Non-elite	Early Classic	Ixtepeque	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
409	1	RR	5	61	Non-elite	Early Classic	El Chayal	
410	1	RR	5	61	Non-elite	Early Classic	El Chayal	
411	1	RR	5	61	Non-elite	Early Classic	Ixtepeque	
412	1	RR	5	61	Non-elite	Early Classic	Ixtepeque	
413	1	RR	5	61	Non-elite	Early Classic	El Chayal	
414	1	PP	6	61	Non-elite	Early Classic	El Chayal	
415	1	PP	6	61	Non-elite	Early Classic	El Chayal	
416	1	PP	6	61	Non-elite	Early Classic	El Chayal	
417	1	PP	6	61	Non-elite	Early Classic	El Chayal	
418	1	PP	6	61	Non-elite	Early Classic	Ixtepeque	
419	1	PP	6	61	Non-elite	Early Classic	Ixtepeque	
420	1	LLL	2	61	Non-elite	Terminal Classic	El Chayal	
421	7	B	1	29	Elite	Late Classic	El Chayal	
422	8	E	8	34	Non-elite	Terminal Classic	Ixtepeque	
423	8	E	12	34	Non-elite	Early Classic	El Chayal	
424	8	E	13	34	Non-elite	Early Classic	El Chayal	
425	8	E	14	34	Non-elite	Early Classic	El Chayal	
426	8	E	17	34	Non-elite	Late Preclassic	El Chayal	
427	8	QQ	1	34	Non-elite	Terminal Classic	Ixtepeque	
428	9	A	4	65	Non-elite	Late Classic	El Chayal	
429	9	A	4	65	Non-elite	Late Classic	El Chayal	
430	9	A	4	65	Non-elite	Late Classic	El Chayal	
431	9	C	2	65	Non-elite	Late Classic	Ixtepeque	
432	9	C	2	65	Non-elite	Late Classic	El Chayal	
433	9	C	2	65	Non-elite	Late Classic	El Chayal	
434	9	F	1	65	Non-elite	Late Classic	Ixtepeque	
435	9	F	1	65	Non-elite	Late Classic	El Chayal	
436	9	G	1	65	Non-elite	Late Classic	El Chayal	
437	9	I	1	65	Non-elite	Late Classic	Ixtepeque	
438	9	I	1	65	Non-elite	Late Classic	El Chayal	
439	9	I	1	65	Non-elite	Late Classic	El Chayal	
440	9	I	1	65	Non-elite	Late Classic	El Chayal	
441	9	U	3	65	Non-elite	Late Classic	Ixtepeque	
442	9	U	3	65	Non-elite	Late Classic	El Chayal	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
443	9	U	3	65	Non-elite	Late Classic	El Chayal	
444	9	Q	3	65	Non-elite	Terminal Classic	El Chayal	
445	9	V	3	65	Non-elite	Late Classic	El Chayal	
446	9	V	3	65	Non-elite	Late Classic	El Chayal	
447	9	V	3	65	Non-elite	Late Classic	El Chayal	
448	10	A/D	1	40	Elite	Terminal Classic	El Chayal	
449	10	A	4	40	Elite	Late Classic	Ixtepeque	
450	10	B	4	40	Elite	Late Classic	El Chayal	
451	10	C	1	40	Elite	Terminal Classic	El Chayal	
452	10	C	1	40	Elite	Terminal Classic	Unknown	
453	10	C	2	40	Elite	Late Classic	El Chayal	
454	10	C	4	40	Elite	Late Classic	Ixtepeque	
455	10	C	4	40	Elite	Late Classic	El Chayal	
456	10	D	4	40	Elite	Late Classic	El Chayal	
457	10	D	4	40	Elite	Late Classic	Unknown	
458	10	D	5	40	Elite	Late Classic	Ixtepeque	
459	10	E	2	40	Elite	Late Classic	Ixtepeque	
460	10	G	6	40	Elite	Early Classic	Ixtepeque	
461	10	F	2	40	Elite	Late Classic	El Chayal	
462	10	F	2	40	Elite	Late Classic	El Chayal	
463	10	F	2	40	Elite	Late Classic	El Chayal	
464	10	F	4	40	Elite	Early Classic	El Chayal	
465	10	G	2	40	Elite	Late Classic	Ixtepeque	
466	10	H	3	40	Elite	Early Classic	El Chayal	
467	10	I	1	40	Elite	Terminal Classic	El Chayal	
468	10	I	1	40	Elite	Terminal Classic	El Chayal	
469	10	K	2	40	Elite	Late Classic	Ixtepeque	
470	10	Q	1	40	Elite	Terminal Classic	El Chayal	
471	10	Q	2	40	Elite	Late Classic	El Chayal	
472	10	Q	2	40	Elite	Late Classic	El Chayal	
473	10	R	2	40	Elite	Late Classic	Ixtepeque	
474	10	S	1	40	Elite	Mixed Context	El Chayal	
475	10	S	1	40	Elite	Mixed Context	Ixtepeque	
476	10	S	1	40	Elite	Mixed Context	El Chayal	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
477	10	S	1	40	Elite	Mixed Context	El Chayal	
478	10	T	1	40	Elite	Mixed Context	El Chayal	
479	10	T	1	40	Elite	Mixed Context	El Chayal	
480	10	T	1	40	Elite	Mixed Context	El Chayal	
481	10	T	1	40	Elite	Mixed Context	El Chayal	
482	10	T	1	40	Elite	Mixed Context	El Chayal	
483	11	A	3	64	Non-elite	Terminal Classic	El Chayal	
484	11	B	2	64	Non-elite	Terminal Classic	El Chayal	
485	11	B	2	64	Non-elite	Terminal Classic	Pachuca	
486	11	B	2	64	Non-elite	Terminal Classic	Pachuca	
487	11	E	2	64	Non-elite	Terminal Classic	Ixtepeque	
488	11	E	3	64	Non-elite	Terminal Classic	El Chayal	
489	11	E	7	64	Non-elite	Terminal Classic	El Chayal	
490	11	F	2	64	Non-elite	Terminal Classic	Ixtepeque	
491	11	F	3	64	Non-elite	Terminal Classic	El Chayal	
492	11	F	7	64	Non-elite	Late Classic	El Chayal	
493	11	F	7	64	Non-elite	Late Classic	El Chayal	
494	11	F	7	64	Non-elite	Late Classic	El Chayal	
495	11	H	2	64	Non-elite	Terminal Classic	El Chayal	
496	11	H	2	64	Non-elite	Terminal Classic	El Chayal	
497	11	I	8	64	Non-elite	Late Classic	El Chayal	
498	11	K	2	64	Non-elite	Late Classic	El Chayal	
499	11	N	2	64	Non-elite	Late Classic	El Chayal	
500	11	N	2	64	Non-elite	Late Classic	El Chayal	
501	11	S	1	64	Non-elite	Late Classic	El Chayal	
502	12	D	2	60	Non-elite	Terminal Classic	Ixtepeque	
503	12	E	1	60	Non-elite	Terminal Classic	Ixtepeque	
504	12	F	2	60	Non-elite	Terminal Classic	El Chayal	
505	12	I	2	60	Non-elite	Terminal Classic	El Chayal	
506	12	W	3	60	Non-elite	Terminal Classic	El Chayal	
507	12	W	3	60	Non-elite	Terminal Classic	El Chayal	
508	12	W	3	60	Non-elite	Terminal Classic	El Chayal	
509	12	X	2	60	Non-elite	Terminal Classic	El Chayal	
510	12	GG	2	60	Non-elite	Terminal Classic	El Chayal	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
511	12	GG	2	60	Non-elite	Terminal Classic	El Chayal	
512	12	GG	2	60	Non-elite	Terminal Classic	El Chayal	
513	12	GG	2	60	Non-elite	Terminal Classic	El Chayal	
514	12	HH	2	60	Non-elite	Terminal Classic	Ixtepeque	
515	12	HH	2	60	Non-elite	Terminal Classic	El Chayal	
516	12	HH	3	60	Non-elite	Terminal Classic	Ixtepeque	
517	12	HH	3	60	Non-elite	Terminal Classic	El Chayal	
518	12	HH	3	60	Non-elite	Terminal Classic	El Chayal	
519	12	HH	3	60	Non-elite	Terminal Classic	Ixtepeque	
520	12	II	2	60	Non-elite	Terminal Classic	El Chayal	
521	12	II	4	60	Non-elite	Late Classic	El Chayal	
522	12	LL	2	60	Non-elite	Terminal Classic	El Chayal	
523	12	NN	2	60	Non-elite	Terminal Classic	El Chayal	
524	1	OOO	2	61	Non-elite	Terminal Classic	Ixtepeque	
525	6	YY	2	41	Elite	Late Classic	El Chayal	
526	9	U	2	65	Non-elite	Late Classic	El Chayal	
527	9	U	2	65	Non-elite	Late Classic	El Chayal	
528	11	U	1	64	Non-elite	Late Classic	El Chayal	
529	11	I	4	64	Non-elite	Late Classic	El Chayal	
530	13	D	6	53	Non-elite	Early Classic	Ixtepeque	
531	13	D	5	53	Non-elite	Early Classic	El Chayal	
532	13	D	5	53	Non-elite	Early Classic	El Chayal	
533	13	D	5	53	Non-elite	Early Classic	El Chayal	
534	13	D	5	53	Non-elite	Early Classic	El Chayal	
535	13	D	5	53	Non-elite	Early Classic	El Chayal	
536	13	D	5	53	Non-elite	Early Classic	El Chayal	
537	13	D	5	53	Non-elite	Early Classic	El Chayal	
538	13	A	4	53	Non-elite	Late Classic	El Chayal	
539	13	A	5	53	Non-elite	Late Classic	El Chayal	
540	13	A	5	53	Non-elite	Late Classic	El Chayal	
541	13	A	5	53	Non-elite	Late Classic	El Chayal	
542	16	A	8	53	Non-elite	Early Classic	Ixtepeque	
543	13	B	1	53	Non-elite	Terminal Classic	Ixtepeque	
544	13	B	3	53	Non-elite	Terminal Classic	El Chayal	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
545	13	B	6	53	Non-elite	Late Classic	El Chayal	
546	13	B	6	53	Non-elite	Late Classic	El Chayal	
547	13	B	6	53	Non-elite	Late Classic	Ixtepeque	
548	13	B	6	53	Non-elite	Late Classic	El Chayal	
549	13	B	7	53	Non-elite	Late Preclassic	El Chayal	
550	13	C	1	53	Non-elite	Terminal Classic	El Chayal	
551	13	C	2	53	Non-elite	Late Classic	El Chayal	
552	13	C	4	53	Non-elite	Early Classic	El Chayal	
553	13	C	4	53	Non-elite	Early Classic	El Chayal	
554	13	C	5	53	Non-elite	Early Classic	El Chayal	
555	13	C	5	53	Non-elite	Early Classic	El Chayal	
556	13	C	5	53	Non-elite	Early Classic	El Chayal	
557	13	C	5	53	Non-elite	Early Classic	El Chayal	
558	13	C	5	53	Non-elite	Early Classic	El Chayal	
559	13	C	5	53	Non-elite	Early Classic	El Chayal	
560	13	D	3	53	Non-elite	Early Classic	El Chayal	
561	13	D	3	53	Non-elite	Early Classic	Ixtepeque	
562	13	D	4	53	Non-elite	Early Classic	Ixtepeque	
563	13	D	2	53	Non-elite	Terminal Classic	Ixtepeque	
564	13	D	2	53	Non-elite	Terminal Classic	El Chayal	
565	13	D	2	53	Non-elite	Terminal Classic	El Chayal	
566	13	D	2	53	Non-elite	Terminal Classic	El Chayal	
567	14	B	2	test pits	Non-elite	Late Classic	El Chayal	
568	14	B	2	test pits	Non-elite	Late Classic	El Chayal	
569	14	B	2	test pits	Non-elite	Late Classic	El Chayal	
570	14	B	3	test pits	Non-elite	Late Classic	El Chayal	
571	14	B	3	test pits	Non-elite	Late Classic	El Chayal	
572	14	B	3	test pits	Non-elite	Late Classic	El Chayal	
573	1	MMMM	3		Non-elite	Late Classic	Ixtepeque	
574	16	B	1	57	Non-elite	Terminal Classic	El Chayal	
575	16	C	7	57	Non-elite	Late Classic	Ixtepeque	
576	16	C	7	57	Non-elite	Late Classic	El Chayal	
577	16	F	5	56	Non-elite	Early Classic	Ixtepeque	
578	16	F	5	56	Non-elite	Early Classic	El Chayal	

ID	Op	Unit	Lot	Structure	Status	Time Period	Inferred Source	Chemical Source
579	16	G	6	56	Non-elite	Late Classic	Ixtepeque	
580	16	G	7	56	Non-elite	Late Preclassic	El Chayal	
581	16	G	5	56	Non-elite	Late Classic	Ixtepeque	
582	16	G	5	56	Non-elite	Late Classic	Ixtepeque	
583	16	E	2	56	Non-elite	Late Classic	El Chayal	
584	16	E	2	56	Non-elite	Late Classic	Ixtepeque	
585	16	A	6	57	Non-elite	Early Classic	Ixtepeque	
586	16	A	6	57	Non-elite	Early Classic	Ixtepeque	
587	16	A	5	57	Non-elite	Late Classic	El Chayal	
588	16	A	12	57	Non-elite	Late Classic	Ixtepeque	
589	16	E	4	56	Non-elite	Late Classic	Ixtepeque	
590	16	F	3	56	Non-elite	Early Classic	El Chayal	
591	16	F	3	56	Non-elite	Early Classic	Ixtepeque	
592	16	H	2	58	Non-elite	Not established	El Chayal	
593	16	K	2	57	Non-elite	Not established	Ixtepeque	
594	16	K	2	57	Non-elite	Not established	El Chayal	

Appendix C

Household	Time Period	Ceramic (g)	Lithic (g)	Obsidian (g)	Volume (m^3)
Group 1	LP	111648	25685.1	8.79	7.48770
	EC	126493	30503	48.65	6.21205
	LC	30605.3	11426.2	4.53	1.03470
	TC				
Group 2	LP	-	-	-	-
	EC	n/a	n/a	0.43	0.55809
	LC	n/a	n/a	0	3.37065
	TC	-	-	-	-
Group 3	LP	-	-	-	-
	EC	n/a	n/a	4.25	1.192559
	LC	n/a	n/a	1.25	1.34399
	TC	-	-	-	-
Group 4	LP	2015.5	845.5	0.30	0.57917
	EC	14791.7	4273.1	0.50	1.87945
	LC	43.1	28.1	0	0.10978
	TC	26454.3	16545.7	0.80	11.54170
Group 5	LP	691	68	0	0.14763
	EC*	-	-	-	-
	LC	14140.1	6059.6	2.83	0.43883
	TC	188123	74330	25.12	7.11279
Group 6	LP	366	112	0.41	0.54885
	EC	17340	8788	8.70	1.17347
	LC	24780	19591	5.19	1.54065
	TC	13789	6750	4.15	0.98421
Group 7	LP	3122	1102	0.46	0.85929
	EC	65405	11298	5.89	2.25989
	LC	78475	24601	12.68	4.03146
	TC	14439	13251	1.78	1.12048
Structure 18	LP	-	-	-	-
	EC	105795	10600	39.22	5.80760
	LC	84666	11266	14.19	2.616
	TC	-	-	-	-
Structure 19	LP	5828	894	0.80	2.12760
	EC	-	-	-	-
	LC	17024	4378	0	6.17860
	TC	-	-	-	-

Structure 20	LP	-	-	-	-
	EC	-	-	-	-
	LC	12003	6360	3.06	4.58850
	TC	-	-	-	-
Structure 29	LP	-	-	-	-
	EC	8880	606.5	0	2.2526
	LC	8226	869	0.75	1.6355
	TC	-	-	-	-
Structure 40	LP	-	-	-	-
	EC	76326	16053	2.20	5.17466
	LC	54102	15298	11.69	5.40556
	TC	9810	3577	5.00	1.29840
Structure 41	LP	61097	10735.5	7.44	8.1236
	EC	38948	2968.6	12.07	3.40719
	LC	191016	47676	57.13	31.382
	TC	84890.4	22278.5	51.93	12.63238
Structure 73	LP	-	-	-	-
	EC	45974	5052	22.00	2.37723
	LC	-	-	-	-
	TC	-	-	-	-

*There is data for Group 5 that has only been assigned to the Classic period since there were no diagnostics to confirm it was from the Early Classic, therefore there likely is data from this time period, but I did not want to make assumptions about which lots were Early Classic without diagnostic confirmation.

Appendix D

Table 1: PXRF elemental concentrations of the submitted artifacts

ANID	MnKa1	FeKa1	ZnKa1	ThLa1	RbKa1	SrKa1	Y Ka1	ZrKa1	NbKa1	CHEMICAL SOURCE
ACT289	547.03	5760.16	41.93	12.53	133.79	129.10	17.06	108.81	9.76	CHY
ACT284	472.14	5765.55	30.50	10.05	131.96	180.48	16.22	106.98	8.54	CHY
ACT041	601.98	5840.49	44.34	13.49	136.54	140.94	19.62	112.49	12.41	CHY
ACT375	574.62	5856.17	39.15	13.82	138.95	164.98	19.05	113.86	12.25	CHY
ACT363	474.16	5903.32	43.76	9.80	143.84	180.22	21.07	105.59	8.12	CHY
ACT151	598.33	5911.33	41.79	13.71	138.30	174.69	19.88	113.40	7.66	CHY
ACT061	573.66	5912.04	34.93	11.75	137.01	149.25	21.47	114.48	8.42	CHY
ACT043	627.73	5980.57	45.80	15.73	129.39	155.95	17.80	111.33	7.73	CHY
ACT098	584.48	6017.72	51.21	12.48	140.66	168.43	16.64	111.47	12.62	CHY
ACT367	444.70	6029.49	45.08	10.08	140.30	120.37	16.59	115.79	9.76	CHY
ACT361	695.30	6086.96	45.58	13.74	140.94	141.75	17.32	113.51	9.14	CHY
ACT229	564.09	6107.92	39.54	9.20	140.72	175.70	17.55	111.64	10.34	CHY
ACT081	716.56	6116.52	42.40	11.37	143.52	171.38	18.39	115.85	9.30	CHY
ACT147	601.78	6134.98	40.15	6.48	133.77	174.58	20.06	114.24	9.26	CHY
ACT276	450.95	6199.02	40.56	7.41	106.27	263.20	11.23	115.27	8.18	SMJ
ACT137	517.54	6363.58	28.25	13.30	141.31	135.32	16.14	107.62	9.27	CHY
ACT057	696.76	6368.40	34.71	12.40	139.31	136.92	17.72	115.70	8.80	CHY
ACT118	565.64	6460.52	36.83	8.99	135.87	153.05	20.16	111.70	9.00	CHY
ACT230	627.35	6486.68	47.45	9.43	145.18	144.50	16.45	115.80	13.54	CHY
ACT259	627.87	6558.97	31.95	15.65	141.31	142.87	21.06	111.54	8.58	CHY
ACT176	438.93	6621.65	45.24	10.29	109.23	217.36	13.61	116.34	9.36	SMJ
ACT220	653.19	6641.44	36.11	10.20	144.97	141.29	17.92	109.59	11.45	CHY
ACT123	570.16	6768.70	42.62	14.22	151.24	148.15	21.18	117.51	12.23	CHY
ACT379	226.65	8422.34	22.44	7.94	99.67	153.95	16.10	163.45	9.03	IXT
ACT357	442.81	8874.87	40.59	8.53	94.46	131.42	16.23	166.33	9.02	IXT
ACT179	431.57	9550.28	36.71	6.20	104.12	154.51	14.70	161.37	10.15	IXT
ACT062	1033.92	45861.55	32.91	2.63	36.46	256.69	32.34	171.21	5.55	UNK (Basalt, Basalt obsidian mixture)

Table 2a: TOF-LA-ICP-MS elemental concentrations of ACT062

ANID	Li	Be	Na	Mg	Al	Si	P	S	K	Ca	Sc
act062-1-a	27.82	1.23	25845.22	4459.72	88635.75	267501.89	436.08	0.00	17931.52	32668.23	50.48
act062-2-a	24.91	1.23	23092.09	4176.38	91661.35	272312.39	409.55	0.00	17311.40	30865.23	49.18
act062-3-a	21.96	1.45	24148.20	3725.37	97170.51	278087.15	341.06	0.00	16084.67	28025.94	49.07
act062-4-a	24.91	1.30	24916.04	4121.39	93266.23	272606.24	398.79	0.00	16808.39	30870.78	52.22
act062-5-a	23.56	1.63	24888.42	4129.31	93518.16	273292.46	351.57	0.00	16452.16	30607.29	50.81
act062-1-b	26.13	1.15	27341.85	3769.37	91982.39	271148.04	518.43	0.51	16452.26	35216.52	44.02
act062-2-b	25.33	1.33	29675.07	3627.28	92839.25	271146.06	527.93	0.00	16813.72	34393.67	45.42
act062-3-b	25.43	1.25	29560.41	3545.19	93712.55	272326.28	521.23	0.00	17153.62	32984.31	45.26
act062-4-b	24.25	1.11	25514.05	3530.04	95780.80	274974.45	498.07	0.00	16393.68	32938.16	46.33
act062-5-b	21.28	1.61	25816.79	3280.42	100822.76	278824.54	446.64	0.00	14519.71	31257.65	42.03
average	24.56	1.33	26079.81	3836.45	93938.98	273221.95	444.93	0.05	16592.11	31982.78	47.48

Table 2b: TOF-LA-ICP-MS elemental concentrations of ACT062

ANID	Ti	V	Cr	Mn	Fe	Ni	Co	Cu	Zn	Ga	Ge	As	Rb
act062-1-a	8880.06	75.04	9.85	2791.63	89789.41	19.31	18.89	2.58	20.24	12.76	0.36	0.00	41.91
act062-2-a	8461.03	71.02	2.32	2622.31	84571.28	9.43	17.61	2.02	19.91	12.54	0.09	0.00	39.27
act062-3-a	7512.87	61.20	0.00	2290.58	73680.26	0.00	15.21	1.86	14.80	11.01	0.00	0.00	34.38
act062-4-a	8174.04	66.25	0.00	2538.65	81245.57	0.00	16.51	1.98	18.53	11.64	0.00	0.00	36.57
act062-5-a	8238.39	65.71	0.00	2507.93	80481.70	0.00	16.56	1.81	18.17	11.66	0.00	0.00	36.02
act062-1-b	7406.30	75.89	27.38	1816.18	80508.01	96.95	18.94	3.54	23.69	13.80	0.88	0.57	40.30
act062-2-b	7216.55	73.69	22.62	1759.65	78161.91	96.80	18.52	2.14	22.12	13.50	1.04	0.75	39.70
act062-3-b	6961.04	73.30	19.37	1745.74	76909.94	81.60	18.27	2.61	27.41	13.23	0.79	0.56	40.54
act062-4-b	6923.91	70.33	16.78	1687.91	74877.04	84.35	18.14	2.31	21.73	12.33	0.30	0.43	37.37
act062-5-b	6443.80	62.13	14.24	1515.96	66557.91	73.22	15.88	2.23	20.45	11.66	0.44	0.24	33.19
average	7621.80	69.46	11.26	2127.66	78678.30	46.16	17.45	2.31	20.71	12.41	0.39	0.26	37.92

Table 2c: TOF-LA-ICP-MS elemental concentrations of ACT062

ANID	Sr	Y	Zr	Nb	Mo	Ag	Cd	Sn	Sb	Te	Cs	Ba	La	Ce
act062-1-a	288.06	24.31	137.12	6.38	0.18	0.04	0.00	0.35	0.08	0.00	1.43	743.98	20.88	38.26
act062-2-a	276.83	24.49	132.13	6.25	0.27	0.04	0.00	0.28	0.05	0.09	1.24	714.19	20.68	37.95
act062-3-a	251.73	21.89	123.97	5.24	0.03	0.04	0.00	0.30	0.04	0.14	1.06	630.58	17.56	33.37
act062-4-a	274.09	25.02	134.66	5.89	0.00	0.04	0.00	0.37	0.06	0.17	1.15	694.65	19.50	35.12
act062-5-a	276.08	23.55	136.45	5.73	0.00	0.06	0.00	0.29	0.06	0.00	0.91	708.85	19.50	36.39
act062-1-b	293.06	24.54	137.61	6.47	0.26	0.05	0.19	0.40	0.06	0.00	1.37	774.96	20.52	38.36
act062-2-b	282.02	23.64	128.52	6.38	0.36	0.06	0.01	0.40	0.04	0.00	1.32	749.27	20.18	37.13
act062-3-b	272.26	22.17	127.19	5.81	0.27	0.04	0.07	0.33	0.06	0.04	1.28	718.99	19.77	36.31
act062-4-b	272.71	23.48	129.92	6.32	0.18	0.05	0.07	0.35	0.05	0.00	1.19	713.96	20.20	36.11
act062-5-b	264.11	24.24	132.85	5.91	0.15	0.05	0.00	0.30	0.05	0.00	0.97	689.22	18.51	34.42
average	275.09	23.73	132.04	6.04	0.17	0.05	0.03	0.34	0.05	0.04	1.19	713.87	19.73	36.34

Table 2d: TOF-LA-ICP-MS elemental concentrations of ACT062

ANID	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	W
act062-1-a	5.00	22.81	5.21	1.64	9.34	0.76	4.56	0.91	2.63	0.31	2.42	0.36	3.07	0.38	0.26
act062-2-a	4.95	21.33	4.70	1.45	9.32	0.71	4.82	0.87	2.58	0.37	2.72	0.47	3.25	0.36	0.22
act062-3-a	4.47	17.92	5.34	1.53	8.30	0.90	4.19	0.92	2.57	0.36	2.45	0.34	2.96	0.30	0.20
act062-4-a	4.73	20.68	5.38	1.49	9.83	0.82	4.76	0.99	2.77	0.41	2.92	0.53	3.20	0.30	0.19
act062-5-a	5.01	21.85	4.77	1.40	8.93	0.84	4.56	0.98	2.78	0.37	3.44	0.39	3.27	0.33	0.16
act062-1-b	5.08	21.80	5.25	1.64	9.24	0.77	4.92	0.95	2.57	0.39	2.74	0.39	3.21	0.28	0.18
act062-2-b	4.69	20.64	5.22	1.56	8.20	0.69	4.07	0.94	2.55	0.38	2.35	0.39	2.86	0.34	0.15
act062-3-b	4.46	19.16	4.71	1.49	8.19	0.74	3.98	0.72	2.25	0.28	2.76	0.48	2.79	0.34	0.20
act062-4-b	4.47	21.85	5.44	1.45	8.99	0.81	4.68	0.88	2.62	0.31	2.75	0.39	2.86	0.24	0.18
act062-5-b	4.65	20.22	4.68	1.65	8.30	0.79	4.18	0.97	2.43	0.36	2.78	0.38	3.16	0.31	0.18
average	4.75	20.83	5.07	1.53	8.86	0.78	4.47	0.91	2.57	0.35	2.73	0.41	3.06	0.32	0.19

Table 2e: TOF-LA-ICP-MS elemental concentrations of ACT062

ANID	Re	Au	Tl	Pb	Bi	Th	U
act062-1-a	0.00	0.00	0.01	0.90	0.01	2.65	0.83
act062-2-a	0.00	0.00	0.01	0.88	0.02	2.51	0.77
act062-3-a	0.00	0.00	0.02	0.80	0.01	2.46	0.69
act062-4-a	0.01	0.00	0.02	0.87	0.01	2.79	0.71
act062-5-a	0.00	0.00	0.02	0.83	0.02	2.75	0.70
act062-1-b	0.00	0.01	0.01	1.13	0.03	2.41	0.87
act062-2-b	0.01	0.00	0.02	0.95	0.00	2.76	0.76
act062-3-b	0.00	0.00	0.01	1.40	0.02	2.52	0.83
act062-4-b	0.00	0.00	0.00	0.95	0.05	2.60	0.77
act062-5-b	0.00	0.00	0.02	0.96	0.05	2.62	0.70
average	0.00	0.00	0.01	0.97	0.02	2.61	0.76