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Chetumal's Dragonglass: Postclassic Obsidian Production and Exchange at Santa Rita Corozal, Belize

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CHETUMAL'S DRAGONGLASS: POSTCLASSIC OBSIDIAN PRODUCTION AND EXCHANGE AT SANTA RITA COROZAL, BELIZE

by

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ABSTRACT

Obsidian is one of the most common materials preserved in the archaeological record of Mesoamerica. Because of this and obsidian's unique chemical properties, it has become one of the most common means by which to explain ancient exchange and production. Northern Belize has largely been absent from discussions of Postclassic Mesoamerican economies. The limited amount of obsidian research that has been done is unable to draw comparisons to the region's primary site during this period, Santa Rita Corozal. This thesis remedies this by exploring the importation, production, and distribution of obsidian at the Postclassic Maya primary center of Santa Rita Corozal, Belize. Through the application of the lithic technology approach and the use of pXRF (portable X-ray fluorescence) spectrometry, it is possible to establish the sources of obsidian being exploited, the stage of reduction of obsidian imports, the major obsidian industry, and obsidian distribution for Santa Rita Corozal's Postclassic Period.

Dedicated to Larry J. Seidita (1947 – 2005)

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LIST OF ABBREVIATIONS

CPP	Corozal Postclassic Project
HCA	Hierarchical Cluster Analysis
INAA	Instrumental Neutron Activation
MURR	University of Missouri Research Reactor
PIXE	Particle-induced X-ray emission
PPM	Parts Per Million
pXRF	portable X-ray Fluorescence

CHAPTER 1: INTRODUCTION

Coming from only a small number of distinct volcanic sources across Central America (Figure 1.1), obsidian has long been used as evidence of long distance trade (D. Chase and A. Chase 1989; Sidrys 1976). Due to the fact that residues of obsidian production are preserved in the archaeological record and that it is possible to accurately trace artifacts to their original source, obsidian has become among the most common means to discuss ancient exchange and production in Mesoamerica.

The Postclassic Period (1150 – 1530 CE) is widely regarded as a time of increased economic activity, where commodities, including obsidian, were traded across Mesoamerica. Ethnohistoric accounts of Central Mexico and the Northern Maya Lowlands describe a thriving economy where goods were exchanged in regional markets (M. Smith and Berdan 2003). In spite of this, debate still exists as to the presence and extent of a market economy prior to contact and whether the markets described by the Spanish were markets as we conceive of them now. Due to its ubiquitous nature and its limited number of sources, obsidian has been used to test for the existence of a market economies at sites throughout Mexico and the Maya Region (Braswell 2010; Braswell and Glascock 2002; D. Chase and A. Chase 2014:244; Hirth 1998:460-462; Masson and Freidel 2012:464 - 471, 2013:214-215; Feinman et al. 2013; M. Smith 2004; M. Smith et al. 2007:445).

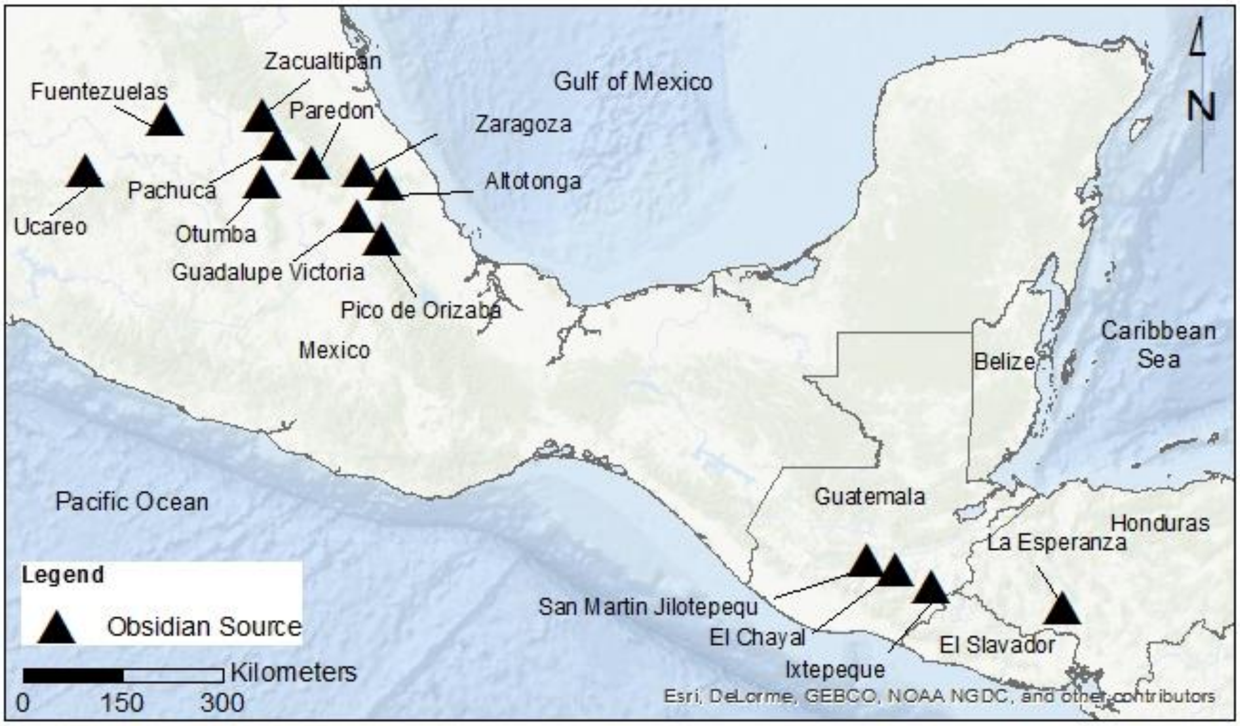

Figure 1.1 Primary Mesoamerican obsidian sources

Studies on the exchange, production, and distribution of obsidian have been far more limited in Postclassic Period northern Belize than other regions of Mesoamerica, but see Masson and Chaya (2000), Mazeau (2000), and Stemp et al. (2011) for economic discussions Hammond et al (1984), McKillop (1995), Neivens et al. (1983) for sourcing studies. Ethnohistorically, this region is known to have been very active economically, exporting cacao and honey (Oviedo 1951-55: book 32, chapter 6; Scholes and Roys 1948:317). Previous studies of exchange in Postclassic Period northern Belize have focused on ceramics (Masson 2000; Masson and Rosenswig 2005; Mock 2005) and most prolifically chert (Dockall and Shafer 1993; Hester et al. 1982; Galup 2007; Shafer and Hester 1983, 1986; 1988; Marino 2014; Masson 2000; McAnany 1989; Santone 1997; Stemp 2004). The limited number of studies concerning Postclassic northern Belize obsidian economies (Figure 1.2) have focused on island trade ports

(Stemp 2004, 2011) or secondary and tertiary inland sites (Masson and Chaya 2000; Mazeau 2000). Sourcing studies conducted in the region have either relied upon small samples for chemical sourcing or larger samples analyzed using unreliable visual sourcing to discuss patterns of obsidian exchange (Neivens et al. 1983; Masson and Chaya 2000; Moholy-Nagy 2003) (Figure 1.2). Because of this, the problem that I address in this thesis is that previous research on Postclassic Period northern Belize obsidian economies have been unable to draw comparisons to the regional capital of Santa Rita Corozal.

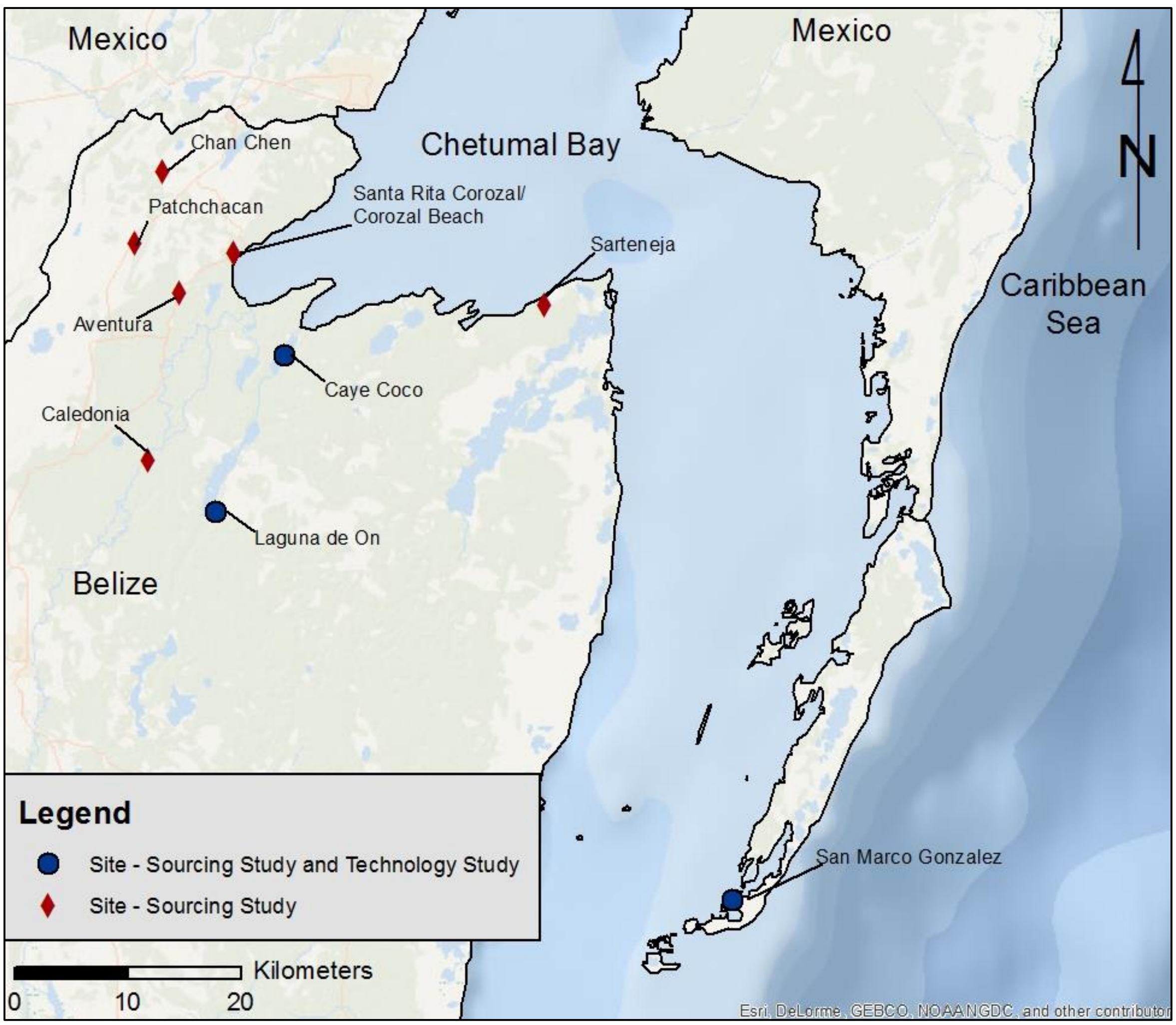

Figure 1.2 Map of Postclassic Period obsidian studies in Northern Belize

This problem is addressed by determining the form in which obsidian is being imported, the obsidian sources being exploited, the type of local production occurring, and the method by which obsidian is being distributed. The obsidian assemblage was analyzed according to the lithic technology approach (Clark and Bryant 1997). By comparing the debitage and artifacts present to those of expected importation forms like nodules, pressure cores, and polyhedral cores, it is possible to determine what form obsidian was being imported while simultaneously characterizing Santa Rita Corozal's Postclassic obsidian industry. Thus, if obsidian is being imported as prepared polyhedral cores, then the assemblage should be comprised solely of initial and final-series blades, cores, and rejuvenation debitage. However, if obsidian is being imported as percussion cores or as raw nodules, the debitage and artifacts should reflect that. If no production debitage is present then finished artifacts are likely being imported. Following importation and production, obsidian would then be distributed to the population of Santa Rita Corozal. Through the use of portable X-ray fluorescence (pXRF) spectrometry, a sample of over 50% of the site's assemblage was assayed to determine the sources being exploited by the population of Santa Rita Corozal. Combining the sources being exploited with a distribution of obsidian densities it is possible to determine the probable method for obsidian distribution at Santa Rita Corozal during the Postclassic Period. If obsidian is being distributed through a market without regards to social status, then all structures should have obsidian in proportion to their need and all statuses should have access to the same kinds of obsidian. However, if distribution of obsidian is being controlled by elites, elite structures should contain statistically more obsidian and a greater variety of obsidian then lower status structures, which would receive obsidian in proportion to their social status. By understanding how commodities are being

distributed archaeologists are able to draw comparisons and analogies with other aspects of prehispanic culture.

Given the great depth of time dealt with by archaeologists, as a field, we are uniquely positioned among the social sciences to offer detailed historical perspectives on modern issues (see A. Chase and Scarborough (2014) for an application of this from the Maya region). An example would be our ability to discuss resilience, the successful adaptation in response to a hardship or change (A. Chase and Scarborough 2014). A common form of resilience is in the adaptability of agricultural systems to environmental changes, such as drought, or to social changes, such as large increases in population. The same methodology may be applied to ancient economies (Scarborough and Valdez 2014). From the Terminal Classic (850-1150 CE) to the Late Postclassic (1300 – 1530 CE) Santa Rita Corozal's population increased by 200% (D. Chase 1990). Understanding how the population adapted to this change in terms of economics is just as important as how they adapted agriculturally. Understanding the resilience of ancient provisioning strategies may help inform modern issues of urban growth.

The following chapter, Chapter 2, is a background on the period, region, and site being discussed in this thesis. Chapter 3 deals with the importation and production of obsidian at Santa Rita Corozal. This chapter reviews the exchange of blades versus cores as well as the obsidian reduction sequence that results in the production of fine prismatic blades. The Postclassic Santa Rita Corozal assemblage is analyzed in detail. Several conclusions are drawn regarding the forms in which obsidian was being imported into Santa Rita Corozal and the type of production occurring at the site. Chapter 4 discusses how obsidian is being distributed at Santa Rita Corozal. In this chapter market theory is reviewed, methods for detecting markets archaeologically are

examined, and how obsidian is being distributed at Santa Rita Corozal is suggested. Chapter 5 is concerned with sourcing obsidian artifacts from Santa Rita Corozal using portable X-ray fluorescence (pXRF) spectrometry. The application, methodology, theory of XRF is presented before considering the results of the pXRF analysis and its implications for the distribution of obsidian at Santa Rita Corozal. Chapter 6 uses the results of the preceding chapters to draw conclusions about the importation, production, and distribution of obsidian at Santa Rita Corozal during the Postclassic Period. Additionally, this chapter outlines potential directions for future research.

CHAPTER 2: BACKGROUND

The Postclassic Period

In the Maya region the Postclassic Period refers to the time between the "collapse" of the city-states of the Southern Lowlands and contact with Europeans. Broadly, this time period lasted from 1150 – 1530 CE (Table 2.1), however the specifics vary at a regional and site level (A. Chase and P. Rice 1985: 9-22). In fact, the collapse does not appear at all sites in the Northern Lowlands. Instead this period is a time of growth and prosperity for some of the region (Andrews et al. 2003) (Figure 2.1). The period has long been characterized as a time of decadence, decline, and degeneration; the term Postclassic is in itself a juxtaposition between the grandeur of the Classic Period Maya and these perceptions (Proskouriakoff 1955; Willey 1986). We now know that this is a mischaracterization of the period (A. Chase and D. Chase 2004).

Table 2.1 Maya time periods and the Central Mexican equivalents.

Maya Time Periods		Central Mexico Time Periods	
Archaic	Pre 1200 BCE	Archaic	Pre 1200 BCE
Early Preclassic	1200 – 900 BCE	Early Formative	1200 – 900 BCE
Middle Preclassic	900 – 300 BCE	Middle Formative	900 – 300 BCE
Late Preclassic	300 BCE – 200 CE	Late Formative	300 BCE– 200 CE
Protoclassic	200 – 300 CE	Protoclassic	200 – 300 CE
Early Classic	300 – 550 CE	Early Classic	300 – 550 CE
Late Classic	550 – 850 CE	Late Classic	550 – 850 CE
Terminal Classic	850 – 1150 CE	Terminal Classic	850 – 1150 CE
Early Postclassic	1150 – 1300 CE	Postclassic	1150 – 1519 CE
Late Postclassic	1300 – 1530 CE		
Contact	1530 CE	Contact	1519 CE

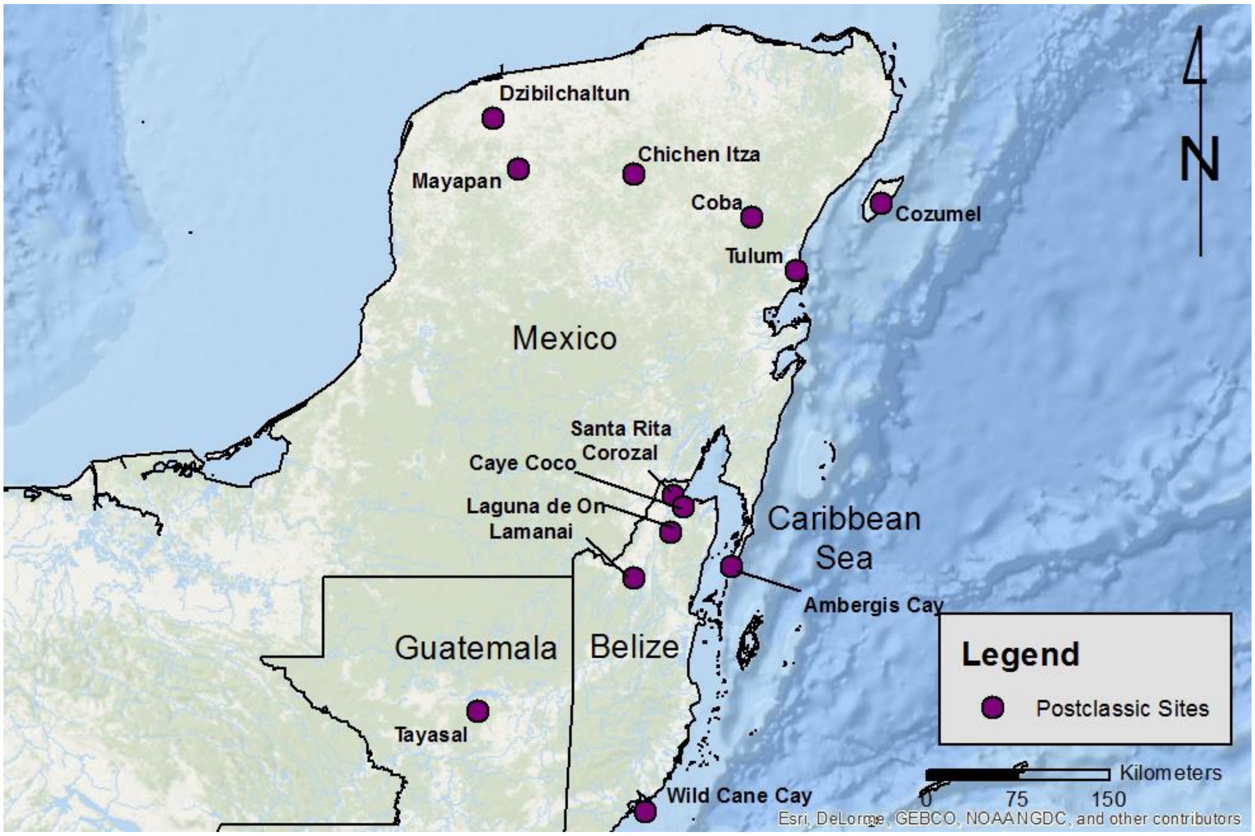

Figure 2.1 Map of major Postclassic Period Maya Sites

Masson establishes three models that have been traditionally applied to the Postclassic Period in the Maya Lowlands. These models include the foreign invasion model, the mercantile model, and the provincial model (Masson 2000: 17). The foreign invasion model posits that during the Postclassic Period the Northern Lowlands and its peripheral regions saw an influx of foreigners. This is seen in the blending of styles at many sites including Colha, Dzibilchaltun, Chichén Itza, Mayapán, Nohmul, Seibal, and Santa Rita Corozal (D. Chase 1982; Pollock 1962; Robles and Andrews 1986; Tourtellot et al. 1992). The foreign "invasion" seems to have played out differently at various sites. Colha and Nohmul both support an incursion by northerners (D. Chase and A. Chase 1982; Eaton 1980; Hester 1982; Masson 2000:18-21); while other sites

appear to have been peacefully incorporated into the new international sphere (D. Chase and A. Chase 1988; Masson 2000:18-21). The mercantile model holds that energy and social emphasis was shifted from the social hierarchy of the Classic Period to the efficient exchange and production of commodities during the Postclassic Period (Rathje 1975; Sabloff and Rathje 1975). In this model, participation in the international sphere was the result of a breakdown of social hierarchy and greater interactions between cultures due to an increase in trade between regions. However, it is also becoming clear that mercantilism was just as important to Classic Period peoples (D. Chase and A. Chase 2004b; Dahlin et al. 2007). The provincial model is based on Spanish accounts of the social structure of the Late Postclassic Maya. Roys (1957) determined the boundaries of sixteen provinces at the time of contact with the Spanish. These provinces were largely independent from each other; however, some regional hierarchies did exist (A. Andrews 1984; G. Jones 1989). Each province had its own social hierarchy comprised of *halach unic* (regional lords), *batab* (town lords), and *ah cuch cab* (town councils) (Masson 2000:27-28). Interactions between these provinces in the forms of alliances and trade may account for the modeled ceramic figures found in caches at many sites during the Postclassic Period including Mayapán, Lamanai, and Santa Rita Corozal. Additionally, Pina Chan (1978) has suggested that different provinces specialized in the production of different commodities (see D. Chase 1986 for specialized production at Santa Rita Corozal).

Northern Belize and The Chetumal Province

Sitting atop a chert bearing limestone shelf, northern Belize is speckled with swamps, bajos, aguadas, and navigable waterways (A. Chase et al. 2014). Averaging 1500 mm of rainfall

annually, the region’s western portion is heavily forested (A. Chase et al. 2014). The area has been occupied continuously since the Paleo-Indian era and the ancient communities of the region relied upon raised fields to meet the agricultural requirements of the population (A. Chase et al. 2014; D. Chase 1992; D. Chase and A. Chase 2004b; Luzzadder-Beach et al. 2012). Additionally, ancient communities may have created canals between navigable waterways and wetlands (Masson 2000:14-15).

Like the Northern Lowlands, many sites in northern Belize and southern Quintana Roo saw substantial growth during the Postclassic Period. These sites are typically located immediately adjacent to or very near waterways. In northern Belize coastal settlements include: Cerros, Santa Rita Corozal and the island site of San Marco Gonzalez (D. Chase and A. Chase 1988; Guderjan and Garber 1995; Masson 2000: 16). Many others are located on or near inland waterways and lagoons (Sidrys 1983). During the Postclassic Period, settlements on or in proximity to waterways saw population increases (A. Chase and P. Rice 1985:6; Masson 2000). This trend is seen in northern Belize by the establishment of new sites and the growth of already established sites, such as Santa Rita Corozal (D. Chase 1992, D; Chase and A. Chase 2004b; Masson 2000; D. Rice 1974).

The Chetumal province was located in what is now modern day northern Belize and southern Quintana Roo, Mexico (D. Chase 1982, 1986; G. Jones 1989; Roys 1957). To the south of the Chetumal province was a province known as Dzuluinicob while to the north, the province of Uaymil controlled a portion of Quintanna Roo. The Chetumal province is named for its capital, Chetumal, which has been identified as Santa Rita Corozal (D. Chase and A. Chase 1988:65-68). At the time of contact the Chetumal province was ruled by a halach uinic, named

Nachan Kan (Masson 2000). It appears that during the Postclassic Period, sites within the Chetumal Province followed a social hierarchy of primary, secondary, and tertiary sites (Masson 2000; Kepecs and Masson 2003). Major sites in the Chetumal province at this time included Santa Rita Corozal, Caye Coco, Laguna de On, Ichpaatun, and Sarteneja. The primary center in the Chetumal province was Santa Rita Corozal which was supported by secondary sites such as Caye Coco, which in turn were supported by tertiary support communities such as Laguna de On (Masson 2000; Kepecs and Masson 2003). However, the relationship between other centers and smaller sites in the Chetumal Province has not been adequately explored.

Santa Rita Corozal

Santa Rita Corozal was located along the coast of the Chetumal Bay, beneath modern day Corozal Town, Belize (Figure 2.2). Santa Rita Corozal is situated near the mouths of three major riverine systems; the New River and Freshwater Creek which flow from central Belize into Chetumal Bay, and the Rio Hondo which demarcates the modern day borders between Guatemala and Mexico, and Mexico and Belize. These three waterways served as important trade and communication routes connecting the Caribbean coast with inland settlements (Barret and Guderjan 2006; D. Chase and A. Chase 1989). Santa Rita Corozal's access to marine resources would have allowed it to provide mainland sites with commodities not available to them locally; some of these objects may have been important ritually (D. Chase and A. Chase 1989). The site's coastal location would also have allowed it to participate in the circum-peninsular trade, which characterized exchange in the region during the Postclassic period (Berdan et al. 2003; Scholes and Roys 1948; Sabloff and Rathje 1975). Much of the ancient site

has been destroyed by the expansion of Corozal Town and the rising sea levels of the bay (D. Chase 1982; D. Chase and A. Chase 1988; McKillop 2002).

Figure 2.2 Map of Santa Rita Corozal. Adapted from A. Chase and D. Chase 1988.

Santa Rita Corozal was first archaeologically investigated by Thomas Gann, a medical doctor who was stationed in Corozal Town at the turn of the 20th century. Gunn noted that the site contained extensive Postclassic material; in particular, modeled and painted effigy caches and murals (D. Chase 1981, 1982, 1985, 1986, 1990b; D. Chase and A. Chase 1988, 2004b; Gann 1900, 1911, 1914, 1918) . The effigy caches noted by Gann are similar to those found across the region during the Postclassic, most notably at Mayapán (D. Chase 1981, 1992; D. Chase and A. Chase 1986, 2004b, 2008). Gann's work was followed by several other projects (Green 1973; Sidrys 1976, 1983). Santa Rita Corozal was most intensely investigated by the Corozal Postclassic Project (CPP) from 1979 – 1985 directed by Diane and Arlen Chase. In the four years of excavation (1979-1980, 1984-1985) the CPP excavated 46 structures and mapped over 200 structures, platforms, and chultuns (D. Chase 1981, 1982; D. Chase and A. Chase 1988). It was the CPP's goal to better understand the Postclassic Period, which had previously been misrepresented in comparison to the grandeur of the Classic period Maya (D. Chase 1982; D. Chase and A. Chase 1988). The CPP did this by investigating how archaeology related to the historic and ethnographic records, by testing vacant terrain, by evaluating several settlement pattern theories, and by emphasizing the importance of contextual analysis (D. Chase 1982; D. Chase and A. Chase 1988, 2004b). The work undertaken by the CPP also spawned several studies of artifact classes including manos and metates (Jaeger 1988; Duffy 2011), chert (Shaffer and Hester 1988; Marino 2014), faunal material (Morton 1988), and shells (Hamilton 1988). The work by the CPP project and those associated with it have contributed to the idea of the Postclassic Maya as a vibrant and thriving international society.

The area of Chetumal Bay where Santa Rita Corozal and modern day Corozal Town are located have been continuously occupied for more than 3000 years. The earliest occupation at Santa Rita Corozal dates to the Early Preclassic when it is believed that the population was only 150 people living on the bluff above the Bay (D. Chase 1990, 2005) (Table 2.2). By the Early Classic Period it is believed that Santa Rita Corozal had gained prominence over Cerros as the key site on the Chetumal Bay. The population for this time is estimated to have been around 1500 people (D. Chase 1990; D. Chase and A. Chase 2005). By the Late Postclassic Period Santa Rita Corozal emerged as a regional power that participated in regional trends with sites such as Tulum, Colha, and Mayapán (D. Chase 1981, 1985, 1988, 1992; D. Chase and A. Chase 1986, 2004b; Sanders 1960; Valdez 1987). By the late-facet of the Late Postclassic (1330-1530 CE), Santa Rita Corozal reached its largest extent with a population estimate of 6,800 within the town itself (D. Chase 1990; D. Chase and A. Chase 2004b). Santa Rita Corozal was abandoned in 1530 ahead of an advancing Spanish force (D. Chase and A. Chase 1988). The site was never intensely occupied by the Maya again. Artifacts of both Spanish and English origin indicate that the site was periodically occupied following abandonment (D. Chase and A. Chase 1988).

Table 2.2 Population estimates by time period at Santa Rita Corozal from D. Chase 1990

Time Period	Estimated Population
Early Preclassic	150 people
Middle Preclassic	150 people
Late Preclassic	1,000 People
Protoclassic	1,000 + People
Early Classic	1,500 People
Late Classic	2,500 People
Terminal Classic/Early Postclassic	2,000 People
Early-facet of Late Postclassic	1,800 People
Late-facet of Late Postclassic	6,800 People

The work of the CPP helped determine that Santa Rita Corozal is likely the location Chetumal, the capital and namesake of the Chetumal Province. Historic accounts of Chetumal describe it as a city of 2,000 houses, located on the Chetumal Bay (D. Chase and A. Chase 1988; Oviedo 1851-55:book 32,chapter 6). Several Spanish expeditions to Chetumal describe it as being located south along the coast from the mouth of the Rio Hondo and between the Rio Hondo and New River (D. Chase 1981, 1982; D. Chase and A. Chase 1988; Scholes and Roys 1948). Archaeologically, Santa Rita Corozal's abandonment corresponds with Spanish accounts of the abandonment of Chetumal prior to their arrival in 1531 (D. Chase and A. Chase 1988:66). Additionally, Spanish accounts of Chetumal describe it as a thriving economic center known for exporting honey and cacao (D. Chase 1986). The work of the CPP identified the Late Postclassic at Santa Rita Corozal as a period where the site participated in extensive trade networks (D. Chase and A. Chase 1988, 1989). Lastly, the caching patterns seen at Santa Rita Corozal during the Postclassic Period suggest that the site participated in a regional tradition and is likely a provincial capital (D. Chase 1985; D. Chase and A. Chase 1988:65 - 68).

CHAPTER 3: OBSIDIAN IMPORTATION AND BLADE PRODUCTION

Prismatic obsidian blades are among the longest lived artifact types in Mesoamerica. While production techniques varied over space and time, the end product remained relatively unchanged for thousands of years (Healen 2009). The enduring appeal for obsidian tools is due to obsidian's well-known ability to produce some of the sharpest edges known. Testimony of obsidian's appeal in Mesoamerica can be seen in its near universal importation to areas where other chipped stone resources, such as chert, were readily available (Golitko et al. 2012). This chapter is concerned with the importation and production of prismatic blades at Santa Rita Corozal during the Postclassic Period. Because obsidian blade production is a reductive process, it is possible to analyze the artifacts and resulting debitage to determine the form in which obsidian was being imported in to Santa Rita Corozal. Each major step of the reduction sequence is characterized by diagnostic products and byproducts whose presence or absence reveals when in the reduction sequence local production began. Thus, if debitage from percussion reduction is missing from Santa Rita Corozal's assemblage, then it is likely that obsidian was being imported in a form characteristic of the later part of the reduction sequence such as polyhedral cores or partially reduced polyhedral cores (Hirth et al.2006). On the other hand, if percussion debitage is present, then, depending on the type of debitage, obsidian may have been being imported as either nodules, core preforms, or macrocores (Hirth et al. 2006). The absence of any production debitage would suggest that the site's prismatic blades were being produced elsewhere and being brought into the site for distribution.

This chapter is chiefly concerned with understanding local obsidian blade production in order to determine the form of obsidian being imported in to Santa Rita Corozal during the Postclassic Period. Obsidian forms are representative of the different stages in the reduction sequence, e.g. nodules, core preforms, polyhedral cores, or finished blades. To this end I do not cover the other known obsidian industry at Santa Rita Corozal, the production of projectile points from obsidian blades, nor is this a use-wear study of the obsidian tools recovered by the Corozal Postclassic Project. The production of obsidian projectile points from blades is a pan-Mesoamerican industry; Meissner (2014) recently discussed their production and exchange in the Maya lowlands, including those from Santa Rita Corozal. Preliminary use-wear analysis of Santa Rita Corozal's obsidian assemblage was conducted by Hartman in the 1980s (Hartman 1980).

Background

The exchange of obsidian underwent a dramatic shift early in the development of Mesoamerican civilizations. The earliest form of obsidian exchange was that of flake cores for the production of expedient flake tools (Clark 1987). Obsidian assemblages from this type of exchange are characterized by small flakes, large amounts of obsidian shatter, and the quality of obsidian is generally lower than is seen in later assemblages (Clark 1987). Boksenbaum (1980) and Clark (1987) both characterize this type of expedient flake production as non-specialized, with Boksenbaum describing this production technique as "nodule smashing." This type of exchange was common throughout Mesoamerica until the introduction of the prismatic blade. Prismatic blades were not an overnight phenomenon, occurring first among the Olmec around 1100 B.C. (Cobean et al. 1971; Coe and Diehl 1980). Prismatic blade exchange was well established throughout central Mexico by the end of the Early Preclassic (Cobean et al. 1971; De

Leon et al, 2009; McNeish et al. 1967; Parry 1987). By the Middle Preclassic, prismatic blades were being exchanged in the Belize River Valley and along the Pacific Coast of Guatemala (Awe and Healy 1994; Jackson and Love 1991). At this time blades were being exchanged as finished products from numerous sources in Guatemala and Mexico (Clark 1987; Moholy-Nagy et al. 2013).

A change occurred during the Late Preclassic Period, a thousand years after blades first appeared in the archaeological record, cores begin to be exchanged rather than finished prismatic blades (Clark 1987; Clark and Lee 1984; de Leon et al. 2009; Jackson and Love 1991). This shift can be seen archaeologically from contexts where only finished blades are found to contexts where cores and debitage associated with blade production are found in conjunction with finished tools. Like the initial adoption of prismatic blades, the replacement of blade exchange with the exchange of cores did not occur rapidly. Clark (1987) attributes this to the politics surrounding exchange systems at this time and further suggests that knowledge of the production of blades may have been restricted. Initially cores were exchanged as macrocores, which are "bulky" and "awkward", rather than polyhedral cores, this factored into a higher upfront cost of procuring obsidian in obsidian deficient regions (Clark 1982, 1987; Crabtree 1968). These two factors, restricted knowledge and cost, lead Clark (1987) to assume that prismatic blade production to meet an individual's needs was out of reach for the average person. Instead, he suggested that the knowledge and raw materials were spread via itinerant blade crafters or by elites monopolizing local production as a means of securing power (Clark 1987:274). Regardless of how the knowledge to produce prismatic blades from cores spread, by the Classic Period the

exchange of cores for local production become ubiquitous, a trend which continued into the initial period of contact with Europeans.

The transformation from raw obsidian nodule to finished obsidian tool or artifact is a complex sequence of steps which are visible in the archaeological record; this is known as the reduction sequence. To make sense of this process archaeologists have developed typologies in order to describe, categorize, and understand the process of obsidian blade production. The first major obsidian typology was created by A. V. Kidder (1947) for the sites of Uaxactun and Kaminaljuyu (see also Clark 2003; Sheets 2003). This work also included a thorough review of manufacturing techniques known ethnohistorically (Clark 2003; Kidder et al. 1946: 138) Kidder's work became the de facto typology for the Maya region through the 1970s (Clark 2003; Johnson 1985, 1996; Sheets 1977, 2003). However, the lasting influence of Kidder's typology is that it demonstrated obsidian artifacts were not only worthy of documentation but also of study (Sheets 2003). During the late 1960s and 1970s, experimental archaeology grew in popularity and, although there are issues with early attempts at understanding obsidian blade production through experimentation (see Clark 2003), the efforts of Crabtree (1968) and Sheets and Muto (1972) laid the foundation for the second major typology, the "behavioral" typology developed by Payson Sheets in 1975. A result of his doctoral work at the site of Chalchuapa, El Salvador, Sheet's behavioral typology is based on the assumption that discontinuities in the reduction sequence are the result of conscious choices made by the crafter. The most common example of this is the change from using percussion for coarse work to pressure for more fine work (Sheets 1975). Since its creation, the behavioral typology has become the prevailing typology throughout Mesoamerica, with several authors making changes to its taxa to suit their specific needs.

Of all the alterations to the original behavioral typology, the most significant was the one created by John Clark and Douglass Bryant in 1997 for the site of Ojo de Agua in Chiapas, Mexico (Clark 1997, 2003; Clark and Bryant 1997; Sheets 2003). The Clark and Bryant typology adds several distinct artifact types to Sheets' original reduction sequence. Termed the lithic technology approach, Clark and Bryant's typology shares many similarities with Sheets' (1975) original typology. Both typologies emphasize a standard reduction sequence and their reduction sequences and terminology is based on earlier technical and experimental studies (Clark 1997, 2003; Clark and Bryant 1997; Crabtree 1968, 1972; Hester 1972; Hester et al 1971; Sheets 1975, 1978; Sheets and Muto 1972). While they employ Sheets' methodology, Clark and Bryant (1997) do not utilize his theory; instead, they view their typology as more technological than behavioral. The reason for this is that, in their opinion, the steps represent a generic process resulting in indistinguishable morphological features rather than a means of interpreting behaviors through the discontinuities in the production process (Clark 2003; Clark and Bryant 1997). The newer typology views the reduction sequence as technical steps with technological outcomes rather than on discreet actions undertaken in the manufacturing process (Clark 2003). The lithic technology approach has a better basis in experimental archaeology compared to the Crabtree (1968) experiments and the experiments by Sheets and Muto (1972). The typology is instead based on Clark's (1988) experiment in producing prismatic blades, which utilized rough obsidian nodules and provided counts of debitage and final products at each stage (Clark and Bryant 1997). The aforementioned earlier studies used already prepared obsidian blocks which were not consistent with the type of raw material used in antiquity (Clark 1988, 2003).

Characterizing Obsidian Blade Production

As alluded to in the proceeding section, the reduction from obsidian nodule to prismatic blade is the result of two production techniques: percussion and pressure. Percussion reduction is reduction via impact and generally occurs at the very beginning of the obsidian core-blade reduction process, although it may be used in core maintenance, rejuvenation, or in the purposeful destruction of an exhausted core (Clark and Bryant 1997:124-128). Ethnographically, the percussion reduction stage is absent from Spanish accounts save one, which describes the pre-pressure preparations as removing sharp corners and having their surfaces abraded with rough stones (Hernádez 1959, translated by Feldman 1971). It is unclear whether this abrasion refers to the grounding of platforms, as was common in Postclassic Mesoamerica (Sidrys 1976), or roughing the entire surface of the core to prevent further damage during transport, as has been described for the Ojo de Agua, Chiapas, assemblage (Clark and Bryant 1997; Healan 2009; Titmus and Clark 2003). Typically, percussion reduction is followed by pressure reduction, which is achieved by the steady application of force via a narrow ended tool. According to ethnohistoric sources from Central Mexico at the time of contact, pressure reduction was done by the crafter holding the core with their feet and pressing along the platforms edges with a wooden tool called an *Itzcolotli* (Mendieta 1971: 406, translated by Titmus and Clark 2003; Motolinía 1973 [1541], translated by Titmus and Clark 2003). While initial experimental replication by Crabtree (1968) suggested this technique was not feasible, subsequent experimentation proved that both native technologies and Spanish accounts of production were viable (Clark 1982, 1985, Timus and Clark 2003). Not every obsidian nodule goes through every stage of production, as different variables (e.g. inclusions, size, initial shape, etc.) may affect the reduction sequence and

crafters may choose different techniques to maximize the efficiency of production or to create a desired outcome (Clark and Bryant 1997). Regardless, the desired result of core-blade reduction is the creation of highly regular blades, defined as being longer than they are wide (Clark and Bryant 1997). The proceeding discussion of blade production follows the typology created by John Clark and Douglass Bryant in 1997 with a few alterations that will be reviewed in the following sections (Clark 1997; Clark and Bryant 1997). In accordance with the typology, Roman numerals are used to describe the stages of reduction via percussion and Arabic numbers are used for the stages and artifacts derived via pressure reduction. (Clark and Bryant 1997).

As discussed earlier the initial reduction technique employed in obsidian blade production is percussion. Percussion reduction, which is used to create rough cores prior to more refined pressure flaking, may be done at the quarry or site of extraction or at obsidian workshops distant from the obsidian sources (Clark and Bryant 1997). Because the individuals extracting obsidian from the different sources did not all prepare their nodules similarly before exchanging them, sites may be importing obsidian at several different stages in the reduction sequence. The reduction stages and their byproducts are summarized in figure 3.1. The initial step is the creation of a core preform from a nodule of obsidian (Sheets 1975, Clark and Bryant 1997). This is done by removing one or more platform preparation flakes horizontally across the nodule (Clark and Bryant 1997). This creates a surface from which flakes and blades may be taken off the vertical length of the nodule. The next step in the reduction sequence is the creation of a macrocore I in preparation of the removal of percussion blades (Clark and Bryant 1997). This is done by the removal of decortication flakes and large I macroflakes from the core preform's perimeter. The macrocore I is then further reduced to a macrocore II by removing II macroflakes

which are smaller than I macroflakes (Clark and Bryant 1997). Clark and Bryant (1997) note that II macroflakes may actually be failed attempts at creating macroblades which, as defined by Tolstoy (1971: 275) are percussion blades greater than 2.5cm wide and that are wider, thicker, and longer than small percussion blades. At this stage the macrocore II is further reduced by removing small percussion blades (less than 2.5cm wide) to create a polyhedral core ready for reduction by pressure.

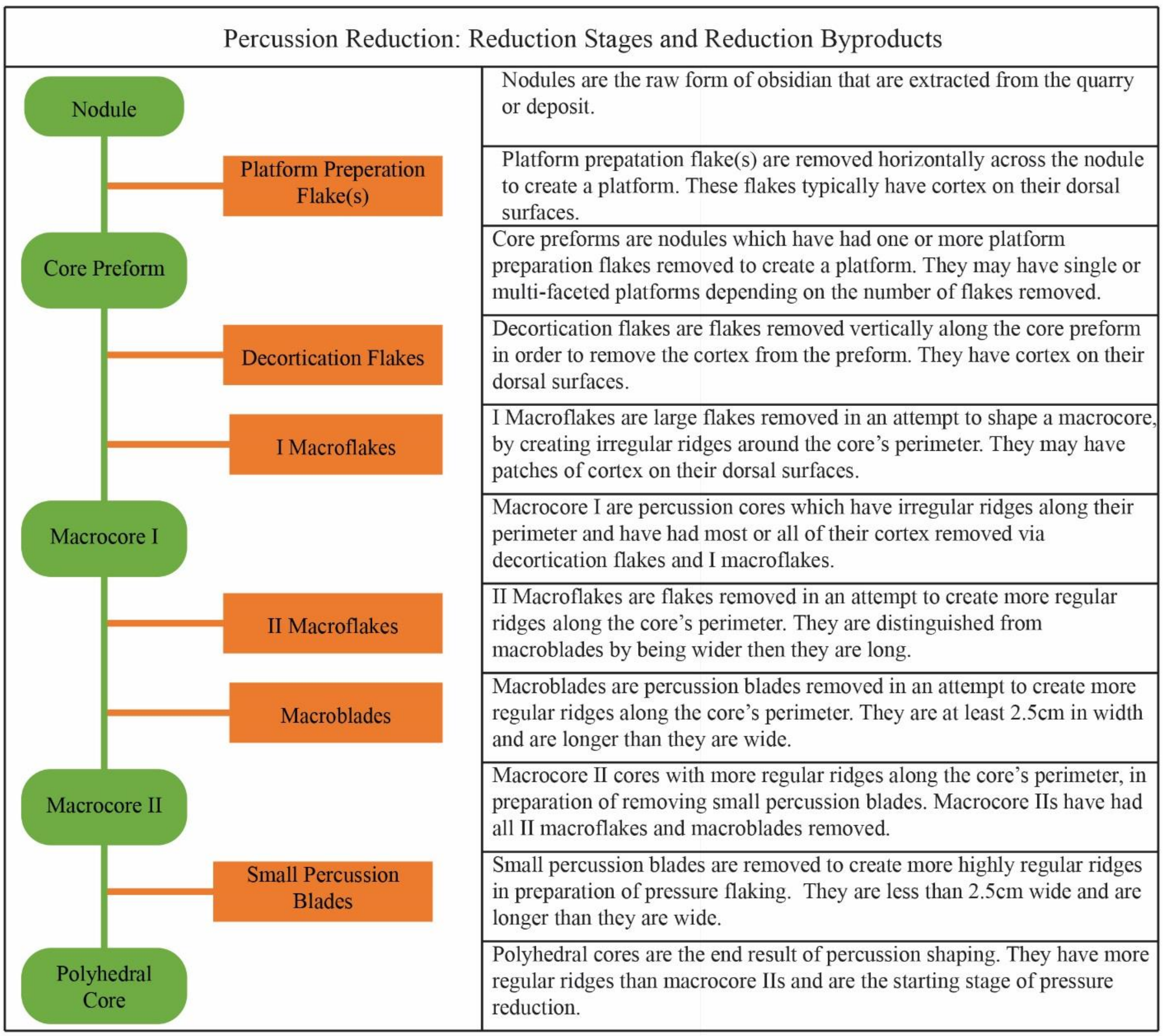

Figure 3.1 Percussion reduction stages and byproducts. Adapted from Hirth and Andrews 2002:3.

It is likely that the rough polyhedral cores were transported next to workshops at their final destination to create prismatic blades (Clark and Bryant 1997:133). It is also at this point that production would have switched from percussion with hammers to more fine pressure tools such as the *Itzcolotli*. To create the fine prismatic blades found throughout Mesoamerica, crafters would have to remove increasingly regular blades with parallel or almost parallel edges. The pressure reduction sequence and its associated byproducts are summarized in Figure 3.2. These blades are known as first-series through third-series blades (Clark and Bryant 1997:118). The initial shaping of the core via pressure is done by the removal of the highly irregular first-series blades from the core. These blades are shorter, wider, and more irregular than second and third-series blades (Clark and Bryant 1997:119). First-series blades do not extend the entire length of the core and terminate before the core's distal end. The goal of first-series blades is to remove the majority of percussion scars from the core's surface (Clark 1997; Clark and Bryant 1997:122). After all first-series blades have been removed, the core is considered a polyhedral core 1 (Clark and Bryant 1997:119). A polyhedral core 2 is created by removing all second-series blades from the core. Second series blades are more regular than first-series blades and are used to remove the remaining percussion scars from the distal portion of the core (Clark 1997; Clark and Bryant 1997:112). Once the crafter has removed all remaining percussion scars from the core it is ready to produce highly regular third-series prismatic blades. Third-series blades, also referred to as fine blades or prismatic blades, are narrow, long, regular blades with parallel edges (Clark and Bryant 1997: 122-124). These blades are consistently regular, as they follow parallel ridges left by the previous blades removed from the core. Once all third-series blades have been removed the blade is considered exhausted (Clark and Bryant 1997:122-124). First

and second-series blades may be difficult to distinguish, especially if the entire blade is not present; because of this, I follow the example set by Hirth et al. (2006) and Santley et al. (1986) by grouping these two types of blades together as initial-series blades; third-series blades are categorized as final-series blades under this scheme.

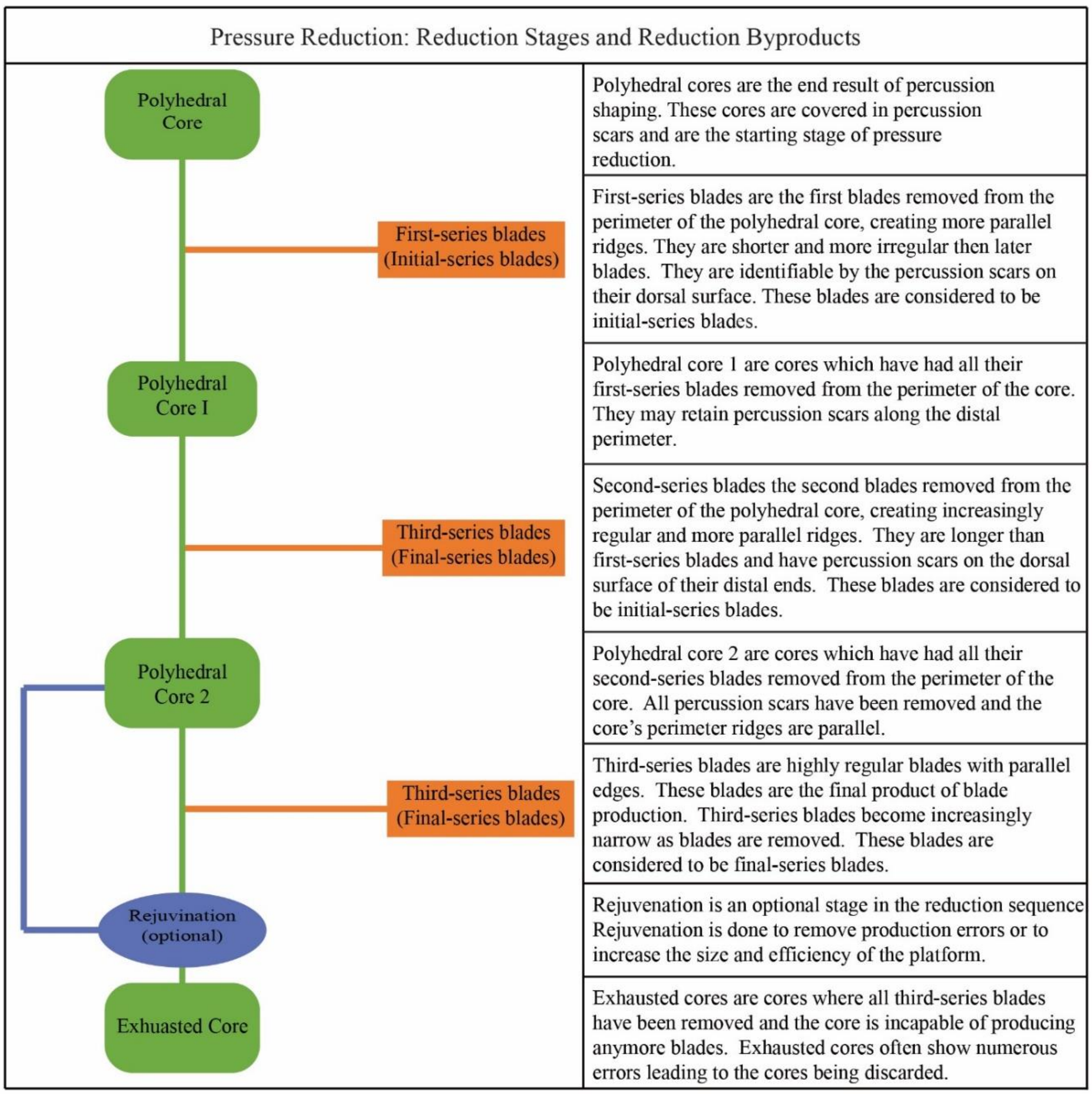

Figure 3.2 Pressure reduction stages and byproducts. Adapted from Hirth and Andrews 2002:4.

Core rejuvenation is most often undertaken to remove a knapping error from the core. Most commonly among the Ojo de Agua assemblage this error was a hinge fracture left by a blade that was not completely removed (Clark 1997:139). Of the six rejuvenation techniques listed by Clark (1997), proximal, lateral, medial, and distal rejuvenation flakes all remove the error as well as a significant amount of material from the core (Clark 1997:151). The other means of removing knapping errors is the direct-rejuvenation technique, a process by which the error is abraded, pecked, or ground away (Clark 1997:115). This technique is economical in terms of material wasted in the rejuvenation process but is more time consuming compared to the removal of an error via one or more flakes (Clark 1997). The last type of rejuvenation described in the lithic technology typology is a platform-rejuvenation flake. These are removed from partially reduced polyhedral cores (Clark 1997). The reason for this is a matter of debate with some (Hester et al. 1971), suggesting it is to increase size of the available platform as pressure reduction tapers cores at both ends, while others arguing that the platforms are removed to maintain a proper angle for pressure flaking (Clark 1985).

The final category of artifacts resulting from the production of blades can be generically termed debitage. This is used as a catch all term for obsidian artifacts derived from the process of blade production, but does not fall within the neat categories of the reduction sequence by which an obsidian nodule becomes prismatic blades. While there are numerous types of debitage, only the three types that are seen in the Santa Rita Corozal obsidian assemblage will be discussed here. The most generic forms of debitage are the chunk and the flake. Chunks are blocky pieces of obsidian from large flakes or cores. Flakes are portions of cores that have been removed by either percussion or force and retain the diagnostic bulbs of force and sometimes a platform.

Flakes differ from blades as they are typically wider then they are long. Flake fragments are pieces of flakes that lack a bulb of force (Clark and Bryant 1997). Both chunks and flakes are used generically and denote that the artifact is non-diagnostic from the standpoint of production. Flakes may alternatively be diagnostic, such as a ribbon flake, which is part of core rejuvenation and is described by Clark and Bryant (1997) as a method for removing the overhang from the core's platform left by the removal of blades. The third type of debitage seen in the Santa Rita Corozal assemblage is crested blades. Crested blades are used to remove core errors that cannot be removed via other means of rejuvenation. The final type of debitage present in the Postclassic assemblage is plunging blades or overshot blades. These are special distal blade fragments, created when a blade being removed from the core via pressure flaking "overshoots" the intended point of termination and, in doing so, removes a portion of the core's distal end (Clark and Bryant 1997; Crabtree 1972). Plunging blades are not complete failures in terms of blade production; often the proximal and medial sections of the blade are perfectly useable and the distal portion containing the overshoot is simply snapped off the blade.

Methods and Materials

The presence or absence of artifacts and debitage resulting from the reduction sequence is an indicator of what form obsidian was being transported into a site. Hirth et al. (2006) apply this concept to their analysis of prismatic blade production at Xochicalco, Mexico. In their description of the categories of artifacts found in Xochicalco's workshop assemblages, the authors describe how different sources of obsidian provided cores in different stages of reduction (Hirth et al. 2006). The same approach was used by Healan (2002) to understand production at the sites of Tula and Ucareo. At Teotihuacan, Andrews (2002) analyzed the site's surface

collection to understand production and importation by applying the lithic technology approach. In their analysis of blade exchange versus core exchange in Formative Period, Mexico de Leon et al. (2009) describe categories of production evidence. These categories include primary production evidence (cores, core fragments, and core rejuvenation) and secondary production debitage (percussion and pressure reduction artifacts and debitage, blade errors, and error recovery debitage). In order to prove blade exchange over core exchange both categories of production evidence need to be absent from the archaeological record.

For Santa Rita Corozal, I applied this methodology by categorizing the different potential forms in which obsidian may be imported in the site (i.e. nodules/preforms, macrocores, polyhedral cores, partially reduced polyhedral cores) and the artifacts and debitage resulting from the production of blades from these forms; these are summarized in Table 3.1. These forms are presented in reverse order of the reduction sequence, because for each step back in the reduction sequence the resultant assemblage should contain all steps of the reduction sequence following that step (e.g. if reduced from a polyhedral core, the assemblage should contain initial and final series blades, cores, core fragments, rejuvenation debitage, etc.). If the Santa Rita Corozal assemblage is characteristic of one of these importation forms, then it is likely the form primarily being imported into Santa Rita Corozal.

Table 3.1 Table of the potential importation forms and their characteristics debitage.

Imported Forms	Characteristic Debitage
Nodule/Preform	- Platform preparation flakes - Decortication flakes - I & II Macroflakes - Percussion blades - Small percussion blades - Initial-series blades - Final-series blades - Rejuvenation debitage - Blade errors - Error removal debitage - Polyhedral cores and core fragments - Exhausted polyhedral cores
Imported Forms	- **Characteristic Debitage**
Macrocores	- II Macroflakes - Percussion blades - Small percussion blades - Initial-series blades - Final-series blades - Rejuvenation debitage - Blade errors - Error removal debitage - Polyhedral cores and core fragments - Exhausted polyhedral cores
Polyhedral Cores	- Initial-series blades - Final-series blades - Rejuvenation debitage - Blade errors - Error removal debitage - Polyhedral cores and core fragments - Exhausted polyhedral cores
Partially Reduced Polyhedral Cores	- Final-series blades - Rejuvenation debitage - Blade errors - Error removal debitage - Polyhedral cores and core fragments - Exhausted polyhedral cores

The latest reduction stage that would logically be imported is partially reduced polyhedral cores, cores where most or all initial series (first and second-series blades) have been removed from the core via pressure flaking. As a result of their importation, the site's assemblage should contain final series blades (third-series blades), rejuvenation debitage, polyhedral cores, polyhedral core fragments, exhausted polyhedral cores, blade errors, and error removal debitage. The importation of polyhedral cores, where initial percussion shaping has been done but initial series blades have not been removed via pressure yet, has a resulting assemblage that should contain all artifacts and debitage from partially reduced polyhedral cores and initial series blades. The importation of macrocores is characterized by both of the aforementioned assemblages as well as II macroflakes, macroblades, and small percussion blades. Though unlikely, if core preforms or nodules are being imported, then the entire reduction sequence should be present at the site, including platform preparation flakes, I macroflakes, and decortication flakes. If none of these characteristic assemblages are present at Santa Rita Corozal during the Postclassic Period, it is possible that finished prismatic blades are being imported after being produced elsewhere.

I analyzed the entire Santa Rita Corozal assemblage during the spring of 2015. However, only artifacts dating to the Postclassic period will be discussed in this thesis. The assemblage was categorized following Clark and Bryant's (1997) lithic technology approach with the aforementioned changes to the classification of pressure blades as either initial-series for first and second-series blades and final-series for third-series blades. In addition to these classifications, blades were categorized by the portion of the blade present. These classifications include proximal, proximal/medial, medial, medial/distal, and distal. This classification scheme was developed by Lucas Martindale Johnson for the site of Caracol, Belize and is preferred over

classifications of proximal, medial, or distal as it is more descriptive of the portion of blade present. Proximal and distal blade sections do not have enough medial section to be useful, while proximal/medial and medial/distal blade sections have enough medial section to be used in cutting and scraping tasks; examples of each category are seen in Figure 3.3. All artifacts were measured for length, width, and thickness at their maximum for each measurement and were weighed to the nearest .01 gram.

Figure 3.3 Examples of portion present classifications

Santa Rita Corozal's Obsidian Assemblage

The Santa Rita Corozal obsidian assemblage dating to the Postclassic Period consists of only 572 pieces (Appendices A). The site's assemblage is able to reveal the form of obsidian that was being imported and several specifics of blade production at the site. Because obsidian production was not a research question for the project, the excavations focused on domestic and ceremonial structures. Thus, the assemblage is comprised of products which would have reached the end user and redeposited refuse used as construction fill.

The primary obsidian industry at Santa Rita Corozal was the production of fine prismatic blades. The assemblage is mostly comprised of blades and blade segments; of the 572 obsidian artifacts dating to the Postclassic Period, 498 are blades or blade segments (Figure 3.4). A small number are initial-series blades (N=2), one from construction fill of platform 2 and the other from the humus layer overlying structure 214. While both blades are complete, neither exhibits the percussion scars characteristic of initial-series blades and may be from later in the initial stage of pressure reduction. Both initial series blades have signs of edge damage, likely related to use. Thus, it is possible that these blades left workshops as tools and not as waste. The remaining 496 blades are classified as final-series blades. Six complete blades were recovered across all contexts, one of which was broken in situ and refits together. These six blades range in size from 2.61 cm to 7.36 cm offering some insight into how large cores at Santa Rita Corozal may have been. Segmented blade sections comprise 98.8% of the final-series blade assemblage. The majority of which are classified as medial; when proximal/medial and medial/distal fragments are included, these segments represent 95.6% of the final-series blade assemblage. This is not surprising, especially as the flatness of the medial section of prismatic blades make them easier

to haft (de Leon 2009). Most of these blade sections retain evidence of their segmentation in the "tongues" and "tongue facets" left from when blades are snapped while being segmented. While initially classified as production errors by Clark and Bryant (1997:24), experimental replication by Hirth and others have found these to be the result of purposeful blade segmentation (Hirth et al. 2006). Manufacturing errors in the blade assemblage include several blades which end in hinge fractures, the result of blades terminating prematurely. This type of termination does not appear to have affected usability of blades. The distal portion of three plunge blades were also recovered. One of the overshoots comes from a bipolar core. Bipolar cores are not uncommon in the archaeological record and there is at least one occurrence of a bipolar core in the Postclassic assemblage at Santa Rita Corozal. Nearly 15% of the assemblage is notched, most commonly with a single, unilateral side notch. This corroborates an earlier use-wear study of Santa Rita Corozal's obsidian that found blade segments were being hafted for repetitive cutting activities (Hartman 1980).

Thirteen cores and core fragments dating to the Postclassic Period were recovered from nine structures (Figure 3.5, 3.6). Of the three cores found during the excavation of Structure 81, one is considered to be complete. Santa Rita Corozal's cores were small; the single complete core is only 3.45 cm in length and the complete fragments average only 1.4 cm in diameter once exhausted. Two percussion platform removal flakes are among the core fragments. Both these and the complete core have had their platforms prepared by grinding. This appears to be the preferred method of platform preparation at Santa Rita Corozal, as the majority of proximal and proximal/medial blade fragments have ground platforms as well. Ground platforms, while labor intensive to produce, provide several benefits including easier and more predictable blade

removal through the facilitation of crack initiation (Clark 1985; Crabtree 1968; Hirth et al. 2006; Sidrys 1976). At least one core, a complete one, displays evidence for bipolar blade removal. Several core fragments exhibited production errors prior to being discarded. These include hinge fractures and overshoots from plunging blades. Evidence for error removal is scarce at Santa Rita Corozal (Figure 3.5). Several of the lateral/medial fragments may be attempts to remove core errors via percussion. Four lateral rejuvenation flakes were recovered; the majority of these represent attempts at removing hinge fractures from the core. Additionally, a single crested blade was found; the result of removing a hinge fracture.

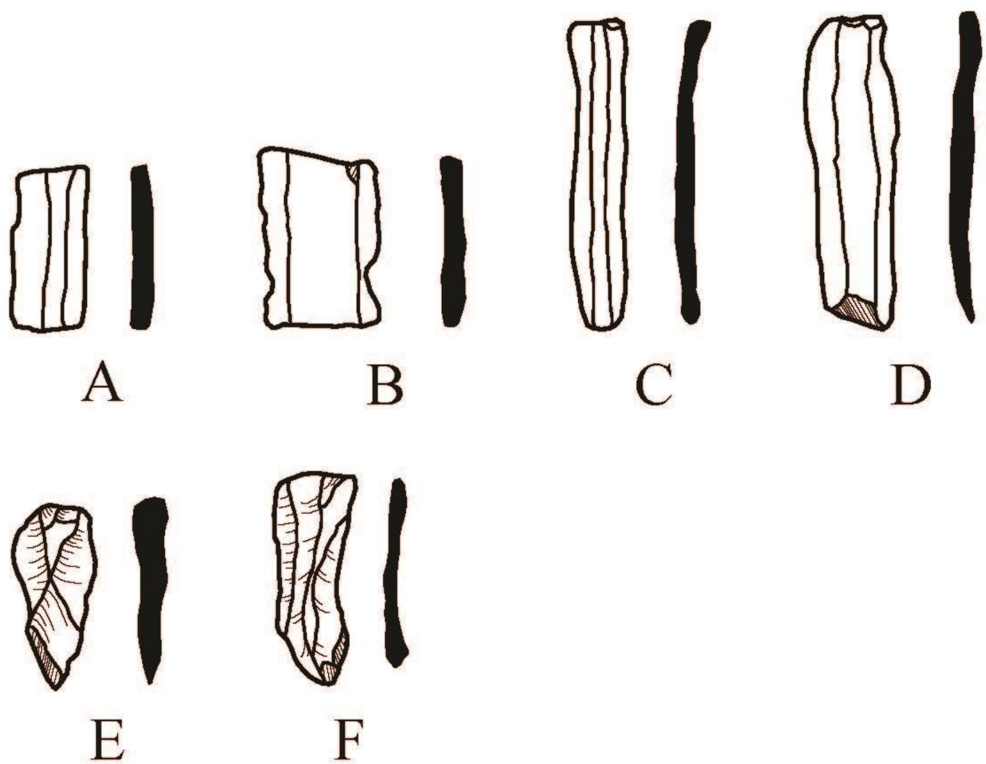

Figure 3.4 Examples of obsidian blades (actual size). A – D: final-series blade segments, E-F: initial-Series blade fragments

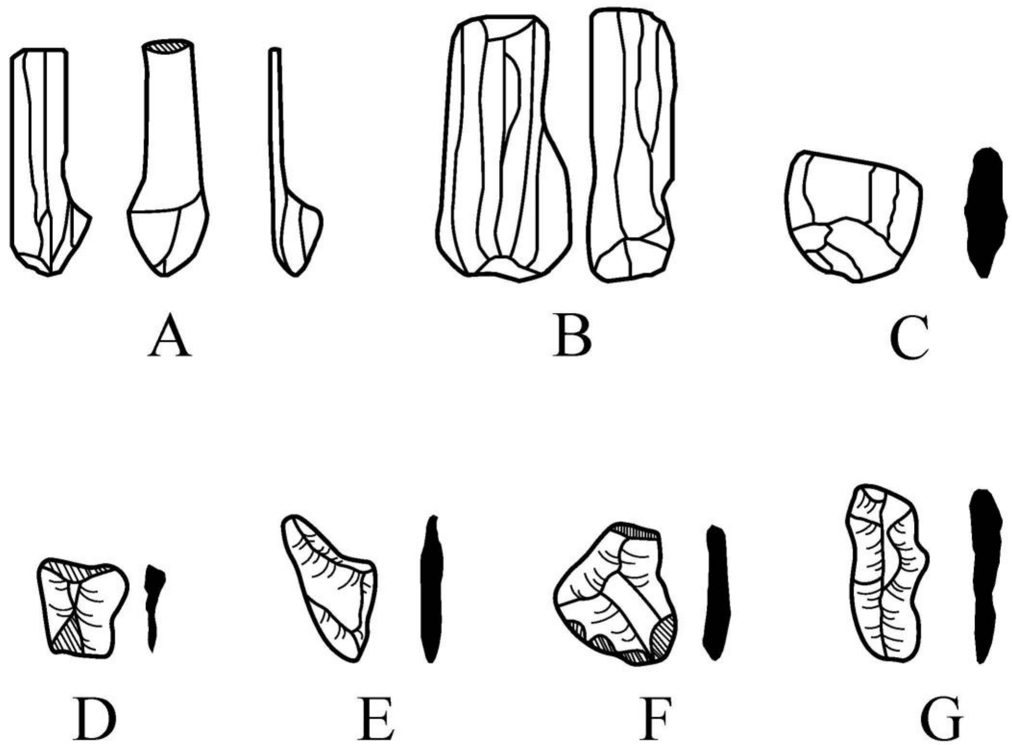

Figure 3.5 Examples of plunge blades, cores, core fragments, and rejuvenation debitage (actual size). A: plunge blade, B: exhausted core, C: lateral distal core fragment, D-F: rejuvenation flakes, G: crested blade fragment

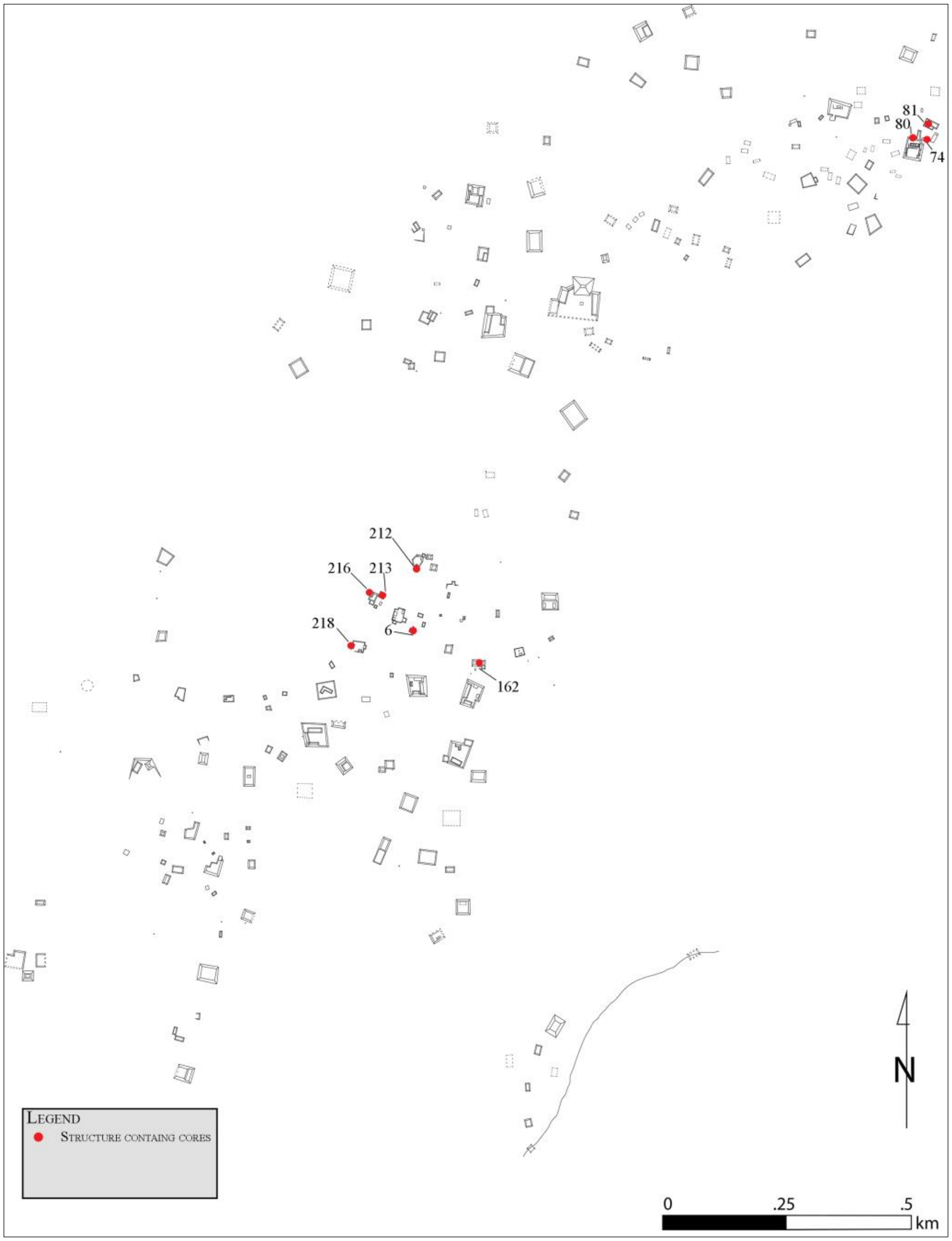

Figure 3.6 Map showing distribution of cores. Adapted from D. Chase and A. Chase 1988.

Discussion and Conclusions

By applying the lithic technology approach to Santa Rita Corozal's lithic assemblage, four specific conclusions may be drawn regarding the importation and production of obsidian during the Postclassic period. These conclusions are related to each other in that several

conclusions rely upon the validity of previous conclusions. As will be discussed, analysis of this type of assemblage in terms of production is something not typically published or reported. Most analysis utilizes large assemblages known to represent workshops or workshops dumps, rather than assemblages of obsidian from strictly domestic or ritual contexts. These contexts, unlike the types which typically characterize production analysis, represent the recipients of the end product of importation and production.

The first conclusion to be drawn from the Postclassic Santa Rita Corozal obsidian assemblage is that the assemblage itself does not contain any sub-assemblages from workshops or workshop dumps. This is not to say that the assemblage doesn't reveal any information about production; rather, that the residues typically associated with loci of obsidian production have not been encountered. It is clear from the assemblage that no workshops were investigated by the Corozal Postclassic Project as the assemblage consists almost entirely final-series prismatic blades, containing very little in the way of production debitage. If a primary or secondary workshop context had been encountered the, sub-assemblage would have been characterized by a lack of final-series blades compared to initial-series blades. This is because final-series blades would have been removed from the workshop for exchange (Clark and Bryant 1997). The production debitage that was recovered included small amounts of error removal debitage and core rejuvenation. Yet this small amount of debitage, along with the presence of an exhausted core and core fragments, is enough to strongly suggest that production was occurring at Santa Rita Corozal. Additionally, the two locations of chert production recently studied by Marino (2014) were also not involved in the crafting of obsidian artifacts, suggesting that these two industries were independent from each other.

Second, with the caveat of the preceding conclusion, obsidian was most likely being imported into Santa Rita Corozal as prepared polyhedral cores. These cores would have required minimal preparation before the pressure flaking of blades could commence. The assemblage lacks all evidence of percussion reduction. There is not a single percussion flake or blade to be found in the entire Postclassic assemblage. While this may be the results of a sampling bias, percussion flakes and blades were useable tools and have been exchanged at other sites in Mesoamerica and, thus, likely would have made their way into the domestic assemblages represented by the Postclassic Santa Rita Corozal assemblage if percussion reduction was taking place (Anderson and Hirth 2008; Parry 1987; Sheets 2002). Along with the presence of exhausted cores and exhausted core fragment, it is probable that obsidian was being imported into the site as prepared polyhedral cores and fine prismatic blades were being produced locally. Similar evidence, although on a much grander scale, has been used to determine how obsidian was imported into Xochicalco, Mexico (Hirth et al. 2006).

Another possibility exists in regards to the importation of obsidian - that obsidian is being imported as partially reduced cores. The relative absence of initial-series blades may suggest that a portion of the cores received by the population of Santa Rita Corozal may have been reduced by pressure earlier in the supply chain. Though this is impossible to demonstrate without the recovery of workshop assemblages, the small size of the Santa Rita Corozal’s exhausted cores suggests the obsidian cores may have been previously reduced and thus crafters at Santa Rita Corozal would have been more conservative with their use of obsidian. A similar situation has been proposed for the Classic Period site of Calakmul (Braswell 2011).

Third, Santa Rita Corozal's obsidian industries differ from those of other communities in the Chetumal polity. Of the 2000+ obsidian artifacts recovered from Caye Coco and Laguna de On, only 4 cores were recovered. Masson (2000) suggests that these sites along the Progresso Lagoon primarily received blades as finished artifacts rather than producing them locally. These finished blades may have come from the island ports along the coast or been produced at Santa Rita Corozal for exchange to sites under its authority (Masson 2000; McKillop 1996; Stemp et al. 2011). The debitage present at Caye Coco and Laguna de On is not rejuvenation, but rather flakes and chunks of obsidian. This differs significantly from the Santa Rita Corozal assemblage, where it is clear that most debitage resulted from the production of fine prismatic blades.

Lastly, the small number of cores recovered from Postclassic contexts at Santa Rita Corozal could easily account for upwards of three times as many final-series blades as were recovered. Assuming Santa Rita Corozal is importing prepared polyhedral cores, each core is capable of producing about 200 finished final-series blades (Clark 1988; Clark and Bryant 1997). Thus the 12 examples of cores found at the site could produce 2,400 final-series blades; if the 3 distal plunge blade segments are each counted as a core then this number climbs to 3,000 final series blades, roughly 6 times as many blades as were recovered; this number increases even more if the segmentation of blades is also taken into account. Research at Tula by Dan Healan (1993:452) suggests that the annual blade consumption would average 7 blades per capita. When this is combined with population estimates and the blade output of a single core, we are able to estimate how many cores would be required to provision the population of Santa Rita Corozal annually. Thus for the period between 900-1300 CE when the population is estimated to have been about 2,000 people (D. Chase 1990), the population would have consumed around 14,000

blades annually; requiring the importation of only 70 cores per year (D. Chase and A. Chase 2004b). From 1300 – 1530 CE, when the population of Santa Rita Corozal was at its height with a population of roughly 6,800 people, the population would have required upwards of 47,600 blades annually, or 238 cores. The importation of this many cores annually is not out of the realm of possibility, given that obsidian is known to be transported as bulk commodity via maritime trade (Edwards 1978; M. Smith 2003). Given that no workshops or workshops dumps have been recovered, the site's continuous occupation through modern times and the subsequent destruction of much of the site, and the purposeful reduction of cores through use, and various other methods of disposal employed by the Maya, it may not be surprising that so few cores have been recovered from what I believe was an important industry at the site (Aoyama 2014; D. Chase 1990; D. Chase and A. Chase 1988; Hirth et al. 2006; Johnson 1996; Moholy-Nagy 1997: 302; Sheets 1983:96).

CHAPTER 4: OBSIDIAN EXCHANGE

Obsidian was an essential utilitarian good throughout Mesoamerica and is ubiquitous at the majority of sites in the region. Because obsidian sources are environmentally distinct from much of Mesoamerica it has long been settled that obsidian artifacts are an indicator of trade in Mesoamerica (D. Chase and A. Chase 1989; Sidrys 1976). What is not understood is the mechanism by which obsidian became so abundant in the archaeological record. The fact that ancient Mesoamerican households and communities were never entirely self-sufficient means that they needed to rely on some form of exchange to meet their basic needs (Berdan et al. 2003; Dalton 1977; McAnany 1991). Households and communities are by their nature conservative and would have developed practices to insulate themselves from fluctuations in supply by exploiting various exchange systems (Dalton 1977; Halstead and O'Shea 1989; Hirth 2010). This chapter explores one of these potential exchange systems, market exchange, at Santa Rita Corozal, Belize, during the Postclassic Period. This is done by applying Hirth's (1998) distribution approach to model the site's Postclassic obsidian assemblage.

In order to determine if obsidian was being distributed via market exchange, Santa Rita Corozal's obsidian distribution needs to meet certain standards. Specifically, market exchange should result in obsidian being distributed in proportion to need and not according to social status. In this type of distribution, structures with higher proportions of obsidian are the result of greater need, such as crafting, or intense occupation, rather than control over distribution. However, if distribution and access is being controlled by social class we would expect high

status structures to have disproportionate amounts of obsidian with lower status structures receiving obsidian in proportion to their social status.

This chapter is specifically concerned with determining whether or not obsidian is being distributed through market exchange. As such, I do not touch on many of the important questions related to market exchange. Garraty (2010) outlines several of these questions, including: how do markets articulate with other sectors of society; how is market exchange recognized archaeologically; how do political and economic spheres relate; and how did markets develop and change over time. Of these four questions, I only touch upon how markets are recognized archaeologically. While interesting, these other questions are outside the realm of this thesis. The CPP's research was not designed to test for the distribution of obsidian through market exchange. Nonetheless, there is sufficient archaeological data at Santa Rita Corozal to allow for a determination of the method by which obsidian is being exchanged. Thus, Santa Rita Corozal represents a good neutral data set to test for a market economy. The current research is limited to only the Postclassic Period occupation of the site. Samples of earlier time periods are not great enough for any meaningful conclusions to regarding markets be made.

Background to Market Exchange

For the past 40 years discussions of Postclassic exchange have focused on the notion of a period characterized by mercantilism. First purposed by Sabloff and Rathje (1975), using Cozumel as a case study, the mercantilism model purposes that during the Postclassic period professional merchants developed, creating a shift that impacted social hierarchy during this time (Freidel 1981; Freidel and Sabloff 1984). Because of this, past studies of Postclassic Maya exchange have emphasized circum-peninsular canoe trade, which became increasingly prevalent

during this period (Berdan et al. 2003; Scholes and Roys 1948; Sabloff and Rathje 1975). Researchers at coastal Maya sites in Belize have also discussed the flow of goods south to north along Belize's coast (McKillop 1996; Stemp et al. 2011). The increase in maritime trade was indicative of what has been characterized as an international economy that was highly commercialized and at least partially based on specialized craft production (M. Smith and Berdan 2003). This characterization is supported by ethnohistoric accounts of a high ranking member of a Mayapán family who avoided his family's massacre by being away on a trading expedition in Honduras at the time (Roys 1962:44-46). Because of its nature, obsidian has always been part of an international economy, but during the Postclassic it is described as being part of the maritime exchange of bulk utilitarian goods (Edwards 1978; M. Smith 2003).

One of the most contentious areas of debate in regards to the archaeological study of exchange is the application of modern economic theories on ancient societies; nowhere is this clearer than in discussions of ancient markets. In Mesoamerica there is debate as to whether the markets known to exist ethnohistorically are indeed true markets as we understand markets in our modern world. Participants in this debate generally fall into one of two camps; formalists, who believe market exchange is a natural byproduct of exchange between self-interested actors, and substantivists, who believe that markets only developed following the industrial revolution and the creation of the modern wage economy (D. Chase and A. Chase 2014; Feinman and Garraty 2010; Garraty 2010). The arguments from both formalists and substantivists is complicated by inconsistent use of definitions, as different researchers and disciplines all have unique definitions of markets, market exchange, marketplaces, and market models that may conflict or exclude different types of exchange (Hodges 1988; Lie 1997; Pryor 1977). Among

the earliest and most cited contributors to this debate is economic anthropologist Karl Polanyi. Polanyi et al. (1957) laid the foundation for much of the economic anthropology/archaeology of the 20th century and continues to have a lasting influence in discussions of ancient markets today. In their seminal work on the subject, Polanyi et al. (1957:34) defined market exchange as an environment where "All goods and services, including the use of land, labor, and capital are available for purchase in markets and have, therefore, a price." This definition is overly strict and particularly problematic when applied to ancient Mesoamerica, where traditionally labor and in particular, land were not exchanged through a market model (Feinman and Garraty 2010; Garraty 2010; M. Smith 2004). From this and his other writings, it is clear that Karl Polanyi believed both that markets did not exist prior to the development of modern capitalism and that the forces of supply and demand were unnatural, causing civil discontent among market participants, which was not conducive to a unified society (Garraty 2010).

For the purposes of this thesis I follow definitions of market exchange, marketplace, and market model as outlined by Feinman and Garraty (2010); these definitions have also been adopted by other researchers in the Maya region (D. Chase and A. Chase 2014; Masson and Freidel 2012, 2013). Market exchange refers to "economic transactions where the economic forces of supply and demand are highly visible and where prices or exchange equivalences exist" (Feinman and Garraty 2010:169). The term marketplace refers specifically to "physical places in which market exchanges are generally conducted at customary times" (Feinman and Garraty 2010:170). With these definitions it is possible to have market exchange outside of the physical marketplace and cover everything from formalized regional markets to itinerant merchants. A market model refers to the economic concept of market exchange and is defined as "an idealized

concept that an economic (market) system is the cumulative effect of market transactions between self-interested buyers and sellers" (Feinman and Garraty 2010: 170). I feel that these definitions are among the best offered in terms of understanding ancient market exchange in Mesoamerica.

The definitions offered by Feinman and Garraty (2010) are supported by what is known of Maya markets at the time of contact. During the 1500s, Bishop Diego de Landa described the market behavior of the Maya thusly: "The occupation to which they had the greatest inclination was trade…and at their markets they traded in everything which there was in that country." (Tozzer 1941:94-96). From the perspective of the Spanish, the Maya engaged in market exchange within physical marketplaces. Colonial dictionaries from both the Yucatan and Chiapas define many indigenous words associated with market exchange, including terms for purchasing on credit, in bulk, in small amounts, by weight, high prices, low prices, the negotiation of prices, the organization of a market, and many others (Ara 1986; Pérez 1976; Tokovinine and Beliaev 2013). These same dictionaries also contain terms that describe merchants as being itinerant or local and the different places foreign merchants came from (Ara 1986; Tokovinine and Beliaev 2013). This linguistic data supports the markets of the Maya region known ethnohistorically and shows that they meet the requirements for all the definitions of market exchange, marketplace, and market model.

In addition to the difficulty defining the terms associated with market exchange, the archaeological study of markets is further complicated by the lasting influence of anti-market researchers (as discussed by: Dahlin et al. 2007; Feinman and Garraty 2010; Hirth 1998, 2010, 2013; Garraty 2010; Gasco and Berdan 2003). Polanyi et al.'s (1957) definition was clearly too

strict to be applied successfully to many ancient cultures. As mentioned previously this is the result of Polanyi's firm substantivists stance. Nonetheless, Polanyi's writings led to a neglect of market exchange in archaeological literature. In Mesoamerica, Polanyi's (1963) "Ports of Trade" model was applied to the Postclassic Period by Anne Chapman (1957) and, again, in Sabloff and Rathje's (1975) widely cited article on mercantilism and Cozumel. In this model exchange is conducted at neutral trading zones located between polities, trade was limited to luxury goods, and traders and merchants were working on behalf of the state not out of their own interests (Gasco and Berdan 2003). This model has been widely criticized; not only does it contradict what is known ethnohistorically, but it also does not account for the distribution of bulk utilitarian goods such as obsidian, salt, ground stone, etc. (Freidel and Sabloff 1984; Gasco and Berdan 2003; McKillop 1996). In many models of household provisioning these bulk goods form the power base for elites, yet there is no evidence for centralized redistribution (Andrew 1983; Blanton and Farhher 2010; D. Chase and A. Chase 2014; Graham 1987; Hirth 1998, 2010; McKillop 2002; Stark and Garraty 2010; Sidrys 1976; Rathje 1971). These models also assume that households and communities were self-sufficient and only relied upon exchange as a means to acquire items from environmentally distinct areas or, alternatively, prestige goods; this was not the case, but it has had a lasting effect on how archaeologists approached the study of household provisioning (Berdan et al. 2003; Dalton 1977; McAnany 1991)

Identifying Markets Archaeologically

A more practical problem than debates about definitions or the lasting influences of anti-market theorists is the difficulty detecting markets archaeologically (Blanton et al. 1982; Dahlin et al. 2007; Hirth 1998; Feinman and Garraty 2010; Feinman and Nicholas 2010; Minc 2006,

2009; Stark and Garraty 2010). To help detect markets, archaeologists have developed four primary approaches; the configurational, the contextual, the spatial, and the distributional approaches (Hirth 1998). All four have been applied to sites throughout the Maya region and more broadly throughout Mesoamerica. The goal of all of these approaches is to detect market activity in the archaeological record. To this end, the contextual and spatial approaches look at circumstances which would be indicative of markets while the configuration and distributional approaches tests for markets and their byproducts directly. Regardless of which approach is used, an ideal study relies upon multiple lines of evidence to determine the existence of markets.

While both the contextual approach and the spatial approach look for conditions where markets are most viable, they do so in different ways. The contextual approach infers the presence of markets from indirect evidence (Hirth 1998, 2009a, 2009b). This evidence could be the presence of large urban populations, full time craft specialists, or large populations in environmentally marginal locations (Hirth 1998, 2009a, 2009b). By looking for situations where market exchange best explains the provisioning needs of a population, this approach assumes the presence of markets rather than directly testing for the presence of markets. In the contextual approach, the development of markets is tied to the rise of large urban centers and the social and political organizations which accompany them (Carrasco 1980; Acheson 1994). This approach has been used most notably at the site of Chinchucmil, Mexico, where a large population is not believed to have been able to support themselves on the surrounding area's marginal land and, thus must have relied on markets to provision even the population's most basic needs (Dahlin 2009; Dahlin et al. 2005, 2007, 2010; Hutson et al. 2008).

The spatial approach attempts to reconstruct economic exchange based on how commodities and populations are distributed across the landscape (Renfrew 1975, 1977). The underlying assumption of the spatial approach is that market exchange increases the efficiency, volume, and distance of trade. Because of this, it is assumed that sites will be situated across the landscape in a way that is most beneficial to exploiting trade routes. This has been applied by Hirth (1978) in his analysis of market exchange via "gateway" communities at Chalcatzingo in Morelos, Mexico. Another adaptation of the spatial approach is the central place theory, which attempts to understand the placement, size, and number of settlements. The central place theory was notably applied to the Valley of Oaxaca during the 1980s (Blanton et al. 1982; Feinman 1982; Feinman et al. 1983).

The two methods that study market exchange via the archaeological record also do so in two different ways. The configurational approach looks at infrastructure and the results of market infrastructure. The distributional approach analyzes artifact distributions to determine if they meet an expected end result of market exchange. The infrastructure of interest to the configurational approach includes the physical remains of market exchange such as plazas, stalls, and proximity to roads, as well as the residues associated with market place activity detected through soil chemistry (Hirth 1998, 2009a, 2009b; Coronel et al. 2015). The physical infrastructure of markets is known to have included rows of stalls, perhaps organized by commodity being exchanged, and may have been surrounded by a wall or arcade (Cortes 1962 [1521 – 1525]; Carrasco et al. 2009; Dahlin et al. 2008, 2010; Hirth 1998; Jones 1996). It is also assumed through archaeology and ethnohistory that large markets tended to be located near transportation routes and near to or adjacent to administrative precincts (Cortes 1962; Hirth

1998). It must be noted that periodic or smaller markets may not meet these details. Nonetheless, markets have successfully been identified at several sites in the Maya region including Calakmul (Dahlin et al. 2007, 2010; Folan et al. 2001); Caracol (A. Chase 1998; A. Chase and D. Chase 2004b; A. Chase et al. 2015; D. Chase and A. Chase 2014); Chichén Itza (Braswell 2002; Ruppert 1943); Chunchucmil (Dahlin et al 2007, 2010); Tikal (Jones 1996; Masson and Freidel 2012, 2013); Seibal (A. Smith 1982). The Calakmul example is particularly interesting, as the North Plaza at the site had been suggested as a market place based off associated architecture (Folan et al. 2001). This assumption has since been supported by the discovery of murals near the plaza which appear to depict commoners working in a market setting (Carrasco et al. 2009; Dahlin et al. 2010).

The approach utilized in this thesis, the distribution approach, identifies markets from the predicted material outcomes of market exchange and the distribution of goods across social strata (Hirth 1998, 2009). The underlying assumption of the distribution approach is that provisioning strategies affect the makeup of domestic assemblages and that different provisioning strategies result in characteristic assemblages. For situations where provisioning is done via market exchange domestic assemblages are characterized by a more homogenous distribution of artifacts where differences are attributed to differences in purchasing power or need and not status (Hirth 1998, 2010; M. Smith 1987, 1999; Stark and Garraty 2010). A perquisite of this type of distribution is equal access to the same kinds of products and in relatively similar amounts, in particular low-cost utilitarian goods (Hirth 1998, 2009a, 2009b). This chapter is concerned with the latter half of the perquisite, the distribution of obsidian artifacts, and the following chapter deals with the kinds (sources) of obsidian available at Santa Rita Corozal.

In his 1998 application of the distribution approach, Hirth outlined four distinguishing features of market exchange. First, households provision themselves directly and independently of each other with minimal involvement of social authority. Thus, markets make available large quantities of resources directly to and from individual households (Hirth 1998). Second, exchanges are concentrated in centralized location, although as stated previously this is not always the case, as indicated by itinerant merchants (Hirth 1998). Third, buyers and sellers interact within marketplaces without regards to social status (Calnek 1978; Hirth 1998; Plattner 1989a, 1989b). Lastly, markets respond to the forces of supply and demand; this last feature is encompassed in the definition of markets that I have adopted from Feinman and Garraty (2010; see also Hirth 1998). A central requirement for the distribution approach to be used effectively is its application across all social strata (Braswell 2010; Hirth and Pillsbury 2013; Hutson et al. 2012). Since Hirth's initial application of the distribution approach at Xochicalco, Mexico, the approach has gone on to be applied throughout Mesoamerica in the Maya region using ceramics at Tikal (Masson and Freidel 2012, 2013); ceramics and obsidian at Mayapán (Masson and Freidel 2012, 2013); ceramics and obsidian at Caracol (D. Chase and A. Chase 2014); and obsidian at Chichén Itza (Braswell 2002).

Alternatives to Market Exchange

In general there are two broad alternatives to market exchange, Dyadic and Polyadic exchange (Polanyi 1960; Polanyi et al. 1957; C. Smith 1975). These types of exchange require some form of social authority to conduct the exchange. Dyadic is direct exchange between two individuals of the same social status. This type of exchange is understood from the iconographic record. Polyadic is also direct exchange, but between individuals of differing social statuses,

from a higher status to the lower status individual. The Inca centralized redistributive economy is an example of Polyadic exchange. As mentioned previously some believe that Polyadic exchange was essential for the Maya elites to create and maintain their power (Hendon 2003; LeCount 2001). However, the only known example of Polyadic exchange to provision entire populations was the centralized redistributive economy of the Inca and no archaeological evidence has been found to support this type of economy as ever being the dominant form of exchange in the Maya region (Blanton and Fargher 2010; Hirth 1998, 2010; Hirth and Pillsbury 2013; Garraty 2010; La Lone 1982; M. Smith 2003; Stark and Garraty 2010). Rather than a one or the other type of exchange system as proposed by Polanyi's original tripartite classification system, it is much more realistic to look at Maya exchange as existing on a continuum. This continuum would factor in how the economy was organized, how different exchange systems articulate, and how the different sectors of society interact within the economy (Hirth 2010; M. Smith 2004). This continuum of exchange would also allow for participation at differing levels of society as households and social institutions interact with the aforementioned features of the economy in very different ways (Feinman and Garraty 2010; M. Smith 2004).

Methods

The distribution approach also was chosen for this thesis as it allows for testing of market exchange through the material record in an easily quantifiable manner. As previously explained, the distribution approach relies upon determining if the distribution of an artifact type or groups of artifacts match the distribution characteristic of market exchange. In this case, the expected distribution is one of relatively equal access across all social strata. This is seen in equal access in amounts and types of obsidian with differences being attributed to need or purchasing power,

not control over the means of distribution (Hirth 1998; Garraty 2009). If the distribution of obsidian is being controlled by Santa Rita Corozal's elites, then the characteristic distribution would be one in which higher status households have greater quantities and more variety in their obsidian assemblages, compared to middle and low status households.

Several issues arose when attempting to create a distribution of obsidian densities for Santa Rita Corozal's Postclassic occupation. First, Santa Rita Corozal's architecture is characterized by low lying mounds or "invisible" sub-surface platforms. These were investigated with aerial excavations which were supplemented with deeper penetrating trenches. Additionally, the Maya of Santa Rita Corozal would construct platforms right on top of earlier structures leading to issues in determining precisely where one construction phase ends and another begins (D. Chase 1990; D. Chase and A. Chase 2008). These factors lead to issues calculating volumes of excavated material for structures that were not entirely Postclassic in construction and occupation. Additionally there is difficulty in the region distinguishing between the Late Terminal Classic and the Early Postclassic. Because of these issues, structures with problematic stratigraphy were excluded from the density distribution. In the end, 9 of the 45 structures excavated by the Corozal Postclassic Project were chosen (Table 4.1). The selection of structures was based on the ability to easily discern and exclude stratigraphic layers of non-Postclassic occupation. While it would be possible to determine the volumes of Postclassic Period materials for all structures, the analysis that would be required for such an endeavor are outside the scope of this thesis. Volumes of excavated material were then calculated using section and plan drawings of the excavations included in the distribution. Obsidian densities were calculated by dividing the amount of obsidian by the cubic meter excavated.

Obsidian densities based on the surface area of excavation units were calculated in order to substitute the small number of excavations for which volumetric data was readily available. This greatly increased the sample of structures available for comparison. In total 30 structures with Postclassic Period occupation were considered including the 9 for which volumetric data was available (Figures 4.1 Table 4.1). The use of two different metrics to calculate obsidian densities allows for greater comparison between structures at Santa Rita Corozal and sites throughout the region. For instance, densities based on surface area have been used at Mayapán to compare obsidian to other artifacts and to discuss obsidian distribution (Masson and Freidel 2012:469-470).

In order to test if significant differences existed between structures of social status, a one-way analysis of variance (ANOVA) test was performed on the density distributions. When considering only two groups ANOVA serves the same purpose as a two-tailed t-test (Lomax and Hahs-Vaughn 391). Prior to the application of an ANOVA test, it must be determined if the variance in the groups is equal. If it is not, then an ANOVA test should not be applied as the degree of error is increased. To test if the group's variance is equal, a Bartlett test was applied to the sample. If a Bartlett test results in a low P value ($< .05$), then the variance is not equal; however if the P value is high ($\geq .05$), the variance between the groups is equal and it is safe to proceed with an ANOVA test. ANOVA tests allow for the comparison of the means of two or more groups of observations. For the research presented here, the groups of observations are the social status of the structures while the observations themselves are the densities of obsidian. By comparing the within group variance with the variance between groups, ANOVA produces an F ratio which describes the variance present in the data set being analyzed. Like the Bartlett test,

ANOVA tests also produce a P value which determines if the null hypothesis should be accepted or discarded. The P value is set to a confidence interval defined by the user; this thesis uses a confidence interval of 95% or α of .05. Thus there is a 5% chance of wrongly concluding the existence of a difference between group means. If the ANOVA P value is ≥ .05, then no statistical difference exists between the groups; however, if the P value is < .05, then a statistical difference exists between the groups.

Table 4.1 Table of structures considered in the volumetric distribution and surface area distribution.

Structure	Volumetric Distribution	Surface Area Distribution
Plat. 2		✓
Str. 6	✓	✓
Str. 35		✓
Str. 36		✓
Str. 37		✓
Str. 38		✓
Str. 39		✓
Str. 58		✓
Str. 69		✓
Str. 70	✓	✓
Str. 73	✓	✓
Str. 74	✓	✓
Str. 77	✓	✓
Str. 79	✓	✓
Str. 80		✓
Str. 81		✓
Str. 156		✓
Str. 159		✓
Str. 162	✓	✓
Str. 179		✓
Str. 181		✓
Str. 182		✓
Str. 183		✓
Str. 189		✓
Str. 212		✓
Str. 213		✓
Str. 214	✓	✓
Str. 215	✓	✓
Str. 216		✓
Str. 218		✓

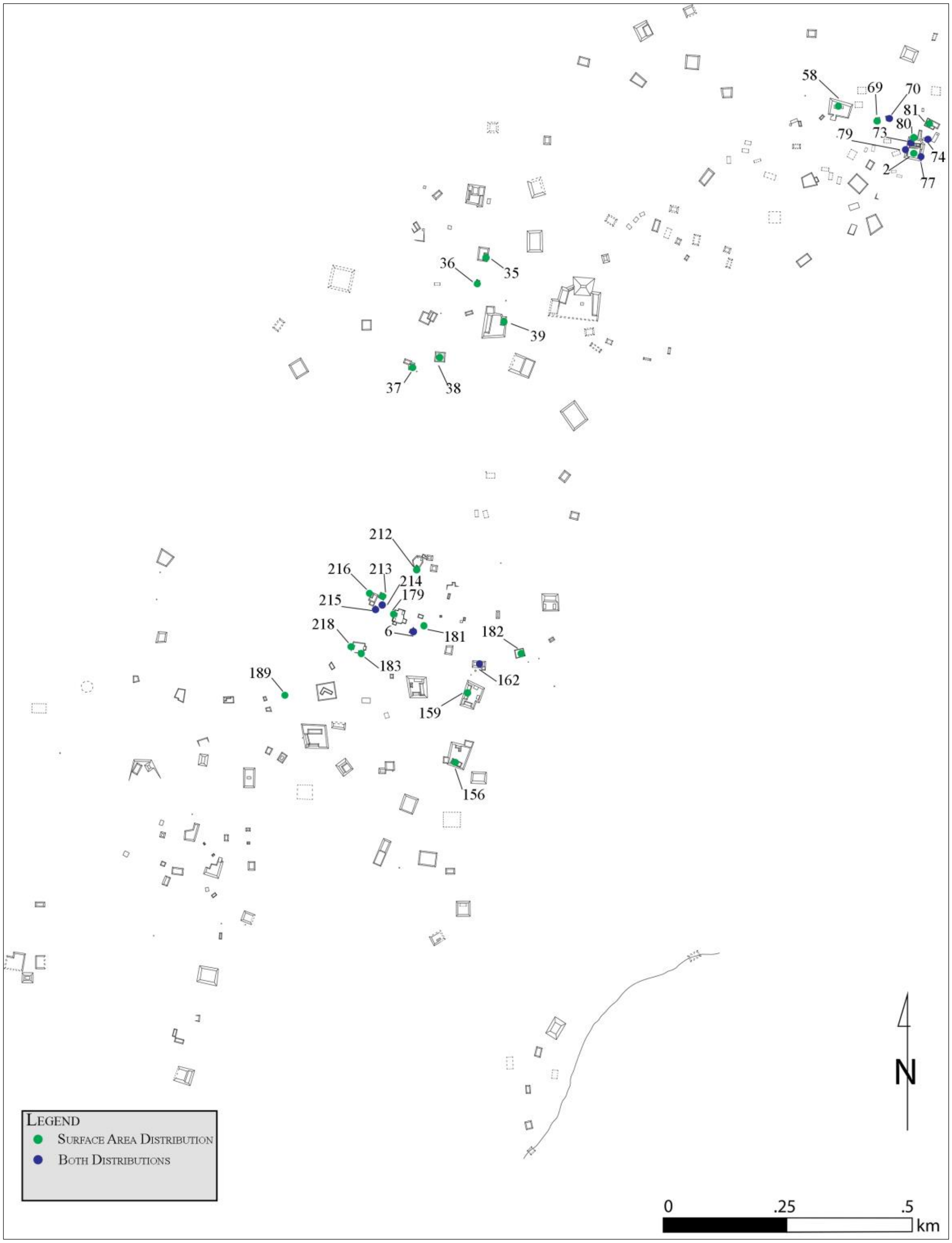

Figure 4.1 Map showing structures included in distribution study

<u>Results and Discussion</u>

Of the nine structures considered in this distribution study, four are considered high status and four structures are considered other status (either middle or low status), and one, Structure 79, is a ritual structure associate with a high status platform, Platform 2. The volumes and obsidian densities are displayed in Table 4.2. A Bartlett test applied to the sample of high status versus other status densities determined that the sample had equal variance (P – 0.1588) and is applicable to be subjected to ANOVA tests. The results of this ANOVA are presented in Table 4.3 and demonstrate that there is no statistical difference (F – 0.5108, P – 0.5068) in the volumetric obsidian densities between high status structures and other status structures. The second group of structures considered were high status and ritual structures associated with Platform 2 and other high status structures. A Bartlett test applied to obsidian densities for high status structures and structures located on Platform 2 indicated that the samples had equal variance (P – 0.1248) and that it was appropriate to apply ANOVA to the sample. The ANOVA (Table 4.4) again found that no statistical difference existed between high status structures and those associated with Platform 2 (F – 0.8584, P – 0.4225).

Table 4.2 Table of Postclassic structures function, status, excavation volumes, number of obsidian artifacts, and obsidian densities. * indicates the structure is located on Platform 2. Statuses are based off D. Chase 1992.

Structure	**Function**	**Status**	**Number of Obsidian Artifacts**	**Volume**	**Obsidian per m^3**
Str. 6	Domestic	Middle	45	77.95 M^3	.5772
Str. 70	Domestic	Low	4	13.26 M^3	.3016
Str. 73*	Domestic	High	13	5.62 M^3	2.3131
Str. 74	Domestic	Middle	21	17.36 M^3	1.2096
Str. 77*	Ritual	N/A	17	26.83 M^3	.6336
Str. 79*	Ritual	N/A	7	15.48 M^3	.4521
Str. 162	Domestic	Low	17	36.3 M^3	.4683
Str. 214	Domestic	High	15	30 M^3	.5000
Str. 215	Domestic	High	15	43.5 M^3	.3448

Table 4.3 Table displaying the results of ANOVA of high status and other status structures.

	High Status (N= 3)	Other Status (N=4)	F	P
Obsidian/Excavation Volume	1.0527	0.6393	0.5108	0.5068

Table 4.4 Table displaying the results of ANOVA of high status structures and structures associated with platform 2.

	Platform 2 (N= 3)	High Status (N=3)	F	P
Obsidian/Excavation Volume	1.1330	0.4224	0.8584	0.4225

The distribution of obsidian based on surface area includes 10 structures considered high status, 13 considered other status, and 7 structures which are believed to have served ritual functions. The area excavated and obsidian densities are displayed in Table 4.5. A Bartlett test applied to the 23 domestic structures, considered either high status or other status, found that the dataset had equal variance (P – 0.6389) and could successfully be subjected to ANOVA tests. The results of this initial ANOVA are summarized in Table 4.6 and demonstrates that no statistical difference (F – 2.9871, P – 0.0986) exists between domestic structures. This mirrors the findings of the volumetric distribution. When considering structures believed to have served primarily domestic functions and those believed to served ritual functions a Bartlett test (P – 0.7140) determined that ANOVA was appropriate. This ANOVA (Table 4.7) determined that structures that are believed to have served ritual purposes contained statistically similar (F – 0.0606, P – 0.8074) amounts of obsidian as domestic structures.

Table 4.5 Table of Postclassic structures function, status, excavation surface area, number of obsidian artifacts, and obsidian densities. * indicates the structure is located on Platform 2. Statuses are based off D. Chase 1992.

Structure	**Function**	**Status**	**Number of Obsidian Artifacts**	**Surface Area**	**Obsidian per m^2**
Plat. 2	Domestic	High	32	51.08	0.6265

Structure	**Function**	**Status**	**Number of Obsidian Artifacts**	**Surface Area**	**Obsidian per m^2**
Str. 6	Domestic	Middle	45	97	0.4639
Str. 35	Domestic	Low	10	41.1	0.2433
Str. 36	Ritual	N/A	2	18.75	0.1067
Str. 37	Ritual	N/A	5	39	0.1282
Str. 38	Domestic	Low	8	6	1.3333
Str. 58	Ritual	N/A	15	54.75	0.2740
Str. 69	Domestic	Low	3	22.5	0.1333
Str. 70	Domestic	Low	3	17.7	0.1695
Str. 73	Domestic	High	13	20.4	0.6373
Str. 74	Domestic	High	21	72	0.2917
Str. 77	Ritual	N/A	15	15.7	0.9554
Str. 79	Ritual	N/A	7	36	0.1944
Str. 80	Domestic	High	16	13.5	1.1852
Str. 81	Domestic	High	56	167.75	0.3338
Str. 156	Domestic	Low	3	198.5	0.0151
Str. 159	Domestic	Middle	4	112.5	0.0356
Str. 162	Domestic	Low	17	110	0.1545
Str. 179	Domestic	Middle	11	77.4	0.1421
Str. 181	Domestic	Middle	8	62.5	0.1280
Str. 182	Domestic	Low	6	32	0.1875
Str. 183	Domestic	High	9	19.5	0.4615
Str. 189	Ritual	N/A	14	81	0.1728
Str. 212	Ritual	N/A	13	30	0.4333
Str. 213	Domestic	High	8	83.8	0.0955
Str. 214	Domestic	High	15	59.7	0.2513
Str. 215	Domestic	High	15	44.8	0.3348
Str. 216	Domestic	High	88	200	0.4400
Str. 218	Domestic	High	93	166.5	0.5586

Table 4.6 Table displaying the results of ANOVA of high status and other status structures

	High Status (N= 10)	Other Status (N=13)	F	P
Obsidian/Excavation Surface Area	0.4925	0.2559	2.9871	0.0986

Table 4.7 Table displaying the results of ANOVA of domestic structures and ritual structures

	Domestic (N= 23)	Ritual (N=7)	F	P
Obsidian/Excavation Surface Area	0.3587	0.3235	0.0606	0.8074

The results of the ANOVA demonstrate that no statistically significant difference exists in terms of obsidian densities between high status and lower status structures during the

Postclassic Period at Santa Rita Corozal. When comparing volumetric densities high status structures certainly contained greater amounts of obsidian, with a mean of 1.0527 pieces of obsidian per cubic meter excavated compared to 0.6393 pieces of obsidian per cubic meter for other status structures. These differences are substantiated by the surface area densities. With high status structures containing a mean of 0.4925 pieces of obsidian per square meter while other status structures only contained .2559 pieces of obsidian per square meter. The two highest status structures at the site, Structure 81 and Structure 216, contained an average of 0.4462 pieces of obsidian per square meter, slightly below the average for high status structures at this time. Ritual structures contained an average of 0.3235 pieces of obsidian per square meter, which is more than the average for non-high status structures, but is very close to the average for all domestic structures, 0.3587 pieces of obsidian per square meter.

The distribution of obsidian expected from market exchange is characterized by obsidian consumption in proportion to need, not social status. This is contrasted by elite redistribution where high status structures would have the highest proportion of obsidian with proportions of obsidian “trickling down” to lower status structures. The obsidian densities at Santa Rita Corozal clearly indicate that obsidian was not being exchanged through elite redistribution. The lack of statistical differences between the two status groups indicates that instead obsidian was being distributed without regard to social status, likely through market exchange. In this way Santa Rita Corozal is similar to the other sites in the Chetumal province such as Caye Coco and Laguna de On where commodities are distributed across all statuses and no one status has exclusive access to any commodity (Masson 2000:188). Market exchange of obsidian is also

noted at Mayapán where some lower status commoner structures contained as much obsidian as those of elites (Masson and Freidel 2012:464-467).

The differences seen in the mean densities between high status and other status structures is the result of certain structures having a greater demand or need for obsidian. Platform 2 was the area of the intense investigation by the CPP. On Platform 2, excavations consisted of a long trench spanning the entire platform including several buildings, and large aerial excavations that revealed several of the structures located upon the platform. Platform 2 is considered high status and the structures associated with it likely serving a multitude of functions including administrative, ritual, and domestic (Figure 4.2) (D. Chase 1982, 1992). Of the three structures associated with Platform 2 considered in the volumetric analysis, Structure 73 may be the most interesting. The exact function of Structure 73 is unknown but it has the highest density of obsidian (2.3132 pieces per m^3, 0.6373 pieces per m^2) of any of the structures considered in this analysis (D. Chase 1982). This density is higher than that of nearby Structure 74 (1.2096 pieces per m^3, 0.2917 pieces per m^2), where it is believed that obsidian was being used for a specialized task (D. Chase 1982; Hartman 1981). The structure's relatively high density of obsidian supports the notion that Structure 74 may have been a locus for subsistence activities associated with the nearby high status structures; but was not itself a high status structure (D. Chase 1982). Given the suspected function of Structure 74, the high obsidian density at Structure 73 may indicate that the building was the loci for an activity which demanded larger quantities of obsidian than the other structures on Platform 2. It should be noted that another structure on Platform 2, Structure 77, is believed to have served a ritual function, yet is among the most obsidian rich structures (0.6336 pieces per m^3, 0.9554 pieces per m^2) at Santa Rita Corozal during the Postclassic Period

(D. Chase and A. Chase 1988:31). Structure 77 is representative of the fact that ritual structures were consuming obsidian on par with domestic structures. Suggesting, that like Structures 73 and 74 Santa Rita Corozal's ritual structures were the loci for an activity that required obsidian blades on a scale similar to domestic needs.

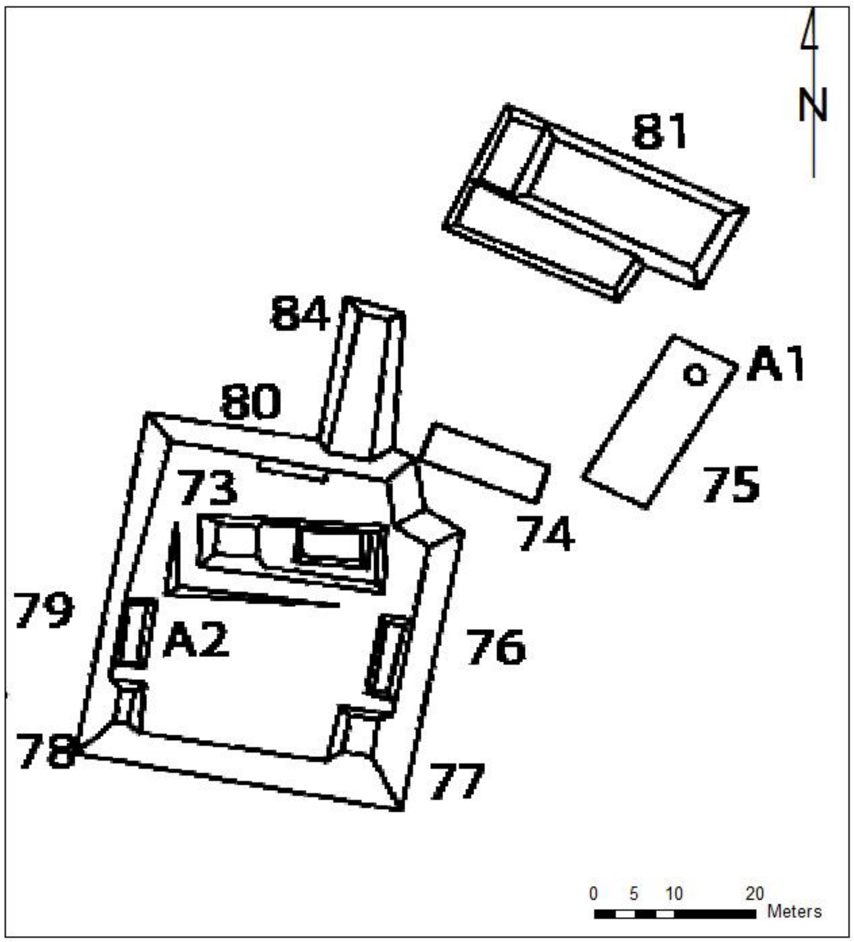

Figure 4.2 Platform 2 and associated structures. After D. Chase and A. Chase 1988

Summary

In his 1998 model, Hirth proposed that three methods of obsidian distribution were probable: distribution through workshops, distribution by elites, and distribution through

markets. At Santa Rita Corozal it is impossible to test for distribution of obsidian directly from workshops as no workshop contexts were found. The distribution of obsidian sources will be discussed in the following chapter and should determine if any patterns of sources show reliance or control, which may indicate workshop procurement. The lack of statistical differences in obsidian densities between social statuses does not suggest that obsidian was being directly distributed by elites along a social hierarchy, as would be characteristic of elite redistribution. Instead, the densities of obsidian at Santa Rita Corozal indicate that obsidian was likely being distributed through market exchange, possibly administered by Santa Rita Corozal's elites. Any differences in the obsidian densities are related to a structure's greater need of obsidian, such as at Structure 74 and suggested for Structure 73, as well as at structures involved in ritual activity, like Structure 77, and not because the access to obsidian was being restricted in any way.

CHAPTER 5: XRF ANALYSIS

This chapter focuses on the use of portable X-ray fluorescence spectrometry (pXRF) to chemically assay a subset of the Santa Rita Corozal obsidian assemblage. The analysis presented here was undertaken in order to determine the sources of obsidian being exploited by Santa Rita Corozal and how distribution and access to specific obsidian sources was managed. These findings will then be compared to earlier time periods at Santa Rita Corozal and to the sites of Caye Coco and Laguna de On in the Chetumal Province and with Chichén Itza and Mayapán in the Yucatan Peninsula. The sources of obsidian present at Santa Rita Corozal also reveal the economic ties the site had to the primary obsidian producing regions of Mesoamerica, the Guatemalan Highlands and Central Mexico.

By determining a distribution of artifacts by sources, the findings of the previous chapter will be supplemented by testing to see if specific sources were being exploited exclusively by certain households, structures, or social statuses. According to Hirth's (1998) distribution approach, not only should market exchange result in a relatively even distribution of artifacts across social statuses, but all individuals should have access to the same types of artifacts. In the case of obsidian, an artifact "type" refers to obsidian sources. In his initial work at Xochicalco, Hirth (1998) found that no one strata of society had exclusive use of a particular obsidian source, nor did the obsidian sources being exploited correlate to the neighboring obsidian workshops. Thus, the results of the XRF analysis presented in this chapter supplement the previous discussion on obsidian distribution at Santa Rita Corozal during the Postclassic Period. If specific sources were being consumed solely by the inhabitants of high status structures, then

potentially some form of elite control over obsidian would have been present at Santa Rita Corozal during the Postclassic.

XRF History, its Applications in Mesoamerica, and Background

X-rays have been used to understand elements for over 100 years. Beginning in the early 1900s, English physicist Henry G. J. Moseley (1913) utilized x-rays to understand electron transitions and their relationship to atomic numbers. Moseley's discovery led directly to the creation of our modern day periodic table of elements which is based on atomic numbers rather than atomic weights. By the 1960s X-ray fluorescent spectrometers were developed, with some of the earliest work being conducted at the University of California at Berkeley (Shackley 2011). In 1960 Edward Hall (1960) became one of the first people to use XRF in archaeology with his analysis of Roman coins. This was followed by Robert Jack and Robert Heizer (1968) who became the first to apply XRF to the study of New World obsidian.

The science behind XRF is rather straightforward. XRF works by bombarding atoms with radiation in the form of X-rays, which are a high energy, high frequency form of radiation. If the energy of the X-ray is high enough, it will dislodge an inner shell electron which is then replaced by a lower energy outer shell electron. When this occurs, radiation is released by the replacement electron as it transits from the low energy outer shell to the high energy inner shell. This radiation is called fluorescent radiation or fluorescence and is always less than the energy of the initial X-ray (Shackley 2011). Because energy differences between electron shells are fixed and known, every element gives off a characteristic fluorescence, which can then be measured and used to detect the abundance of an element within a sample (Shackley 2011). These transitions are named K – O, which corresponds to the name of the shell the original electron was ejected

from. In obsidian analysis, K line transitions are of most interest because they represent the mid Z elements, Z being an element's atomic number, which are used to distinguish obsidian sources. In this study, the elements Iron (Fe), Rubidium (Rb), Strontium (Sr), Yttrium (Y), Zirconium (Zr), and Niobium (Nb) are of most interest for distinguishing between obsidian sources (Ferguson 2012; Shackley 2011).

This thesis utilized portable X-ray fluorescence (pXRF) to determine the chemical composition of the obsidian from Santa Rita Corozal. Compared to other methods of analysis such as Instrumental Neutron Activation Analysis (INAA), and Particle-induced X-ray emission (PIXE), XRF is both cheaper and faster. Additionally for the purposes of obsidian source attribution, XRF is as reliable as other forms of chemical analysis (Craig et al. 2007; Frahm 2007, 2013a, 2013b; Millhauser et al. 2011; Nazaroff et al. 2010; Speakman 2012). pXRF, in particular, has benefited archaeology in that it allows researchers to quickly, reliably, and non-destructively assay artifacts without the need to export the materials from their country of origin. In this regard pXRF, sampling has the potential to replace the unreliable results of visually sourcing obsidian. Visual sourcing relies on the following 7 criteria to determine sources: refracted color, reflected color, translucency/opacity, sharp/diffused light, inclusions, luster and texture of the surface, and cortex (Braswell et al. 2000). Given that the majority of obsidian artifacts lack cortex and that Braswell et al. (2000) noted that colors change with light sources and that certain sources may distort color, visual sourcing is unreliable for the majority of gray obsidian which is highly visually similar (Braswell and Glascock 2011; Carballo et al. 2007; Jackson and Love 1991; Knight and Glascock 2009; Moholy-Nagy 2003; Moholy-Nagy et al. 2013). Despite these facts, visual sourcing substituted by limited chemical analysis has become

the accepted approach in obsidian sourcing studies. However, frequently these studies do not discuss the training of the individual doing the visual sourcing or the characteristics used to discern between sources of gray obsidian.

Obsidian has been described as the ideal substance for chemical sourcing (Clark 1981; Ferguson 2012; Glascock 2002; Glascock et al. 1998; Popelka-Folcoff 2006; Shackley 2011). This is because each obsidian source has a unique chemical "finger-print" that allows it to be identified. In this way obsidian meets the requirements for the Provenance Postulate, which was first proposed by Weigand et al. (1977) and later simplified and reworded by Neff (2001): "sourcing is possible as long as there exists some qualitative and quantitative chemical or mineralogical difference between sources that exceeds the qualitative or quantitative variation within each source." In the case of Mesoamerica the only interregional (between Mexican, Guatemalan, and Honduran) overlap of obsidian sources chemically is Otumba, Mexico, which is chemically similar in some ways to Guatemalan sources (Glascock et al 1998). However, proper use of multivariate analysis eliminates this overlap (Glascock et al. 1998).

Because of how obsidian is formed, there are two types of sources, primary and secondary. Primary sources are lava flows which have rapidly cooled and pyroclastic bombets which are ejected from a volcano during an eruption. Secondary sources are the result of erosional activities. Nearly all sources exploited by the Maya and other Mesoamerican groups in antiquity were primary sources (Glascock et al 1998). Over the past 30 years these sources have been systematically sampled and analyzed and the prepared source samples as well as the chemical compositions of sources have been made available to researchers (Cobean et al. 1991; Glascock and Cobean 2002; Glascock et al. 1998; Stocker and Cobean 1984). In addition to its

chemically distinct sources, obsidian does not normally change in chemical composition over time and the fragility of obsidian objects means that they have a high replacement rate and are thus ubiquitous at the majority of Maya sites (Clark 1981; Glascock 2002; Glascock et al 1998).

Methods and Materials

The sourcing data presented in this thesis comes from 370 obsidian artifacts analyzed via pXRF at the University of California at Berkeley's Archaeological Research Facility over the course of three days during the Summer of 2015. This sample represents nearly 50% of the 788 obsidian artifacts that comprise the total Santa Rita Corozal site assemblage. Of the 370 artifacts analyzed using pXRF the vast majority (N=303) date from the Early Postclassic through the Abandonment of Santa Rita Corozal by the Maya. These 303 artifacts represent over 50% of the Postclassic obsidian assemblage (N=572) of the site. For earlier time periods only 3 artifacts dating to the Late Classic and 6 artifacts dating to the Early Classic were assayed. While small, these earlier sub-assemblages represent 100% of obsidian artifact able to be assayed by pXRF from contexts that date to those periods. The remaining 67 scanned artifacts come from either mixed date contexts or contexts without confirmed dates. Overall the 370 scanned artifacts represent roughly 50% of the obsidian from each structure that contained obsidian at Santa Rita Corozal. Some excavations contained no obsidian (Structures 6, 18, 40, 42, 78, 89, 166, 167) and, while one excavation produced a small amount of obsidian (N=2), both samples were too thin to be assayed by pXRF (Structure 200).

All 370 artifacts were scanned using a Bruker Tracer-III pXRF located at the University of California at Berkeley's Archaeological Research Facility. The Tracer-III uses Energy Dispersive X-ray Fluorescence (ED-XRF) to assay sample and is equipped with an Rh target X-

ray tube. Samples were assayed for 180 seconds, at 40kV max voltage, without vacuum, using the green filter (0.006” Cu, .001”, .012 Al) provided by Bruker. These are the settings and filter recommended by Bruker to measure elements Fe to Mo which are of most interest in sourcing obsidian   To insure consistency between scanning sessions, a known geological specimen, RGM 2, was assayed each time the machine was powered on and the scatters were overlain on an earlier scan as a control to establish that there were no irregularities. Parts per million (PPM) counts were generated using the calibration procedure provided by Bruker, which uses 40 samples of obsidian which encompass the range of variation present in obsidian sources around the world. Sample preparation was minimal, as the majority of the obsidian sampled was washed in the field by the Corozal Postclassic Project prior to being packaged for exportation. In cases were obsidian had not been washed, the surface which would be facing the X-ray beam was dry-brushed clean. This was done as precaution for consistency to create the flattest surface possible, but was not necessary, as unwashed surfaces do not affect the results of XRF analysis (Shackley 2011; Shackley and Dillian 2002).

Fifty-nine source samples were assayed by Lucas Martindale Johnson using the same machine with the same settings using samples provided by University of Missouri Research Reactor (MURR) for this purpose. This includes five samples from every source considered here except Ixtepeque, for which only four samples were able to be assayed. These samples were both ground discs with flat surfaces and flakes with uneven surfaces. Ground discs result in more accurate PPM data but do not affect the conclusions drawn about non-flat artifacts as the provenance postulate is not violated by these fluctuations (Liritzis and Zacharias 2011). Additionally several sources of obsidian located in Mexico were not included in this study

because there was no access to samples representative of these sources. Published XRF PPM data was not used to supplement the MURR samples, as it was not known which calibration routines were used, nor is it known what type of XRF and settings were used to generate these data. Additionally, the most comprehensive list of obsidian PPM data was published in 2002 by Glascock and Cobean and it was feared that the data may be out of date with the newer XRF technology used in this thesis. While not representative of the entirety of variability of individual sources, the 4-5 samples per known source established baselines for comparison.

Following Moholy-Nagy et al. (2013), this thesis uses cluster analysis as a data discovery tool and bivariate and trivariate scatter plots to display source attribution for these groups. By plotting PPM values it is possible to separate known sources and to generate confidence ellipsis that may be used to determine source attribution of the Santa Rita Corozal Samples. Analysis was done for each of the time periods represented by firmly dated samples. Prior to plotting the PPM data, cluster analysis was applied to both known source samples and the Santa Rita Corozal dataset. This was done to identify the number of chemical groups within the dataset and offered preliminary identification of group sources. Cluster analysis is not useful for demonstrating the cause of differences between clusters nor does it test the probability of source group membership as other forms of multivariate analysis do (Glascock et al. 1998; Popelka-Folcoff 2006). Cluster analysis creates groups of samples (clusters) based off how dissimilar a sample is to the rest of the samples in the dataset. Thus, the clusters represent samples which are more dissimilar to the rest of the samples than they are to members of their cluster. This is accomplished by calculating the squared Euclidean distance to determine just how dissimilar a sample is to all other samples.

This thesis utilizes hierarchical cluster analysis (HCA), which naturally forms clusters of related samples unlike k-means clustering, where the user dictates the number of clusters present in the sample. In hierarchical cluster analysis, samples are grouped together on how similar they are to each other and how dissimilar they are to the rest of the dataset. These samples form clusters which are then linked based on similarity and dissimilarity to other clusters until only one cluster remains. This process is commonly displayed as a dendrogram to visually represent the relatedness of samples and clusters to each other. The variables considered by the HCA routine were the PPM values of Fe, Rb, Sr, Y, Zr, Nb, Mn, and Zn for all individual Santa Rita Corozal samples dating to a specific time period. These were grouped using the hierarchical clustering routine within SAS JMP® using the centroid method and with standardized data checked. The standardized data option standardizes data by subtracting the column's mean from each sample and then dividing by the column's standard deviation. The centroid method uses the distance between the means of two clusters, as calculated using the squared Euclidean distance. Following Moholy-Nagy et al. (2013), the means of each of the eight elements used as variables were calculated for the resulting clusters. These were combined with means for groups of known source samples and were subjected to the same hierarchical clustering routine using the same options. Dendrograms of the resulting clusters are then used to gain an understanding of how many distinct chemical groups may be present in the assemblage and what sources those groups may be attributed too.

Results

The HCA of the Postclassic data set identified 6 distinct chemical groups. When these groups are compared to the 12 known source samples, 5 of the 6 chemical groups have potential

source assignments (figure 5.1). These potential sources include El Chayal, Ixtepeque, Otumba, San Martin Jilotepeque, and Pachuca. The fifth group was unassigned to any of the 12 sources. It is suspected that this unassigned chemical group is in fact Pico de Orizaba for which no source sample was available, but whose presence was confirmed during the Postclassic period by a previous INAA study (Neivens et al. 1983). A bivariate plot of Sr and Zr confirms the presence of the five known groups (figure 5.2). The Ixtepeque and Otumba samples have significant overlap, as the Otumba samples do not fall within the confidence ellipse. Similarly the samples from Pachuca fall far outside the confidence ellipse generated from the source samples. While the Pachuca samples are easily identifiable visually due to their unique green color, Otumba is not easily visually distinguishable and is known to be chemically similar to the three major Guatemalan sources (Glascock et al. 1998). The addition of Rb in a ternary plot better characterizes the sources, while not as tightly clustered as the Guatemalan sources, Otumba is clearly distinct from the other sources being represented (figure 5.3). The issue of distinguishing Otumba on the bivariate plot may be a result of the available source samples not being representative of the same obsidian flow that the Santa Rita Corozal samples originated from or the texture and shape of the Santa Rita Corozal samples compared to the MURR samples. Of the 303 obsidian artifacts dating from the Postclassic Period, the majority (67.3%) were determined to have originated from the Ixtepeque source in Guatemala (Table 5.1). The other major Guatemalan source present in the sample, El Chayal, comprises nearly a quarter of the assemblage (23.4%) (Table 5.1). Perhaps the most interesting result of XRF analysis of the obsidian artifacts dating to this period was the amount (6%) of obsidian originating from Otumba, Mexico; the significance of which will be discussed in the following section. Pachuca

comprised a little over 1.3% of the assemblage while San Martin Jilotepeque and the unassigned source both accounted for less than 1% of the 303 artifacts assayed via XRF. Of the 13 cores recovered by the Corozal Postclassic Project 10 were able to be assayed (Table 5.2), 8 of the cores come from Ixtepeque, and 1 each was attributed to Otumba and the unassigned source.

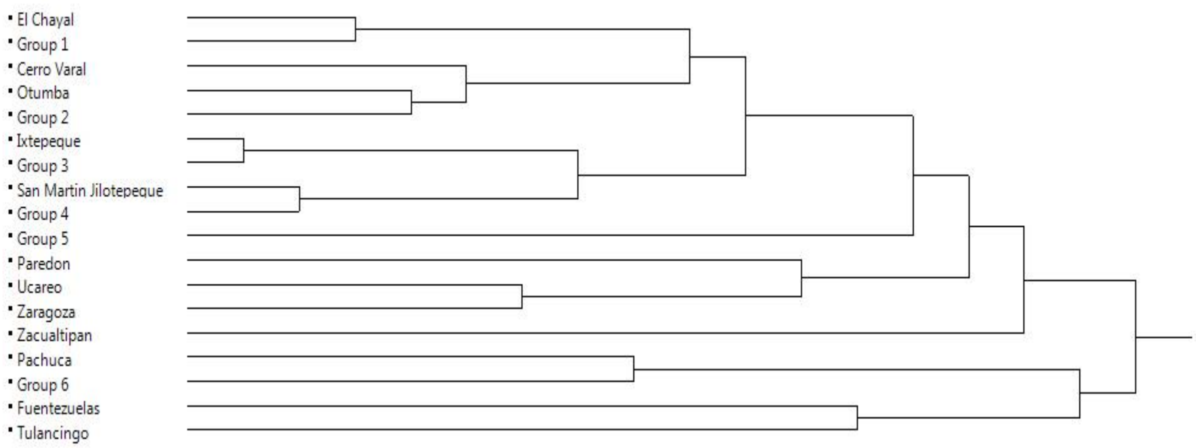

Figure 5.1 Hierarchical cluster analysis of means for the elements Mn, Fe. Zn, Rb, Sr, Y, Zr, Nb for Postclassic chemical groups and known sources.

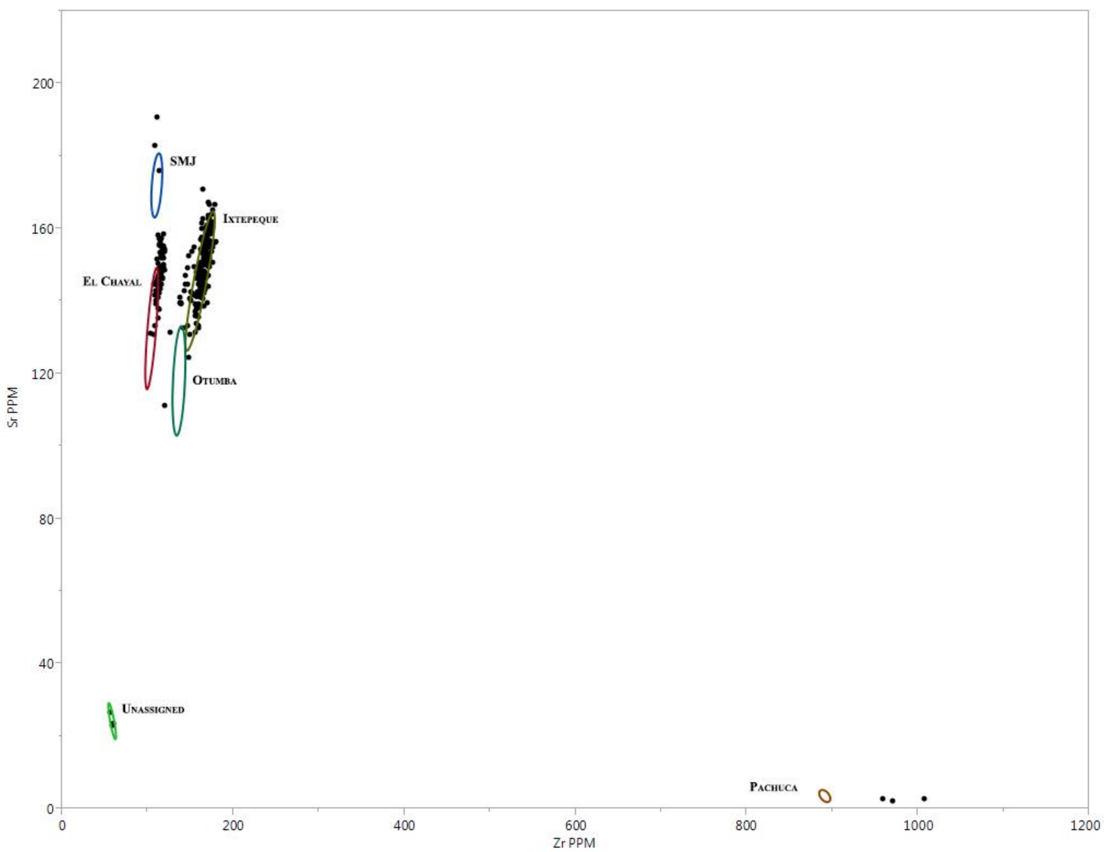

Figure 5.2 Bivariate plot of PPM values for Sr and Zr, with 95% confidence ellipses of Santa Rita Corozal's Postclassic assemblage

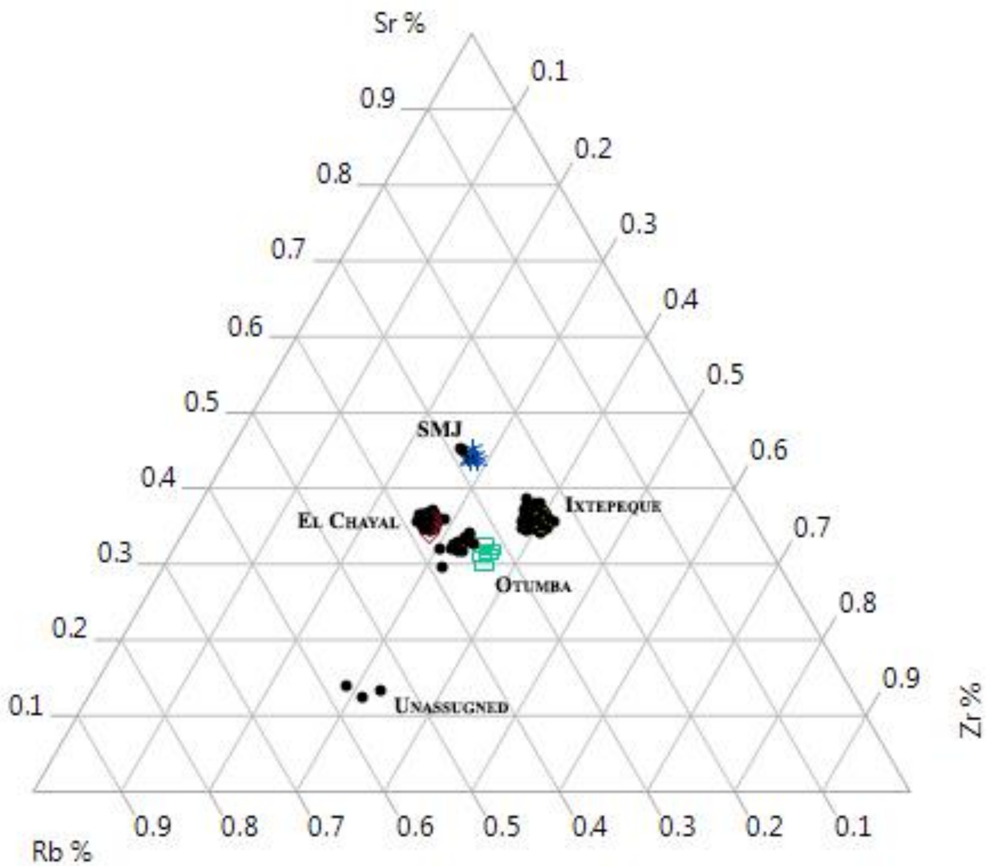

Figure 5.3 Ternary plot of the percentage of Rb, Sr, and Zr of Santa Rita Corozal's Postclassic assemblage. Plot displaying the three Guatemalan sources, Otumba, and the unassigned group. Mexican sources including Pachuca excluded to not influence plotting of other sources.

Table 5.1 Sources present in the Postclassic assemblage.

Sources	El Chayal	Ixtepeque	Otumba	Pachuca	San Martin Jilotepeque	Unassigned
N	71	204	18	4	3	3
%	23.4%	67.3%	6%	1.3%	< 1%	< 1%

Table 5.2 Sources present in assemblage of obsidian cores

Sources	El Chayal	Ixtepeque	Otumba	Pachuca	San Martin Jilotepeque	Unassigned
N	0	8	1	0	0	1
%	0%	80%	10%	0%	0%	10%

For the Late Classic period only 3 samples were assayed via XRF. When subjected to HCA only 2 chemical groups were found to be present in the dataset; these were preliminarily identified as belonging to the El Chayal and Ixtepeque sources (Figure 5.4). Two pieces may be attributed to Ixtepeque while one falls just outside the confidence ellipse of El Chayal, again considering a third element addresses this issue (Figures 5.5 and 5.6). The results for the Late Classic period are summarized in Table 5.3, showing that 66% of the sample is attributed to Ixtepeque. The six samples dating to the Early Classic period are all from the same chemical group, preliminarily identified as El Chayal by HCA (Figure 5.6). Like the previous periods, the inclusion of a third element serves to better characterize the source samples and the Santa Rita Corozal samples (Figures 5.7 and 5.8). The results from this period are summarized along with the Late Classic period in Table 5.3. These samples are too small to make interpretations about these periods, but serves to show that the two major sources being exploited during the Postclassic Period are found in the Late and Early Classic Periods as well.

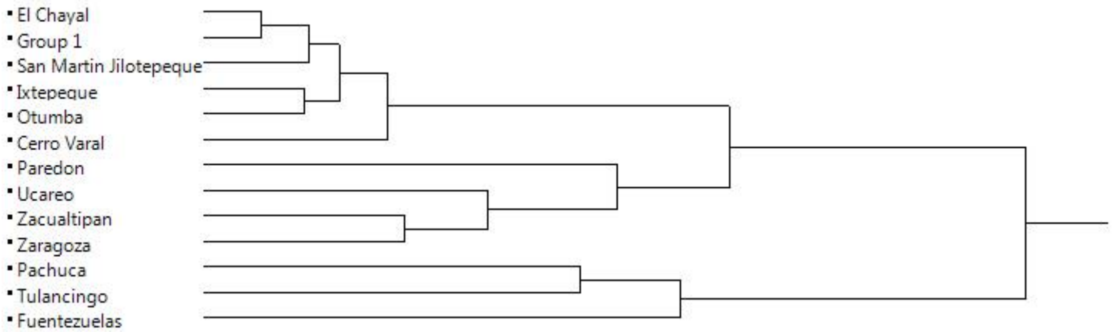

Figure 5.4 Hierarchical cluster analysis of means for the elements Mn, Fe. Zn, Rb, Sr, Y, Zr, Nb for Late Classic Period chemical groups and known sources.

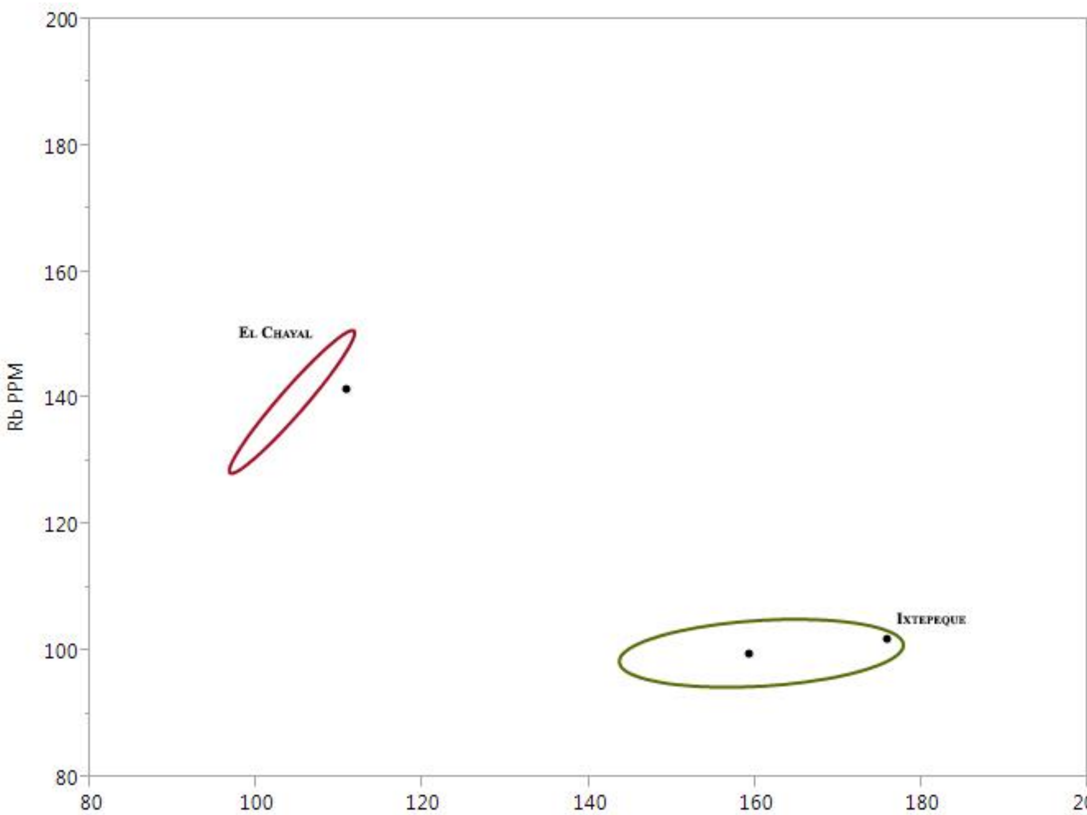

Figure 5.5 Bivariate plot Zr and Rb with 95% confidence ellipses of Santa Rita Corozal's Late Classic assemblage

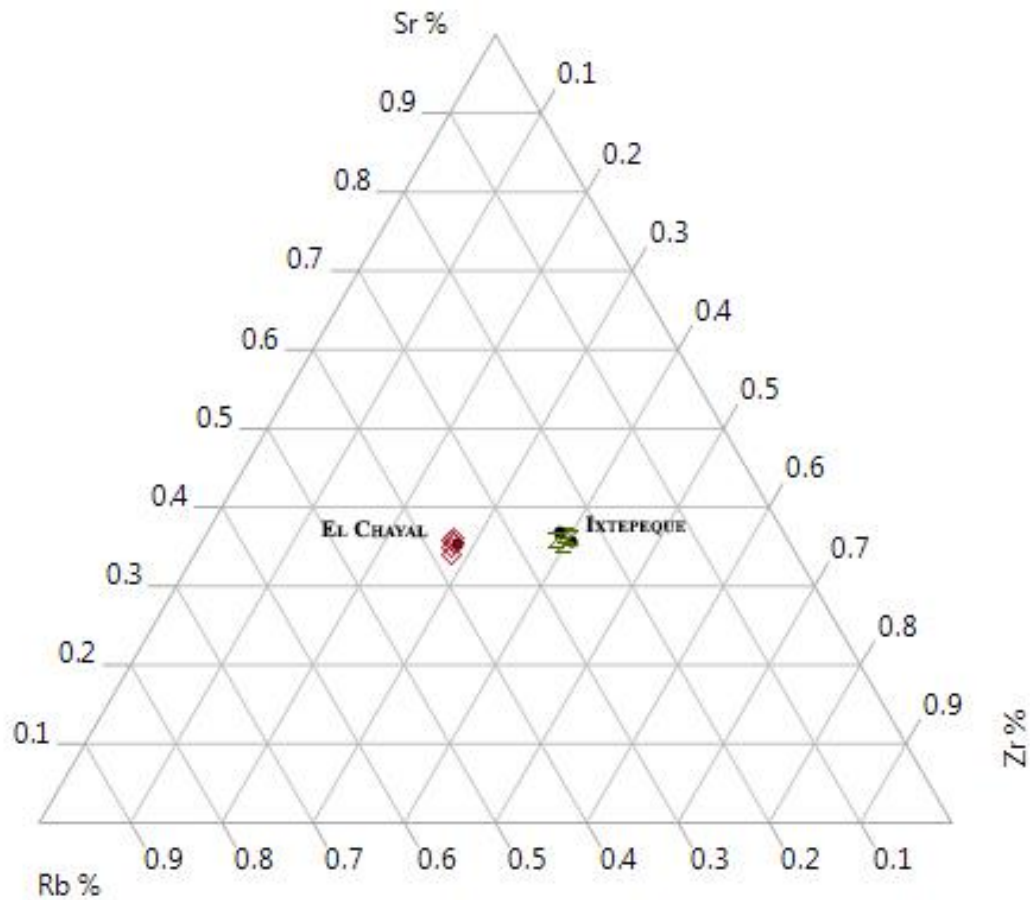

Figure 5.6 Ternary plot of the percentages of Rb, Sr, and Zr of Santa Rita Corozal's Late Classic assemblage

Table 5.3 Sources present in the Late Classic and Early Classic samples.

Late Classic Period		
	El Chayal	Ixtepeque
N	1	2
%	33.33%	66.66%
Early Classic Period		
Sources	El Chayal	Ixtepeque
N	6	0
%	100%	0%

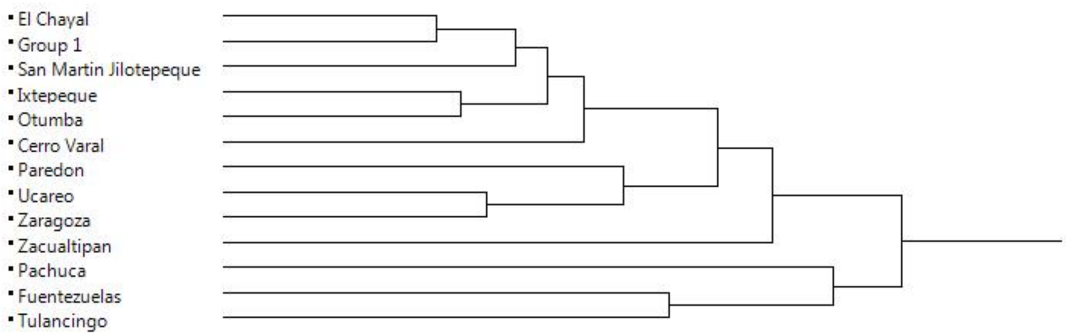

Figure 5.7 Hierarchical cluster analysis of means for the elements Mn, Fe. Zn, Rb, Sr, Y, Zr, Nb for Early Classic chemical groups and known sources.

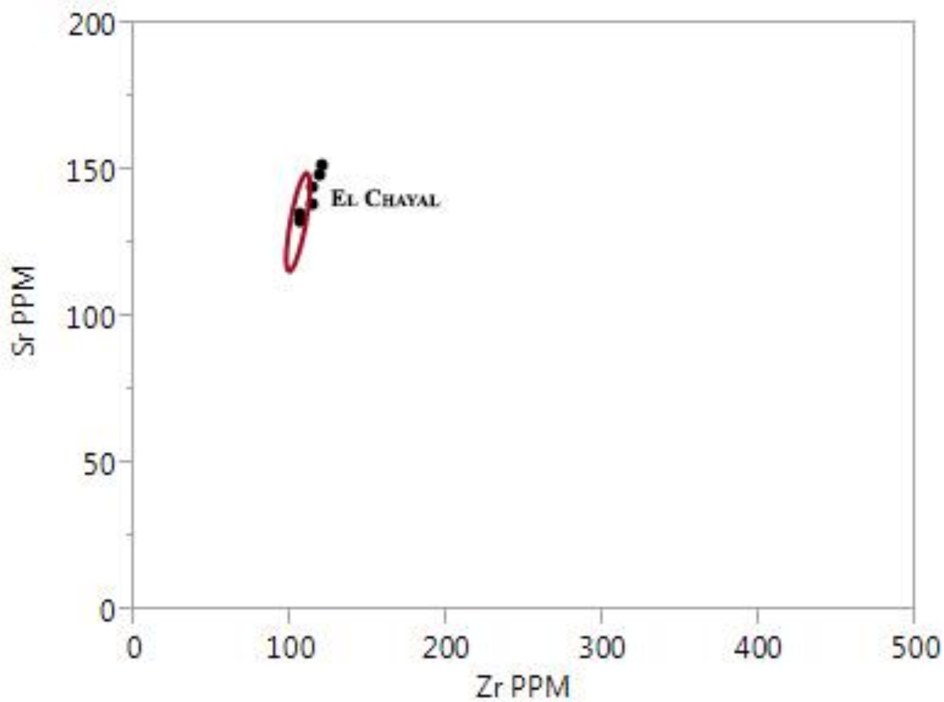

Figure 5.8 Bivariate plot Zr and Rb with 95% confidence ellipses of Santa Rita Corozal's Early Classic assemblage.

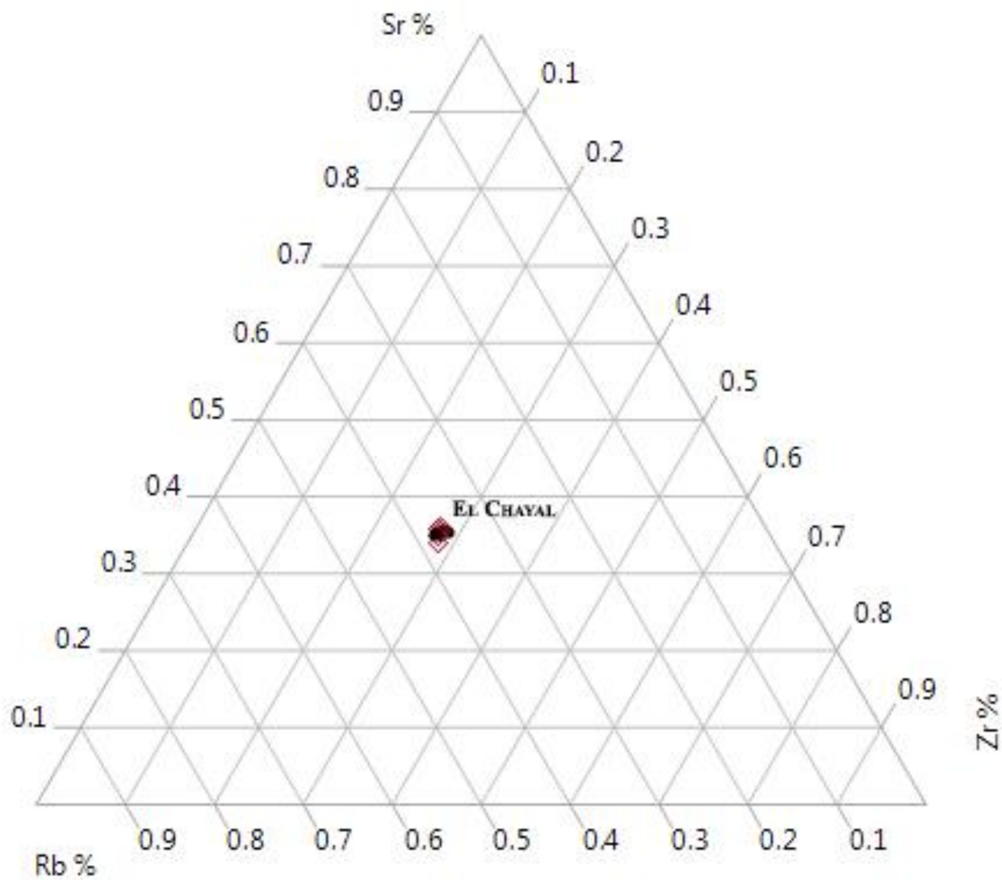

Figure 5.9 Ternary plot of the percentages of Rb, Sr, and Zr of Santa Rita Corozal's Early Classic assemblage

Discussion

Nearly all sites in Mesoamerica that have obsidian as part of their chipped stone assemblage exploited multiple obsidian sources (Braswell 2003; Glascock 2002). The results of the XRF analysis show that during the Postclassic Period Santa Rita Corozal exploited five different known sources, with a sixth unknown source. Combined with Neivens et al.'s (1983) INAA analysis of obsidian in northern Belize, this number becomes six known sources with the inclusion of Pico de Orizaba (Table 5.4). As previously mentioned, the unknown source found in the XRF study is believed to be Pico de Orizaba; however, this is unconfirmed at this point as it

is not known which artifacts INAA determined to have come from the Pico de Orizaba source. Because of this, its presence is noted in discussions of which sources are being exploited, but it is left out of the discussion of source distribution. The total number of sources for earlier periods did not change with the inclusion of the INAA results (Table 5.4). In terms of obsidian source exploitation, the transition from the Classic Period to the Postclassic Period is characterized by a shift from primarily relying upon obsidian from El Chayal to a near exclusive reliance on the Ixtepeque source (Braswell 2003). Michels (1979) has suggested that this shift is the result of the abandonment of Kaminaljuyú during the 9th century CE, although Braswell (2003) notes that there is no evidence from El Chayal's quarries to support this assumption. By the Postclassic Period Ixtepeque was being heavily exploited at many sites in the Maya region, some of which have evidence of having previously relied primarily upon El Chayal (Table 5.5) (Gotlico et al. 2013). It is still unclear who was controlling the exploitation of Ixtepeque obsidian during the Postclassic; the closest major urban center was Copán, 72 km away but it was abandoned by the Postclassic. Braswell (2003) suggests local communities oversaw the exploitation and exchange of obsidian at Ixtepeque.

Table 5.4 Sources determined by Neivens et al.'s (1983) INAA study and sources determined by the current XRF study

Time Period	**INAA Study (1983)**	**XRF Study (2015)**	**Combined sources**	**Total**
Classic	El Chayal Ixtepeque	El Chayal (Late & Early Classic) Ixtepeque (Late Classic)	El Chayal Ixtepeque	2
Postclassic	El Chayal Ixtepeque Pico de Orizaba San Martin Jilotepeque	El Chayal Ixtepeque Otumba Pachuca San Martin Jilotepeque Unassigned (probably Pico de Orizaba)	El Chayal Ixtepeque Otumba Pachuca Pico de Orizaba San Martin Jilotepeque	6

Table 5.5 Percentage of sources at other sites mentioned in the text, all sources not found at Santa Rita Corozal included in the other sources category. OUT = Otumba, PAC = Pachuca, PDO = Pico de Orizaba, CHY=El Chayal, IXT = Ixtepeque, SMJ = San Martin Jilotepque. * = visual sourcing, ** = from a single structure, sourced visually.

Site	N	OUT	PAC	PDO	CHY	IXT	SMJ	Other Sources	Unassigned	Reference
Chichén Itzá*	2745	1%	21%	4%	10%	12%	4%	48%		Braswell 1998
Wild Cane Caye	75				8%	84%	1%	6%		McKillop 1996
Caye Coco	1466				30%	68%	1%			Mazeau 2000
Laguna de On	658				27%	67%	3%		3%	Mazeau 2000
Santa Rita Corozal	303	6%	1.3%	N/A	23.4%	67.3%	>1%			
Mayapán**	1241		<1%	<1%	1%	98%	<1%	< 1%	<1%	Braswell 2003

Santa Rita Corozal does not appear to fit within the pattern of source exploitation, as summarized in Braswell (2003). While Ixtepeque certainly comprises the majority of Santa Rita Corozal's Postclassic assemblage, it is not as predominant as at other Postclassic sites such as Wild Cane Caye and in particular Mayapán (Braswell 2003; McKillop 1996). Within the Chetumal polity itself, a sourcing study at the sites of Caye Coco and Laguna de On have suggested that Ixtepeque comprised about 68% of obsidian at both sites (figure 5.2) (Mazeau 2000). Both these sites were believed to have been under the control of Santa Rita Corozal during this time yet both display obsidian source patterns that are different than those seen at Santa Rita Corozal, as neither site has Mexican obsidian among its assemblage. All three sites, Caye Coco, Laguna de On, and Santa Rita Corozal, have El Chayal and San Martin Jilotepeque obsidian present. These two sources are found in relatively even amounts across all three sites, between 27%-30% for El Chayal obsidian and from 1%-3% are attributed to San Martin Jilotepeque (Mazeau 2000). The numbers from the Chetumal province are in stark contrast to

those suggested for Mayapán, where 98% of obsidian artifacts analyzed are attributed to Ixtepeque (Braswell 2003). It is believed that Mayapán was part of a marine trade route that brought obsidian from Guatemala's highlands north along Belize's coast (Masson and Freidel 2012). It would stand to reason, then that Santa Rita Corozal would have also participated in this trade route given its location and its status as a region capital. Santa Rita Corozal appears to have exploited more obsidian source regions than other sites at this time, including those in the Northern Maya Lowlands such as Chichén Itza. During the Terminal Classic Period Chichén Itza relied upon many sources from Mexico, including three that are seen in the Santa Rita Corozal assemblage: Pachuca, Pico de Orizaba, and Otumba. Chichén Itza also utilized the Paredon, Ucareo, Zacualtipan, and Zaragoza sources (Nelson et al. 1977; Moholy-Nagy and Ladd 1992; Braswell and Glascock 2002).

The relative abundance of sources at Santa Rita Corozal compared to the patterns of source exploitation at Caye Coco, Laguna de On, and Mayapán may be the result of several factors. First, the sourcing studies at all three of those sites largely relied upon visual sourcing methods to characterize assemblages comprising several thousand artifacts. While rapid, this approach is also not as reliable as chemical analysis, especially concerning the differentiation of grey obsidian sources (Braswell and Glascock 2011; Carballo et al. 2007; Jackson and Love 1991; Knight and Glascock 2009; Moholy-Nagy 2003; Moholy-Nagy et al. 2013). Given the greater access and relative decrease in cost of highly reliable XRF sourcing, visual sourcing studies would benefit from increases in the proportion chemical sourcing used to supplement their findings (Frahm 2013b) .

Adaptationist models of obsidian provisioning explain the exploitation of multiple sources of obsidian as a form of insulating the flow of obsidian into a site from fluctuations in the supply chain (Brumfiel and Earle 1987; Fowler et al. 1987; Stross et al. 1983; P. Rice 1984). Smith and his colleagues (2007) are critical of these models, as they presuppose that each obsidian source had a distinct distribution system. While I agree with Smith's assessment that during the Postclassic Period evidence suggests that obsidian was being exchanged commercially, I do not necessarily believe that this negates the conservative economic nature of community provisioning (Dalton 1977; Halstead and O'Shea 1989; Hirth 2010, M Smith and Berdan 2003). Hirth's (2008) work modeling possible obsidian supply methods at Xochicalco and their expected outcomes helps resolve this issue. Following Hirth's model Santa Rita Corozal may have participated in unspecialized, indirect procurement of obsidian. Evidence for this type of procurement includes the importation of polyhedral cores or partially reduced polyhedral cores, as discussed in Chapter 3, as well as the presence of multiple obsidian sources (Hirth 2008); as opposed to a political procurement or specialized procurement where low source variation is expected given the reliance upon political and economic ties with specific sources.

While it appears that political involvement in the procurement of obsidian was minimal, the extent to which social status influenced access to sources still needs to be considered. Following the distributional approach, if obsidian is being redistributed by elites, then access to sources should follow the social hierarchy, with elites having the greatest diversity or sole access to sources and lower status households having less access to a diverse number of sources (Hirth 1998). Redistribution is contrasted by market exchange which should result in relative equal access to sources across social statuses (Hirth 1998). Unfortunately, because no obsidian

workshops were found at Santa Rita Corozal, it is impossible to test Hirth's third method of obsidian exchange, direct procurement from workshops. When combined with the results from the preceding chapter, a distribution of sources across social statuses should determine the type of exchange being employed by Santa Rita Corozal during the Postclassic Period. Following the class/function classifications determined by D. Chase (1992) for 28 structures, Table 5.6 shows which sources are present at these structures during the Postclassic Period. From this initial sorting of sources by social status, it is clear that all social statuses had access to all obsidian sources being imported into Santa Rita Corozal during the Postclassic Period. Structure function does not appear to influence the diversity of sources present in the structure's assemblage.

Table 5.6 Table showing structures, their function, their status, and the sources present from the Postclassic Period. Statuses are based on D. Chase 1992.

Str. No	Status	Status	El Chayal	Ixtepeque	Otumba	Pachuca	San Martin Jilotepeque	Unassigned
Plat. 2	Domestic	High	✓	✓	✓	✓		
Str. 6	Domestic	Middle	✓	✓				
Str. 35	Domestic	Low	✓	✓				
Str. 36	Ritual	N/A		✓				
Str. 37	Ritual	N/A	✓	✓				
Str. 38	Domestic	Low	✓					
Str. 39	Domestic	Low	✓					
Str. 58	Ritual	N/A	✓	✓	✓			
Str. 69	Domestic	Low	✓	✓				
Str. 70	Domestic	Low	✓					
Str. 73	Domestic	High	✓	✓				
Str. 74	Domestic	Middle	✓	✓	✓		✓	
Str. 77	Ritual	N/A	✓	✓			✓	
Str. 79	Ritual	N/A	✓	✓				
Str. 80	Domestic	High	✓	✓	✓			
Str. 81	Domestic	High	✓	✓	✓	✓		
Str. 156	Domestic	Low		✓				✓
Str. 159	Domestic	Middle	✓		✓		✓	
Str. 162	Domestic	Low	✓	✓	✓			
Str. 179	Domestic	Middle	✓	✓				✓
Str. 181	Domestic	Middle	✓	✓		✓		
Str. 182	Domestic	Low	✓	✓				
Str. 183	Domestic	High	✓	✓				

Str. No	Status	Status	El Chayal	Ixtepeque	Otumba	Pachuca	San Martin Jilotepeque	Unassigned
Str. 212	Ritual	N/A	✓	✓				
Str. 213	Domestic	High		✓	✓			
Str. 214	Domestic	High		✓				
Str. 215	Domestic	High	✓	✓				
Str. 216	Domestic	High	✓	✓	✓			
Str. 218	Domestic	High	✓	✓	✓			

Despite all sources being present across social statuses the question still remains as to what extent access was equal to these sources and source regions. To determine the degree of access to obsidian sources at Santa Rita Corozal the percentage each source comprised of a structures assemblage was calculated (Table 5.7). These percentages were then compared against each other for high status and other status (middle and low status) structures. Following Hirth (1998), structures with fewer than 5 pieces of obsidian were excluded in order to ensure reliable determination of access to sources. This means that Structure 159 was excluded from the determination of access and, thus, all San Martin Jilotepeque obsidian in the sample (N=2) comes from elite residences. To control for this, access was first determined separately for the percentages of obsidian from El Chayal and Ixtepeque, the two major sources of obsidian present in the Santa Rita Corozal assemblage, and then again for the percentages of all Guatemalan obsidian sources and all Mexican sources. Subjecting the dataset to a Bartlett test determined that the sample of domestic structures had equal variance for all sources and source regions; except for the Guatemalan source region whose sample had an unequal variance. ANOVA was then applied and it was determined that no statistical difference existed between domestic structures across statuses (Table 5.8). Welch's ANOVA was applied to the Guatemalan source region sample in order to account for the sample's unequal variance. This strongly suggests that there

was minimal involvement of the elite in the control of the distribution of specific obsidian sources at Santa Rita Corozal during the Postclassic Period.

Table 5.7 Table showing structures, their function, their status, and the percentage each sources comprises of assayed obsidian dating to the Postclassic Period. Statuses are based on D. Chase 1992.

Str. No	**Status**	**Status**	**N**	**El Chayal**	**Ixtepeque**	**Otumba**	**Pachuca**	**San Martin Jilotepeque**	**Unassigned**
Plat. 2	Domestic	High	30	20%	70%	7%	3%	-	-
Str. 6	Domestic	Middle	21	14%	86%	-	-	-	-
Str. 35	Domestic	Low	6	33.33%	66.66%	-	-	-	-
Str. 36	Ritual	N/A	1	-	100%	-	-	-	-
Str. 37	Ritual	N/A	3	66.66%	33.33%	-	-	-	-
Str. 38	Domestic	Low	3	100%	-	-	-	-	-
Str. 39	Domestic	Low	2	100%	-	-	-	-	-
Str. 58	Ritual	N/A	12	33.33%	50%	8.33%	-	-	-
Str. 69	Domestic	Low	3	66.66%	3.33%	-	-	-	-
Str. 70	Domestic	Low	1	100%	-	-	-	-	-
Str. 73	Domestic	High	9	11%	89%	-	-	-	-
Str. 74	Domestic	Middle	12	25%	58%	8%	-	8%	-
Str. 77	Ritual	N/A	8	37.5%	50%			12.5%	-
Str. 79	Ritual	N/A	5	40%	60%	-	-	-	-
Str. 80	Domestic	High	8	37.5%	50%	12.5%	-	-	-
Str. 81	Domestic	High	29	17%	72%	3%	3%	-	3%
Str. 156	Domestic	Low	2	-	100%	-	-	-	-
Str. 159	Domestic	Middle	3	33.33%	-	33.33%	-	33.33%	-
Str. 162	Domestic	Low	9	11%	66%	11%	-	-	11%
Str. 179	Domestic	Middle	5	20%	80%	-	-	-	-
Str. 181	Domestic	Middle	6	33.33%	33.33%	-	33.33%	-	-
Str. 182	Domestic	Low	2	50%	50%	-	-	-	-
Str. 183	Domestic	High	5	40%	60%				
Str. 189	Ritual	N/A	8	25%	62.5%	-	-	-	12.5%
Str. 212	Ritual	N/A	9	33.33%	66.66%	-	-	-	-
Str. 213	Domestic	High	4	-	75%	25%	-	-	-
Str. 214	Domestic	High	6	-	100%	-	-	-	-
Str. 215	Domestic	High	8	25%	75%	-	-	-	-
Str. 216	Domestic	High	40	20%	70%	10%	-	-	-
Str. 218	Domestic	High	40	7.5%	80%	12.5%	-	-	-

Table 5.8 ANOVA Means for high status and other status structures from Postclassic. * Welch's ANOVA applied to compensate for unequal variance.

	High Status Strs. (N= 9)	Other Status Strs. (N= 6)	F	P
% of El Chayal Obsidian	0.1989	0.2267	0.1984	0.6634
% of Ixtepeque Obsidian	0.7400	0.6500	1.0862	0.3163
% of Guatemalan Obsidian*	0.9389	0.8917	0.6035	0.4660
% of Mexican Obsidian	0.05778	0.0867	0.3561	0.5609

Summary

The sourcing of the Santa Rita Corozal assemblage allows for several conclusions to be drawn regarding the importation and distribution of obsidian during at Santa Rita Corozal during the Postclassic Period. The Postclassic Period assemblage contained a greater variety of obsidian sources than those seen at other sites in the region during this time. Within the Chetumal polity, Santa Rita Corozal shows stronger ties with sources in Mexico than do the sites of Caye Coco and Laguna de On. In particular, the presence of Otumba as determined by the pXRF analysis presented here is not noted in any significant quantity at other sites in the region at this time. This is likely due Santa Rita Corozal being a regional capital and trade center located along several important trade route. Combined with the earlier INAA study demonstrating the presence of Pico de Orizaba obsidian; it appears that Santa Rita Corozal likely participated in multiple obsidian trade routes. These trade routes likely included those flowing north along Belize's Coast as well as the southern flowing circum-peninsular routes. However, following Hirth (2008: 440-448) obsidian procurement at the site was likely informal and unspecialized as evident in the importation of polyhedral cores from multiple obsidian sources. Meaning that the individuals supplying obsidian to Santa Rita Corozal were more generalized and did not exclusively deal in the procurement of obsidian from the source regions. If obsidian procurement had been formal,

then fewer sources would have been exploited, and the few that were exploited would follow political and social ties (Hirth 2008: 443-444). It can also be concluded that all social statuses had equal access to the variety of sources and source regions being utilized at Santa Rita Corozal. Additionally, it may be concluded that all statuses procured obsidian through a distribution method that allowed for the equal consumption of obsidian from different sources; the research presented here strongly suggests that this method was market exchange.

CHAPTER 6: CONCLUSION AND FUTURE RESEARCH

Discussions of exchange in Postclassic northern Belize have largely focused on the exploitation of locally available chert. Research on obsidian has largely been limited to small sourcing studies or discussions of local obsidian industries (Dreiss 1988; Hammond et al. 1984; Masson and Chaya 2000; Mazeau 2000; McKillop 1995; Neivens et al. 1983; Stemp 2011). Previously these discussions were largely unable to draw comparisons to Santa Rita Corozal, the primary site in the region during the Postclassic. This thesis has attempted to resolve this issue by determining the sources of obsidian being exploited, the form in which obsidian was being imported, the type of production occurring, and the method by which obsidian was distributed.

pXRF analysis of 370 obsidian artifacts determined that during the Postclassic Period the population of Santa Rita Corozal was exploiting at least six obsidian sources. These include the three major Guatemalan sources, Ixtepeque, El Chayal, and San Martin Jilotepeque, and three Mexican sources, Pachuca, Otumba, and Pico de Orizaba. This is a different pattern of sources than those seen at other sites in the Chetumal Province that relied upon the three Guatemalan sources (Mazeau 2000); however, this may be a result of the earlier studies using unreliable visual sourcing that was supplemented by limited chemical sourcing. While difficult to prove the exploitation of multiple obsidian sources and source regions would have insulated the population of Santa Rita Corozal from fluctuations in the obsidian supply chain. It is highly unlikely that this was purposeful and rather was a result of the exploitation of multiple trade routes.

By applying the lithic technology approach to Santa Rita Corozal's Postclassic assemblage it was determined that obsidian was most likely being imported in the form of

prepared or partially reduced polyhedral cores. This assumption is supported by the presence of pressure artifacts and debitage such as final series blades, core rejuvenation flakes, error removals, exhausted cores, and the lack of the percussion debitage associated with stages earlier in the reduction process. Combined with the pXRF results, this indicates that procurement of obsidian was unspecialized and indirect. Unspecialized procurement is characterized by the exploitation of multiple sources and source regions, contrasted with specialized procurement which relies upon social ties to procure obsidian from a small number of sources (Hirth 2008). Indirect procurement is characterized by obsidian being imported later in the reduction sequence, polyhedral cores or partial reduced polyhedral cores, while direct procurement results in importation of nodules and macrocores (Hirth 2008). This type of procurement is contrasted by specialized procurement where a limited number of sources are exploited following political and economic relationships as well as direct procurement that results in the importation of obsidian earlier in the reduction sequence.

No workshop contexts, including debitage dumps, were recovered by the CPP in their four seasons of excavation at Santa Rita Corozal. Despite this, it is clear that production at the site was geared to the production of fine prismatic blades from polyhedral cores. The assemblage contains many of the byproducts associated with production including: exhausted cores, core fragments, rejuvenation debitage, attempts at error removal, and production errors. The limited amount of cores that were recovered could easily have accounted for all the final-series blades present in the assemblage. Santa Rita Corozal's obsidian industries also differ greatly from that of Caye Coco and Laguna de On, where no evidence of local production of blades was found (Masson 2000).

At Santa Rita Corozal during the Postclassic Period, obsidian was being distributed via market exchange without regard to social status. Both high status and lower status individuals consumed obsidian in relatively even proportions and no statistical difference in consumption patterns existed. Additionally, structures associated with all social statuses and functions had access to the different sources and source regions exploited by Santa Rita Corozal during the Postclassic. If distribution of obsidian had been controlled, the expected distribution would have been one characterized by the inhabitants of higher status structures consuming greater quantities and sources of obsidian with the inhabitants of lower status structures consuming obsidian in proportion to their social rank. The two high status structures that contained a disproportionate amount of obsidian appear to have been the loci of activities that required greater amounts of obsidian.

Future Research

This thesis supports the hypothesis that during Santa Rita Corozal's Postclassic Period obsidian was being distributed through market exchange. Other sites in Mesoamerica have used ratios of obsidian to chert tools and densities per 1000 sherds for comparative purposes (Levine 2014; Masson 2000; M. Smith et al. 2007). These findings should also be supplemented with different classes of artifacts such as marine shell, chert tools, net weights, and ceramics in order to determine the extent of market exchange and whether multiple distribution systems coexisted. While this thesis chemically sourced a large portion of Santa Rita Corozal's obsidian, over 50%, additional XRF sourcing may result in the discovery of more sources or more pieces attributable to the sources established by this research, such as the San Martin Jilotepeque source for which only three pieces have been attributed. If possible, more work should be done on assigning time

periods to the pieces that have none. This would boost sample sizes for earlier periods and offer greater insight into how procurement patterns have changed over time. Both the extent of market exchange and the sources being exploited should be considered over a more refined timeline to determine if, and to what extent, exchange changed with fluctuations in the population.

APPENDICES A:
POSTCLASSIC OBSIDIAN ASSEMBALAGE

Table of Postclassic assemblage with sources. Sources: Ixtepeque – IXT, Pachuca – PAC, San Martin Jilotepeque – SMJ, Otumba – Out, N/A – not assayed, ? – Unassigned

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Plat. 2	P6B/1-3a	blade	medial	final series	18.66	12.63	2.97	0.85	IXT
Plat. 2	P6B/1-3b	blade	proximal/medial	final series	23.4	17.53	3.89	2.09	IXT
Plat. 2	P6B/1-3c	blade	medial	final series	23.01	10.86	4.18	1.27	IXT
Plat. 2	P6B/1-3d	blade	proximal/medial	final series	44.87	11.86	3.43	2.24	IXT
Plat. 2	P6B/1-3e	blade	medial	final series	39.53	10.33	2.86	1.46	OTU
Plat. 2	P6B/3-1b	blade	proximal/medial	final series	18.07	8.1	2.95	0.53	IXT
Plat. 2	P6B/3-1c	blade	medial	final series	10.92	13.32	2.02	0.46	IXT
Plat. 2	P6B/3-6	blade	proximal/medial	final series	34.05	17.69	4.2	2.56	IXT
Plat. 2	P6B/4-1	blade	medial	final series	13.59	12.85	2.81	0.52	IXT
Plat. 2	P6B/6-2a	blade	medial	final series	25.28	16.1	3.68	1.47	IXT
Plat. 2	P6B/6-2b	blade	medial	final series	12.09	6.93	2.01	0.19	N/A
Plat. 2	P6B/6-2c	blade	medial	final series	14.04	9.81	2.28	0.39	N/A
Plat. 2	P6B/6-2d	blade	medial		19.99	5.67	1.5	0.29	N/A
Plat. 2	P6B/6-3	blade	proximal/medial	final series	18.36	11.36	2.77	0.73	PAC
Plat. 2	P6B/6-4	blade	medial	final series	46.21	10.52	3.01	2.03	CHY
Plat. 2	P6B/6-5a	blade	proximal/medial	final series	22.79	11.39	2.49	0.91	IXT
Plat. 2	P6B/6-5b	blade	medial	final series	16.54	9.32	2.05	0.36	N/A
Plat. 2	P6B/7-2a	projectile point	complete		28.46	11	3.49	1.4	IXT
Plat. 2	P6B/7-2b	blade	medial	final series	26.93	9.02	3.25	0.97	CHY
Plat. 2	P6E/11-1	blade	medial	final series	22.21	14.18	2.61	1.13	IXT
Plat. 2	P6E/15-1	blade	proximal/medial	final series	23.16	11.2	2.44	0.92	CHY
Plat. 2	P6E/19-1	blade	medial	final series	17.89	9.12	2.6	0.49	N/A

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Plat. 2	P6E/22-1	blade	medial	final series	16.41	12.95	2.35	0.78	CHY
Plat. 2	P6E/36-2a	debitage			7.59	5.53	1.51	0.05	N/A
Plat. 2	P6E/36-2b	blade	distal	final series	14.86	8.08	2.15	0.27	N/A
Plat. 2	P6E/4-2	blade	proximal/medial	final series	19.09	12.78	3.62	1.11	OTU
Plat. 2	P6E/48-1	blade	proximal/medial	final series	19.99	14.08	3.97	1	IXT
Plat. 2	P6E/53-1a	blade	proximal/medial	final series	19.66	9.1	3.91	0.78	CHY
Plat. 2	P6E/53-1b	blade	medial	final series	19.73	8.53	2.01	0.5	N/A
Plat. 2	P6E/7-4	blade	medial	final series	9.33	11.75	3.45	0.52	IXT
Plat. 2	P6E/8-2	blade	medial	final series	21.86	10.35	2.91	0.93	CHY
Plat. 2	P6E/9-2	blade	medial	final series	21.28	8.96	2.2	0.51	N/A
Plat. 2 & Str. 73	P6E/3-6a	blade	medial	final series	16.9	10.44	2.25	0.52	IXT
Plat. 2 & Str. 73	P6E/3-7	blade	medial	final series	25.39	8.03	2.57	0.67	N/A
Plat. 2 & Str. 73	P6E/3-9	blade	medial	final series	29.45	14.75	3.36	1.88	IXT
Plat. 2 & Str. 80	P6E/1-11	blade	proximal/medial	final series	15.33	11.15	2.71	0.57	IXT
Plat. 2 & Str. 80	P6E/1-5?	blade	medial	final series	23.09	8.05	2.14	0.52	N/A
Plat. 2 & Str. 80	P6E/1-5a	blade	proximal/medial	final series	24.65	8.3	1.77	0.5	N/A
Plat. 2 & Str. 80	P6E/1-5b	blade	medial	final series	17.47	11.97	2.99	0.82	IXT
Plat. 2 & Str. 80	P6E/1-5e	blade	medial	final series	16.37	11.75	3.08	0.75	IXT
Plat. 2 & Str. 80	P6E/1-5f	blade	proximal/medial	final series	22.63	15.88	4.31	1.93	IXT
Plat. 2 & Str. 80	P6E/1-7	blade	proximal/medial	final series	29.1	15.52	3.82	2.04	IXT

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Plat. 2 & Str. 80	P6E/2-2a	blade	proximal/medial	final series	17.99	4.69	1.38	0.14	N/A
Plat. 2 & Str. 80	P6E/2-2b	blade	medial	final series	9.71	8.73	1.94	0.28	N/A
Str. 134	P12A/1-2	blade	medial	final series	16.03	10.08	1.9	0.34	N/A
Str. 156	P18A/12-5	blade	medial	final series	19.85	14.61	1.79	0.55	N/A
Str. 156	P18A/2-2	blade	medial	final series	15.84	8.97	2.62	0.59	IXT
Str. 156	P18A/25-2	blade	proximal/medial	final series	17.67	25.12	3.66	1.64	IXT
Str. 159	P19A/11-6	blade	proximal/medial	final series	28.43	8.47	3.08	1.12	N/A
Str. 159	P19A/9-7	blade	proximal/medial	final series	29.03	11.89	3	1.39	SMJ
Str. 159	P19A/9-8a	blade	medial	final series	23.33	11.75	2.95	1.01	OTU
Str. 159	P19A/9-8b	blade	proximal/medial	final series	33.93	12.44	2.69	1.35	CHY
Str. 162	P23A/13-3	blade	medial	final series	37.97	15.95	4.17	3.15	Unassigned
Str. 162	P23A/13-9	blade	medial	final series	25.7	5.8	1.8	0.35	N/A
Str. 162	P23A/14-10	plunge blade	medial/distal	final series	26.77	7.69	11.62	1.55	OTU
Str. 162	P23A/17-4	blade	medial	final series	17.19	12.05	3.73	0.91	IXT
Str. 162	P23A/21-3	blade	medial	final series	14.52	11.21	2.24	0.6	N/A
Str. 162	P23A/23-2	blade	proximal/medial	final series	28.07	16.11	2.36	1.63	CHY
Str. 162	P23A/25-4	blade	medial	final series	32.45	11.43	2.74	1.56	IXT
Str. 162	P23A/26-3	flake	complete		26.17	27.14	3.15	2.06	IXT
Str. 162	P23A/27-4	blade	medial/distal	final series	24.1	12.78	3.08	1.06	N/A
Str. 162	P23A/7-5a	blade	proximal/medial	final series	36.18	12.67	2.94	1.84	IXT
Str. 162	P23A/7-5b	blade	medial	final series	20.81	13.42	2.48	1	N/A
Str. 162	P23A/7-5c	blade	medial	final series	23.48	7.5	1.78	0.54	N/A
Str. 162	P23A/7-5d	blade	medial	final series	24.72	10	2.65	1.04	N/A
Str. 162	P23A/7-5e	blade	medial	final series	20.57	9.74	2.27	0.57	N/A

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 162	P23B/16-2	projectile point	complete		22.87	9.42	3.86	0.95	IXT
Str. 162	P23B/24-3	blade	medial	final series	19.92	9.67	2.2	0.6	N/A
Str. 162	P23B/25-2	core	lateral/medial	fragment	18.93	12.65	4.52	1.18	IXT
Str. 179	P34A/10-3a	projectile point	complete		26.7	9.08	2.98	0.93	IXT
Str. 179	P34A/10-3b	blade	medial/distal	final series	14.24	8.82	1.72	0.25	N/A
Str. 179	P34A/3-7	blade	medial	final series	7.45	11.86	1.92	0.19	N/A
Str. 179	P34A/4-12a	blade	proximal/medial	final series	23.59	8.78	2.16	0.57	N/A
Str. 179	P34A/7-11a	blade	medial	final series	29.89	14.33	3.78	2	CHY
Str. 179	P34A/7-11b	blade	medial	final series	13.98	10.07	2	0.44	N/A
Str. 179	P34A/7-11c	blade	medial	final series	12.42	14.29	3.38	0.66	IXT
Str. 179	P34B/3-9	projectile point	distal		19.84	12.7	3.06	0.73	IXT
Str. 179	P34B/4-1	blade	medial/distal	final series	22.5	7.54	2.59	0.62	N/A
Str. 179	P34B/4-2a	blade	medial	final series	22.11	14.12	2.89	1.1	IXT
Str. 179	P34B/4-2b	blade	proximal/medial	final series	23.59	9.68	3.12	0.92	N/A
Str. 181	P36A/1-2	blade	medial	final series	12.23	10.24	3.13	0.51	PAC
Str. 181	P36A/1-8	blade	medial	final series	18.16	12.36	2.16	0.73	PAC
Str. 181	P36A/4-3	projectile point	distal		26.6	6.75	2.85	0.6	CHY
Str. 181	P36B/10-7	blade	medial/distal	final series	22.37	5.73	1.8	0.25	N/A
Str. 181	P36B/15-3a	blade	proximal/medial	final series	25.65	14.05	3.53	0.97	IXT
Str. 181	P36B/15-3b	blade	medial	final series	23.49	10.8	2.64	1.16	IXT
Str. 181	P36B/15-3c		medial/lateral		21.42	24.47	7.26	6.45	CHY
Str. 181	P36B/17-6	blade	medial	final series	21.73	8.14	2.2	0.55	N/A
Str. 182	P28B/2-3	blade	proximal/medial	final series	23.72	12.5	2.25	0.98	IXT
Str. 182	P28B/26-8	blade	medial	final series	11.61	9.95	2.31	0.38	N/A
Str. 182	P28B/26-9	blade	proximal/medial	final series	27.8	11.88	3.5	1.37	CHY
Str. 182	P28C/12-5a	projectile point	distal		16.2	8.63	2.19	0.35	N/A

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 182	P28C/12-5b	blade	medial	final series	13.89	10.4	3.49	0.65	N/A
Str. 182	P29A/9-2	blade	medial	final series	18.8	5.69	1.46	0.21	N/A
Str. 183	P37A/18-7a	blade	proximal/medial	final series	39.88	8.88	2.56	1.13	N/A
Str. 183	P37A/18-7b	blade	medial	final series	18.26	10.74	2.54	0.55	IXT
Str. 183	P37A/18-7c	Rejuv.	proximal/medial		19.87	12.68	3.04	0.63	IXT
Str. 183	P37A/18-7d	blade	medial	final series	17.03	9.49	3.2	0.63	N/A
Str. 183	P37A/18-7e	blade	medial	final series	10.96	10.06	2.24	0.3	N/A
Str. 183	P37A/4-7	blade	proximal/medial	final series	25.02	5.11	1.8	0.34	N/A
Str. 183	P37C/3-7a	blade	proximal/medial	final series	26.33	11.25	3.62	1.2	CHY
Str. 183	P37C/3-7b	blade	proximal/medial	final series	36.22	9.68	2.13	1.05	CHY
Str. 183	P37C/3-7c	blade	medial	final series	25.61	16.52	3.19	1.61	CHY
Str. 189	P30B/18-2	blade	medial	final series	26.76	13.01	2.55	0.91	N/A
Str. 189	P30B/20-5	blade	proximal/medial	final series	19.14	8.36	2.26	0.46	N/A
Str. 189	P30B/20-6	blade	medial	final series	17.74	9.05	2.88	0.65	CHY
Str. 189	P30B/23-2	blade	medial	final series	30.48	13.56	3.82	1.75	IXT
Str. 189	P30C/18-1	projectile point	proximal		14.75	10.9	3.11	0.45	N/A
Str. 189	P30C/19-2	blade	distal	final series	19.89	8.31	2.3	0.32	N/A
Str. 189	P30C/19-3	projectile point	complete		16.74	8.39	2.58	0.32	N/A
Str. 189	P30C/20-9a	blade	proximal/medial	final series	21.81	14.52	3.89	1.27	IXT
Str. 189	P30C/20-9b	blade	medial	final series	18.85	11.12	3.05	0.88	Unassigned
Str. 189	P30C/25-5	blade	medial/distal	final series	22.51	8.59	2.35	0.42	N/A
Str. 189	P30C/7-16a	blade	proximal/medial	final series	23.1	12.32	3.1	1.14	CHY
Str. 189	P30C/7-16d	blade	medial	final series	17.16	12.83	2.3	0.81	IXT
Str. 189	P30C/7-16e	blade	medial	final series	20.17	10.81	2.2	0.7	IXT
Str. 189	P30C/7-16f	projectile point	complete		18.71	10.79	3.72	0.68	IXT

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 200	P14B/1-3	blade	medial/distal	final series	24.81	12.93	2.35	0.77	N/A
Str. 200	P14B/2-2	blade	medial	final series	22.95	13.74	2.97	1.23	N/A
Str. 212	P27B/16-2	blade	medial	final series	19.35	14.2	5.37	1.35	CHY
Str. 212	P27B/24-3a	blade	medial	final series	23.54	9.18	2.85	0.71	N/A
Str. 212	P27B/24-3b	blade	medial	final series	18.62	10.6	2.66	0.7	IXT
Str. 212	P27B/24-3c	blade	medial	final series	12.86	10.07	2.24	0.46	CHY
Str. 212	P27B/25-5a	blade	proximal/medial	final series	24.42	15.16	3.3	1.48	IXT
Str. 212	P27B/31-3a	blade	medial	final series	16.01	11.22	2.7	0.6	N/A
Str. 212	P27B/31-3b	blade	medial	final series	21.69	10.4	2.85	0.68	CHY
Str. 212	P27B/5-1a	blade	proximal/medial	final series	21.85	15.65	3.09	1.52	IXT
Str. 212	P27B/5-1b	blade	medial/distal	final series	20.06	9.63	2.23	0.44	N/A
Str. 212	P27B/7-3	blade	medial	final series	15.92	11.85	2.89	0.55	IXT
Str. 212	P27B/8-1	blade	medial	final series	14.62	7.96	2.08	0.36	N/A
Str. 212	P27C/3-1	projectile point	complete		21.94	10.89	3.38	0.75	IXT
Str. 212	P27C/3-2	core	lateral/medial	fragment	21.25	15.94	6.2	1.77	IXT
Str. 213	P26A/13-7a	blade	medial	final series	19.75	8.61	2.03	0.47	N/A
Str. 213	P26A/13-7b	blade	proximal/medial	final series	28.54	8.72	3.03	0.83	N/A
Str. 213	P26A/13-8	core	distal	fragment	19.9	10.96	5.35	1.45	IXT
Str. 213	P26A/6-4	core	lateral/distal	fragment	25.43	17.86	12.74	5.15	IXT
Str. 213	P26A/6-5	blade	proximal/medial	final series	27.38	9.66	2.56	0.91	N/A
Str. 213	P26A/8-28	blade	proximal/medial	final series	29.8	8.95	2.68	0.95	N/A
Str. 213	P26A/8-3	blade	proximal/medial	final series	21.91	14.1	3.83	1.57	OTU
Str. 213	P26B/25-6	projectile point	complete		31.1	13.95	3.22	1.49	IXT
Str. 214	P32A/1-2	debitage			10.38	7.59	2.61	0.2	N/A
Str. 214	P32A/5-1a	debitage			20.07	4.42	2.8	0.26	N/A
Str. 214	P32A/5-1b	blade	medial	final series	11.97	8.65	2.36	0.26	N/A
Str. 214	P32B/1-4	projectile point	complete		20.06	11.7	3.08	0.89	IXT

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 214	P32B/1-7	blade	proximal/medial	final series	15.05	6.69	1.43	0.19	N/A
Str. 214	P32B/2-3	blade	medial	final series	16.12	9.44	2.89	0.58	IXT
Str. 214	P32B/3-2	blade	proximal/medial	final series	36.02	11.34	3	1.35	IXT
Str. 214	P32C/11-3a	projectile point	complete		19.66	10.98	3.64	0.67	N/A
Str. 214	P32C/11-3b	blade	medial	final series	26.15	14.41	3.03	1.07	IXT
Str. 214	P32C/11-3c	blade	proximal/medial	final series	21.55	7.12	2.13	0.43	N/A
Str. 214	P32C/11-3d	blade	medial	final series	15.42	10.57	1.78	0.42	N/A
Str. 214	P32C/11-3e	blade	complete	initial series	25.64	11.22	5.02	1.17	IXT
Str. 214	P32C/11-3f	flake			12.67	10.51	2.41	0.33	N/A
Str. 214	P32C/14-4	blade	medial	final series	23.62	13.2	3.34	1.45	IXT
Str. 214	P32C/21-4	blade	medial	final series	27.16	15.47	3.39	1.84	N/A
Str. 215	P29B/10-2	projectile point	complete		27.01	12.13	3.09	1.24	IXT
Str. 215	P29B/15-1	blade	medial	final series	3.93	14.46	3.18	0.28	N/A
Str. 215	P29B/17-2	blade	medial	final series	31.57	15.14	3.53	1.12	IXT
Str. 215	P29B/21-3	blade	medial	final series	16.15	8.96	2.33	0.45	N/A
Str. 215	P29B/22-2	blade	medial	final series	28.89	11	2.83	1.24	CHY
Str. 215	P29B/23-10	blade	proximal/medial	final series	25.07	11.76	2.8	1.01	CHY
Str. 215	P29B/23-1a	blade	medial	final series	20.19	10.32	2.43	0.58	IXT
Str. 215	P29B/23-1b	blade	proximal/medial	final series	29.94	10.39	2.27	0.95	IXT
Str. 215	P29B/23-1c	blade	medial	final series	19.85	10.94	2.45	0.63	N/A
Str. 215	P29B/23-2	blade	medial/distal	final series	37.81	7.85	2.38	0.8	N/A
Str. 215	P29B/23-3a	blade	proximal/medial	final series	27.51	5.95	1.51	0.29	N/A
Str. 215	P29B/23-3b	blade	medial/distal	final series	16.34	3.82	1.12	0.09	N/A
Str. 215	P29B/25-5b	blade	medial	final series	19.2	14.43	2.7	0.74	IXT
Str. 215	P29B/3-6	blade	medial	final series	26	11.33	3.32	1.41	IXT

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 215	P29B/6-1	blade	medial	final series	13.68	12.68	1.3	0.42	N/A
Str. 216	P33A/15-3	blade	medial	final series	16.74	6.58	2.06	0.28	N/A
Str. 216	P33A/15-3	blade	medial	final series	23.75	7.98	3.26	0.73	N/A
Str. 216	P33A/17-3	blade	medial	final series	19.27	7.06	1.77	0.28	N/A
Str. 216	P33A/36-4	blade	medial	final series	19.66	11.92	2.33	0.66	N/A
Str. 216	P33A/4-3	blade	medial	final series	11.35	10.34	2.5	0.4	IXT
Str. 216	P33A/5-2	blade	proximal/medial	final series	18.1	5.65	1.52	0.18	N/A
Str. 216	P33A/5-5	blade	medial	final series	17.04	12.61	2.71	0.66	IXT
Str. 216	P33B/10-11	blade	proximal/medial	final series	18.22	13.4	3	0.71	IXT
Str. 216	P33B/10-4a	blade	medial	final series	17.28	8.42	2.46	0.48	N/A
Str. 216	P33B/10-4b	blade	medial	final series	18.46	10.8	3.06	0.79	OTU
Str. 216	P33B/10-4c	blade	medial	final series	26.56	7.48	2.05	0.48	N/A
Str. 216	P33B/10-5a	blade	medial	final series	26.24	8.98	2.65	0.83	N/A
Str. 216	P33B/10-5b	plunge blade	distal	final series	22.61	10.8	5.02	1.22	N/A
Str. 216	P33B/10-6	projectile point	distal		21.12	14.59	3.25	0.99	IXT
Str. 216	P33B/11-10	blade	proximal/medial	final series	37.26	11.23	3.84	2.07	CHY
Str. 216	P33B/11-17	blade	distal	final series	23.61	10.78	2.29	0.46	N/A
Str. 216	P33B/12-3	blade	medial	final series	12.78	6.29	1.32	0.16	N/A
Str. 216	P33B/12-4	blade	medial	final series	24.44	13.22	2.3	1.03	OTU
Str. 216	P33B/13-6	blade	medial	final series	13.03	9.29	2.11	0.19	N/A
Str. 216	P33B/13-9a	blade	proximal/medial	final series	14.55	13.22	3.9	0.76	N/A
Str. 216	P33B/13-9b	blade	medial	final series	15.18	10.69	3.17	0.42	N/A
Str. 216	P33B/14-2	blade	medial/distal	final series	13.53	6.59	2.27	0.2	N/A
Str. 216	P33B/14-3	blade	proximal/medial	final series	22.93	11.62	3.03	0.92	IXT
Str. 216	P33B/14-4	blade	medial	final series	14.45	13.91	2.79	0.74	IXT

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 216	P33B/14-5	blade	medial	final series	15.09	6.35	1.8	0.2	N/A
Str. 216	P33B/1-4a	blade	proximal	final series	10.87	6.99	2.26	0.16	N/A
Str. 216	P33B/1-4b	core	lateral/distal	fragment	17.32	7.25	3.66	0.48	N/A
Str. 216	P33B/15-25	flake	lateral	rejuv	11.85	19.8	2.63	0.43	N/A
Str. 216	P33B/15-25	blade	medial	final series	8.94	11.42	1.87	0.28	N/A
Str. 216	P33B/15-25	flake	complete	rejuv	21.54	9.19	3.22	0.65	N/A
Str. 216	P33B/15-25	flake	lateral	rejuv	14.05	16.35	3.76	0.62	N/A
Str. 216	P33B/15-25	debitage		undiagnostic	20.21	9.5	2.61	0.44	IXT
Str. 216	P33B/15-7	blade	proximal/medial	final series	16.56	13.64	3.31	0.58	IXT
Str. 216	P33B/15-9a	core	lateral/medial	fragment	23.25	12.74	4.48	1.43	OTU
Str. 216	P33B/15-9b	blade	medial	final series	13.66	7.2	2.99	0.19	N/A
Str. 216	P33B/16-2	blade	medial/distal	final series	31.7	9.81	2.65	1.03	CHY
Str. 216	P33B/17-10a	blade	proximal/medial	final series	23.37	13.46	2.84	1.01	IXT
Str. 216	P33B/17-14	blade	medial	final series	20.51	14.26	2.95	0.94	CHY
Str. 216	P33B/17-9	debitage		undiagnostic	13.66	7.67	1.71	0.17	N/A
Str. 216	P33B/19-10	blade	proximal/medial	final series	14.83	11.79	3.45	0.57	IXT
Str. 216	P33B/19-11	flake		rejuv	18.33	13.97	2.45	0.56	CHY
Str. 216	P33B/19-11	blade	medial	final series	17	11.33	2.27	0.61	N/A
Str. 216	P33B/19-11	blade	proximal/medial	final series	16.69	5.98	3.22	0.32	N/A
Str. 216	P33B/19-11	blade	medial/distal	final series	17.13	9.79	2.84	0.45	N/A
Str. 216	P33B/19-7a	blade	distal	final series	10.89	8.67	2.21	0.32	N/A
Str. 216	P33B/19-7b	blade	medial	final series	17.53	7.84	2.28	0.34	N/A
Str. 216	P33B/19-8	flake	lateral/distal	error removal	11.76	10.2	3.4	0.22	N/A
Str. 216	P33B/20-7	blade	medial	final series	26.13	7.28	1.87	0.5	N/A
Str. 216	P33B/20-8	blade	medial	final series	18.83	13.69	2.95	0.86	IXT
Str. 216	P33B/23-4a	debitage			17.22	8.56	2.92	0.43	N/A
Str. 216	P33B/23-4b	blade	medial	final series	16.33	8.87	2.7	0.48	CHY
Str. 216	P33B/2-4	blade	medial	final series	17.83	13.73	2.17	0.66	N/A

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 216	P33B/24-3a	blade	medial	final series	28.35	8.43	2.65	0.81	N/A
Str. 216	P33B/24-3b	blade	proximal/medial	final series	27.93	14.83	3.17	1.51	CHY
Str. 216	P33B/2-5	blade	medial	final series	25.27	11.12	1.87	0.82	IXT
Str. 216	P33B/26-8	debitage			21.13	18.27	3.54	1.38	IXT
Str. 216	P33B/2-9	blade	medial/distal	final series	33.27	11.83	2.36	1.22	IXT
Str. 216	P33B/3-10	blade	medial	final series	17.55	11.48	1.75	0.39	N/A
Str. 216	P33B/31-1	blade	proximal/medial	final series	15.87	10.06	2.08	0.38	N/A
Str. 216	P33B/31-5	blade	medial	final series	43.22	12.9	3.99	2.35	IXT
Str. 216	P33B/3-18	blade	medial	final series	16.01	16.27	3.71	0.94	IXT
Str. 216	P33B/32-1	blade	proximal/medial	final series	36.74	10.7	3.03	1.55	IXT
Str. 216	P33B/33-1	blade	medial/distal	final series	27.15	11.57	3.05	1.18	CHY
Str. 216	P33B/35-4	blade	medial	final series	28.11	14.67	3.55	1.74	IXT
Str. 216	P33B/3-8	blade	medial	final series	11.96	9.2	2.96	0.46	N/A
Str. 216	P33B/38-5a	blade	proximal/medial	final series	16.55	7.89	2.52	0.28	N/A
Str. 216	P33B/38-5b	blade	medial	final series	33.17	14.43	2.75	1.93	N/A
Str. 216	P33B/3-9	blade	medial	final series	30.96	14.18	4.56	1.92	IXT
Str. 216	P33B/39-2	blade	medial	final series	29.03	11.72	3.21	1.53	IXT
Str. 216	P33B/41-1	debitage			11.98	5.39	2.03	0.15	N/A
Str. 216	P33B/41-2	projectile point	complete		21.51	12.88	3.22	0.97	IXT
Str. 216	P33B/41-3	blade	medial	final series	21.97	8.63	1.88	0.56	N/A
Str. 216	P33B/44-4	blade	proximal/medial	final series	33.73	10.19	2.69	0.97	IXT
Str. 216	P33B/45-1	debitage			22.22	14.03	2.89	0.71	IXT
Str. 216	P33B/4-6	blade	proximal/medial	final series	21.71	10.32	3.38	0.85	OTU
Str. 216	P33B/47-2	projectile point	complete		21.61	8.55	2.11	0.55	IXT
Str. 216	P33B/47-6b	blade	medial	final series	18.37	11.28	2.38	0.79	IXT
Str. 216	P33B/48-11	debitage			22.17	9.46	2.19	0.65	IXT

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 216	P33B/48-12	blade	medial	final series	16.94	9.37	1.96	0.44	N/A
Str. 216	P33B/48-2	blade	medial	final series	20.1	8.36	2.09	0.54	N/A
Str. 216	P33B/49-2	blade	medial	final series	17.48	8.68	1.32	0.25	N/A
Str. 216	P33B/5-7a	blade	distal	final series	17.35	10.6	2.28	0.54	N/A
Str. 216	P33B/5-7b	blade	medial	final series	22.44	7.21	3.36	0.55	N/A
Str. 216	P33B/5-8a	blade	medial	final series	18	9.59	2.93	0.75	IXT
Str. 216	P33B/5-8b	blade	medial	final series	14.67	12.61	2.74	0.71	N/A
Str. 216	P33B/7-6	blade	medial	final series	24.14	8.85	2.89	0.83	CHY
Str. 216	P33B/8-4	blade	medial	final series	43.41	13.65	3.32	2.18	IXT
Str. 216	P33C/3-2	blade	medial	final series	15.09	9.39	1.68	0.42	N/A
Str. 218	P38A/1-1	blade	medial/distal	final series	19.62	7.93	1.84	0.33	N/A
Str. 218	P38A/12-4	blade	proximal/medial	final series	37.17	13.35	3.13	1.82	OTU
Str. 218	P38A/1-4	blade	medial	final series	15.78	7.45	1.98	0.28	N/A
Str. 218	P38A/16-7	blade	proximal/medial	final series	25	8.86	3.54	0.73	N/A
Str. 218	P38A/17-16(2)	blade	medial	final series	22.26	8.04	2.38	0.5	N/A
Str. 218	P38A/17-16a	blade	medial	final series	17.21	10.18	2.83	0.73	IXT
Str. 218	P38A/17-16b	blade	medial	final series	15.48	9.25	4.18	0.78	N/A
Str. 218	P38A/17-16c	blade	medial	final series	18.21	9.58	2.45	0.5	N/A
Str. 218	P38A/17-16d	blade	medial	final series	18.15	9.17	2.77	0.67	OTU
Str. 218	P38A/17-16f	blade	medial	final series	26.51	12.59	2.77	0.8	IXT
Str. 218	P38A/17-9a	blade	medial	final series	26.76	13.34	3.15	1.42	IXT
Str. 218	P38A/17-9b	blade	medial	final series	19.67	9.91	2.51	0.76	CHY
Str. 218	P38A/20-10a	blade	medial	final series	16.64	10.07	2.95	0.61	IXT
Str. 218	P38A/20-10b	projectile point	complete		15.7	7.78	3.31	0.44	N/A
Str. 218	P38A/20-10c	blade	medial	final series	18.31	11.48	2.73	0.72	IXT

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 218	P38A/20-10d	blade	medial	final series	23.05	12.69	2.73	1.06	IXT
Str. 218	P38A/20-10e	blade	proximal/medial	final series	19.6	9.21	2.97	0.48	N/A
Str. 218	P38A/20-9	blade	proximal/medial	final series	26.33	17.11	4.2	1.81	IXT
Str. 218	P38A/21-5	blade	medial/distal	final series	17.86	9.35	1.69	0.42	N/A
Str. 218	P38A/21-9	blade	proximal	final series	11.93	14.15	3.17	0.56	IXT
Str. 218	P38A/22-5	blade	medial	final series	19.86	13.66	3.81	1.32	IXT
Str. 218	P38A/4-1	blade	proximal/medial	final series	14.39	14.87	4.23	0.88	IXT
Str. 218	P38A/5-2	plunge blade	distal	final series	12.53	6.57	14.7	0.99	IXT
Str. 218	P38A/5-4a	blade	proximal/medial	final series	23.67	17.51	4.18	1.38	IXT
Str. 218	P38A/5-4b	blade	medial	final series	10.52	9.08	1.55	0.24	N/A
Str. 218	P38A/6-1a	blade	proximal/medial	final series	19.06	7.3	1.64	0.3	N/A
Str. 218	P38A/6-1b	blade	medial	final series	16.31	7.84	2.31	0.35	N/A
Str. 218	P38A/8-2	blade	medial	final series	13.62	4.68	2.09	0.18	N/A
Str. 218	P38A/8-4	blade	medial	final series	25.87	22.97	3.28	2.75	IXT
Str. 218	P38B/11-15	blade	medial	final series	23.36	8.9	2.48	0.73	N/A
Str. 218	P38B/11-17	blade	proximal	final series	13	7.72	3.48	0.39	N/A
Str. 218	P38B/11-20a	blade	medial	final series	40.54	10.2	2.76	1.59	IXT
Str. 218	P38B/11-20b	blade	medial	final series	25.19	8.91	2.24	0.74	N/A
Str. 218	P38B/11-7a	blade	proximal/medial	final series	24.69	15.09	3.87	1.44	IXT
Str. 218	P38B/11-7b	blade	medial	final series	20.83	10.54	2.32	0.55	N/A
Str. 218	P38B/11-7c	blade	medial	final series	20.11	10.15	3.65	0.81	IXT
Str. 218	P38B/11-7d	blade	medial	final series	13.57	10.13	2.6	0.53	N/A
Str. 218	P38B/1-3	blade	medial	final series	16.4	11.3	2.85	0.57	N/A
Str. 218	P38B/13-9	blade	medial	final series	15.97	10.7	2.79	0.57	N/A
Str. 218	P38B/14-12	blade	medial	final series	19.21	13.93	3.64	1.23	IXT

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 218	P38B/14-2	blade	proximal/medial	final series	25.57	14.78	3.97	1.64	N/A
Str. 218	P38B/16-1a	blade	medial	final series	11.26	10.12	2.6	0.31	N/A
Str. 218	P38B/17-3	blade	medial	final series	11.83	6.01	3.28	0.31	N/A
Str. 218	P38B/17-4	blade	medial	final series	23.51	11.32	3.14	0.93	IXT
Str. 218	P38B/18-2a	blade	medial	final series	17.47	13.91	2.78	0.94	OTU
Str. 218	P38B/18-2b	blade	medial	final series	20.82	10.08	1.74	0.4	N/A
Str. 218	P38B/18-2c	blade	medial	final series	16.3	11.2	2.32	0.54	N/A
Str. 218	P38B/19-1	blade	medial	final series	18.93	12.27	3.2	1.01	IXT
Str. 218	P38B/20-2	blade	medial	final series	16.85	7.39	1.84	0.24	N/A
Str. 218	P38B/21-1	blade	medial	final series	16.87	8.84	2.57	0.44	N/A
Str. 218	P38B/2-2	blade	proximal/medial	final series	16.83	7.68	2.81	0.44	N/A
Str. 218	P38B/24-1a	blade	medial	final series	20.89	9.53	2.61	0.62	N/A
Str. 218	P38B/24-1b	blade	medial	final series	16.43	9.85	2.28	0.55	CHY
Str. 218	P38B/25-1a	blade	medial	final series	21.42	10.63	3.24	1.01	IXT
Str. 218	P38B/25-1b	blade	medial	final series	11.9	12.32	2.22	0.36	N/A
Str. 218	P38B/25-6	blade	proximal/medial	final series	19.23	15.33	3.9	1.04	IXT
Str. 218	P38B/25-7	blade	medial	final series	21.85	9	2.07	0.53	N/A
Str. 218	P38B/26-9	blade	medial	final series	23.94	9.28	2.7	0.65	IXT
Str. 218	P38B/27-4a	blade	proximal/medial	final series	33.29	12.33	3.69	1.84	OTU
Str. 218	P38B/27-4b	blade	medial	final series	27.33	10.01	3.15	1.13	IXT
Str. 218	P38B/27-5a	blade	medial	final series	27.77	9.07	2.54	0.82	N/A
Str. 218	P38B/27-5b	blade	medial	final series	14	9.26	2.07	0.35	N/A
Str. 218	P38B/27-5d	blade	medial	final series	23.75	6.79	1.88	0.38	N/A
Str. 218	P38B/28-3	blade	medial	final series	31.26	12.57	2.63	1.23	IXT
Str. 218	P38B/29-6	blade	medial	final series	26.33	10.72	2.9	0.82	N/A

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 218	P38B/33-6	blade	medial	final series	23.95	11.82	1.82	0.75	N/A
Str. 218	P38B/40-5	blade	proximal/medial	final series	21.28	11.97	4.07	1.05	CHY
Str. 218	P38B/40-5b	blade	proximal/medial	final series	27.47	7.05	3.07	0.75	N/A
Str. 218	P38B/41-12	blade	medial	final series	23.57	11.04	3.12	1.13	IXT
Str. 218	P38B/41-14	blade	proximal/medial	final series	22.04	8.98	2.33	0.61	N/A
Str. 218	P38B/4-2	blade	medial	final series	22.4	13.92	2.71	1.11	IXT
Str. 218	P38B/42-6	blade	medial	final series	27.29	8.27	2.41	0.61	N/A
Str. 218	P38B/43-13	blade	medial	final series	30.26	13.29	3.21	1.39	IXT
Str. 218	P38B/43-2	blade	medial	final series	23.57	8.63	2.44	0.61	N/A
Str. 218	P38B/44-13a	blade	medial	final series	23.52	14.85	2.97	1.52	OTU
Str. 218	P38B/44-13b	blade	medial	final series	21.47	8.52	2.53	0.56	N/A
Str. 218	P38B/44-13c	blade	medial	final series	11.32	11.52	1.98	0.39	N/A
Str. 218	P38B/44-13e	blade	proximal	final series	11.4	12.16	2.82	0.47	N/A
Str. 218	P38B/45-12	blade	medial	final series	13.65	11.1	1.68	0.32	N/A
Str. 218	P38B/47-6	blade	medial	final series	50.13	16.96	3.84	4.39	IXT
Str. 218	P38B/47-6c	blade	medial	final series	24.15	14.98	2.41	1.27	IXT
Str. 218	P38B/48-14	blade	proximal/medial	final series	22.71	16.39	3.12	1.37	IXT
Str. 218	P38B/49-11	blade	medial	final series	21.38	11.68	1.73	0.61	N/A
Str. 218	P38B/55-6	blade	medial	final series	25.84	7.82	2.23	0.51	N/A
Str. 218	P38B/57-5	blade	medial	final series	21.54	8.05	2.29	0.53	N/A
Str. 218	P38B/7-2	blade	proximal/medial	final series	21.89	10.27	3.77	0.83	N/A
Str. 218	P38B/7-7	blade	medial	final series	12.86	16.88	3.05	0.55	IXT
Str. 218	P38B/8-1a	blade	proximal/medial	final series	37.36	11.7	3.73	1.6	IXT
Str. 218	P38B/8-1b	blade	medial	final series	15.93	10.77	2.13	0.45	N/A
Str. 218	P38B/8-1c	core	proximal/lateral	fragment	19.16	4.59	3.9	0.45	N/A

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 218	P38B/9-1a	blade	medial	final series	31.9	9.36	3.14	1.09	N/A
Str. 218	P38B/9-1b	blade	medial	final series	18.51	7.12	1.66	0.32	N/A
Str. 218	P38B/9-1c	blade	medial	final series	9.59	7.63	1.52	0.1	N/A
Str. 35	P10B/10-2	blade	medial/distal	final series	23.04	11.57	2.26	0.85	IXT
Str. 35	P10B/10-3a	blade	medial	final series	16.06	9.58	2.63	0.54	IXT
Str. 35	P10B/10-3b	blade	medial	final series	16.49	10.1	2.42	0.63	N/A
Str. 35	P10B/10-3c	blade	medial	final series	25.79	11.86	2.98	1.09	CHY
Str. 35	P10B/10-4	blade	medial	final series	20.4	16.59	2.81	1.42	IXT
Str. 35	P10B/4-4	blade	medial	final series	23.69	7.97	2.51	0.61	N/A
Str. 35	P10B/4-5a	blade	medial	final series	23.24	11.2	3.06	0.8	IXT
Str. 35	P10B/4-5b	blade	complete	final series	36.43	9.82	1.99	1.14	N/A
Str. 35	P10B/6-2	blade	medial	final series	27.41	13.57	2.31	1.36	CHY
Str. 35	P10B/8-4	blade	medial	final series	27.86	7.66	2.48	0.62	N/A
Str. 36	P9B/3-1	blade	medial/distal	final series	19.94	7.4	2.84	0.39	N/A
Str. 36	P9B/9-1	blade	medial	final series	36.84	11.53	2.86	1.8	IXT
Str. 37	P22A/15-8	blade	proximal/medial	final series	21.91	10.5	2.47	0.7	N/A
Str. 37	P22A/34-6	blade	medial	final series	17.9	18.31	2.45	0.65	CHY
Str. 37	P22A/37-3	blade	medial	final series	27.49	10.14	3.61	1.31	CHY
Str. 37	P22A/37-7	blade	proximal/medial	final series	15.77	19.49	4.72	1.46	IXT
Str. 37	P22A/40-11	blade	proximal/medial	final series	22.8	9.98	2.43	0.58	N/A
Str. 38	P35B/1-13a	blade	medial	final series	19.03	11.8	2.32	0.8	N/A
Str. 38	P35B/1-13b	blade	medial	final series	21.33	9.11	2.88	0.77	N/A
Str. 38	P35B/1-13c	blade	medial	final series	16.64	8.22	2.27	0.42	N/A
Str. 38	P35B/1-13d	blade	distal	final series	14.43	7.45	3.39	0.38	N/A
Str. 38	P35B/1-18a	blade	proximal/medial	final series	29.57	7.65	2.97	0.73	N/A

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 38	P35B/1-18b	blade	medial	final series	30.42	10.39	2.63	1.11	CHY
Str. 38	P35B/1-18c	blade	proximal/medial	final series	20.42	11.1	3.28	0.76	CHY
Str. 38	P35B/1-4	blade	proximal/medial	final series	39.94	16.03	3.21	2.29	CHY
Str. 39	P20A/29-2	blade	medial	final series	26.82	12.33	3.17	1.34	CHY
Str. 39	P20A/50-5	blade	proximal/medial	final series	29.08	9.57	2.78	0.9	CHY
Str. 58	P3B/10-21a	blade	proximal/medial	final series	25.95	12.95	2.94	1.51	IXT
Str. 58	P3B/10-21b	blade	medial	final series	15.58	10.81	2.52	0.59	IXT
Str. 58	P3B/10-21c	blade	medial	final series	13.83	9.21	3.01	0.52	IXT
Str. 58	P3B/10-3a	blade	proximal/medial	final series	15.31	15.24	4.77	1.04	OTU
Str. 58	P3B/10-3b	blade	medial	final series	14.23	6.95	1.69	0.19	N/A
Str. 58	P3B/11-1	blade	medial	final series	16.66	9.05	3.36	0.56	IXT
Str. 58	P3B/11-2	blade	medial	final series	17.43	11.48	3.3	0.9	CHY
Str. 58	P3B/2-1	blade	medial	final series	17.97	11.88	2.23	0.67	CHY
Str. 58	P3B/24-2	blade	proximal/medial	final series	29.02	11.85	3.69	1.88	IXT
Str. 58	P3B/3-3	blade	complete	final series	43.65	7.45	2.4	1.01	N/A
Str. 58	P3B/37-6	blade	proximal/medial	final series	22.15	9.51	2.41	0.68	N/A
Str. 58	P3B/48-6	blade	medial	final series	12.92	13.57	3.49	0.73	CHY
Str. 58	P3B/49-2	blade	proximal/medial	final series	27.22	12.69	2.72	1.39	CHY
Str. 58	P3B/5-2b	blade	proximal/medial	final series	29.43	10.14	2.48	0.92	IXT
Str. 58	P3B/81-1	blade	proximal/medial	final series	39.21	13.7	3.16	2.15	IXT
Str. 6	P31A/1-26	blade	medial	final series	23.53	15.72	3.22	1.59	IXT
Str. 6	P31A/1-30a	blade	proximal/medial	final series	27.11	11.14	3.22	1.01	N/A
Str. 6	P31A/1-30b	blade	medial	final series	18.15	12.28	2.62	0.79	N/A
Str. 6	P31A/1-35a	blade	medial	final series	20.22	10.52	2.13	0.59	N/A
Str. 6	P31A/1-35b	blade	proximal/medial	final series	18.44	5.95	1.42	0.15	N/A

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 6	P31A/2-5a	blade	proximal/medial	final series	25.78	12.51	4.36	1.55	IXT
Str. 6	P31A/2-5b	blade	medial	final series	21.11	10.58	2.35	0.83	N/A
Str. 6	P31A/2-5c	blade	proximal/medial	final series	20.24	11.1	3.12	0.99	IXT
Str. 6	P31A/2-5d	blade	medial	final series	20.55	9.5	2.51	0.73	N/A
Str. 6	P31A/2-5e	blade	medial	final series	17.74	11.73	2.68	0.72	IXT
Str. 6	P31A/2-5f	blade	medial	final series	16.79	11.32	3.2	0.67	N/A
Str. 6	P31A/2-5g	blade	medial	final series	15.92	11.05	2.94	0.66	N/A
Str. 6	P31A/2-5h	blade	medial	final series	17.49	8.77	2.91	0.56	N/A
Str. 6	P31A/2-5i	blade	medial	final series	9.13	6.74	2.02	0.11	N/A
Str. 6	P31A/3-2	blade	medial	final series	31.24	13.16	2.59	1.3	IXT
Str. 6	P31A/3-8a	blade	medial	final series	13.16	8.61	2.16	0.37	N/A
Str. 6	P31A/3-8b	blade	medial	final series	16.27	9.45	3.09	0.71	IXT
Str. 6	P31A/3-8c	blade	medial	final series	25.15	12.26	2.86	1.06	IXT
Str. 6	P31A/4-12a	blade	proximal/medial	final series	23.84	8.89	2.22	0.56	N/A
Str. 6	P31A/4-12b	blade	medial	final series	13.6	10.23	3.22	0.44	N/A
Str. 6	P31A/4-3a	blade	medial	final series	23.51	13.02	2.68	0.99	CHY
Str. 6	P31A/4-3b	blade	medial	final series	17.9	11.5	2.26	0.65	IXT
Str. 6	P31A/5-2a	blade	medial	final series	20.59	15.08	2.22	1.25	IXT
Str. 6	P31A/5-2b	blade	proximal/medial	final series	29.45	16.38	4.16	1.93	IXT
Str. 6	P31A/6-1	blade	proximal/medial	final series	30.77	10.6	3.21	1.51	N/A
Str. 6	P31A/9-1	blade	medial/distal	final series	34.16	12.83	3.02	1.35	IXT
Str. 6	P31B/2-1a	blade	medial	final series	16.48	12.61	1.91	0.52	N/A
Str. 6	P31B/3-2b	debitage			11.23	7.2	1.23	0.13	N/A
Str. 6	P31B/3-6	blade	medial	final series	16.37	12.22	3.22	0.8	IXT
Str. 6	P31B/4-13	blade	medial	final series	14.29	11.57	2.1	0.51	IXT

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 6	P31B/6-7a	blade	medial	final series	16.64	11.55	2.5	0.59	N/A
Str. 6	P31B/6-7b	blade	medial	final series	15.76	12.48	2.36	0.63	CHY
Str. 6	P31B/7-1	blade	medial/distal	final series	28.41	10.44	2.47	0.72	N/A
Str. 6	P31C/2-10a	blade	complete	final series	73.64	14.36	3.41	3.73	IXT
Str. 6	P31C/2-10b	blade	medial	final series	24.03	16.1	2.98	1.75	IXT
Str. 6	P31C/2-10c	blade	proximal/medial	final series	47.35	14.61	3.61	3.23	N/A
Str. 6	P31C/2-11a	blade	proximal/medial	final series	30.62	18.36	3.85	1.78	IXT
Str. 6	P31C/2-11b	blade	medial	final series	46.59	14.89	3.2	2.49	N/A
Str. 6	P31C/3-6a	blade	proximal/medial	final series	37.79	10.17	2.23	1.28	N/A
Str. 6	P31C/3-6b	debitage			18.4	13.49	6.52	1.34	N/A
Str. 6	P31C/3-7	core	proximal	fragment	37.02	13.37	23.66	9.95	IXT
Str. 6	P31D/3-7a	blade	proximal/medial	final series	37.24	10.3	4.01	1.49	N/A
Str. 6	P31D/3-7b	blade	medial	final series	18.02	15.95	3.7	1.36	IXT
Str. 6	P31D/3-7c	blade	medial	final series	11.68	8.99	3.24	0.44	N/A
Str. 6	P31D/3-7d	blade	medial/distal	final series	37.4	9.55	3.83	1.38	CHY
Str. 69	P4B/2-6	blade	proximal/medial	final series	16.58	16.63	2.87	1.04	IXT
Str. 69	P4B/2-7	blade	medial	final series	27	9.49	3.04	1	CHY
Str. 69	P4B/2-8	blade	medial	final series	22.58	10.7	3.23	0.97	CHY
Str. 70	P5B/17-1	blade	proximal/medial	final series	20.27	5.57	1.87	0.25	N/A
Str. 70	P5B/6-3	blade	proximal/medial	final series	18.73	8.94	2.82	0.61	CHY
Str. 70	P5B/7-1	blade	medial	final series	16.88	10.51	1.93	0.52	N/A
Str. 73	P6A/1-1	blade	medial	final series	21.55	13.26	2.95	1.24	IXT
Str. 73	P6A/1-1a	blade	medial	final series	10.8	13.99	3.64	0.74	IXT
Str. 73	P6E/10-1	blade	proximal/medial	final series	20.58	20.71	3.87	1.46	IXT
Str. 73	P6E/10-2	blade	medial	final series	11.9	11.47	2.39	0.48	IXT
Str. 73	P6E/42-1a	blade	medial	final series	17.4	8.99	2.82	0.65	IXT

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 73	P6E/42-1b	blade	medial/distal	final series	25.17	12.02	2.79	0.85	CHY
Str. 73	P6E/42-1c	blade	medial	final series	21.82	12.47	4	1.29	IXT
Str. 73	P6E/42-1d	blade	proximal/medial	crested blade	17.46	11.01	3.29	0.69	IXT
Str. 73	P6E/42-1e	blade	proximal/medial	final series	35.99	11.08	2.29	1.31	IXT
Str. 73	P6E/42-1f	blade	proximal/medial	final series	35.12	10.92	2.53	1.21	N/A
Str. 73	P6E/42-1g	blade	medial	final series	10.88	7.17	1.41	0.14	N/A
Str. 73	P6E/42-1h	blade	proximal	final series	11.75	7.75	2.03	0.21	N/A
Str. 73	P6E/57-1	blade	medial	final series	20.5	6.96	3.02	0.52	N/A
Str. 74	P6C/1-40	blade	medial	final series	13.66	11.45	3.37	0.74	SMJ
Str. 74	P6C/1-8	blade	medial	final series	11.02	6.95	2.4	0.24	N/A
Str. 74	P6C/1-9?(1)	projectile point	distal		17.95	9.9	3.39	0.63	IXT
Str. 74	P6C/1-9?(2)	core	lateral	fragment	15.87	17.07	6	1.64	IXT
Str. 74	P6C/1-9?(3)	blade	proximal/medial	final series	19.46	15.12	3.68	1.18	IXT
Str. 74	P6C/1-9?(4)	blade	medial	final series	23.83	10.4	2.89	0.99	CHY
Str. 74	P6C/1-9?(5)	blade	proximal/medial	final series	18.94	13.41	4.19	0.83	IXT
Str. 74	P6C/1-9?(6)	blade	proximal/medial	final series	25.68	13.94	2.18	0.85	CHY
Str. 74	P6C/1-9a	blade	medial	final series	26.89	26.88	11.54	2.77	IXT
Str. 74	P6C/1-9b	blade	medial	final series	15.41	5.26	1.49	0.17	N/A
Str. 74	P6C/1-9d	blade	complete	final series	26.71	4.94	1.22	0.18	N/A
Str. 74	P6C/1-9e	debitage	flake		17.83	11.68	1.94	0.4	N/A
Str. 74	P6C/1-9i	blade	medial	final series	26.78	6.43	2.18	0.42	N/A
Str. 74	P6C/2-1	blade	proximal/medial	final series	19.79	7.77	2	0.47	N/A
Str. 74	P6C/2-2	blade	proximal	final series	11.05	11.04	4.56	0.61	IXT
Str. 74	P6C/2-8	debitage			15.29	12.48	2.2	0.47	IXT
Str. 74	P6C/3-1	blade	medial	final series	13.12	10.53	1.98	0.4	N/A
Str. 74	P6C/4-1a	blade	proximal/medial	final series	31.06	6.77	4.25	1.04	N/A

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 74	P6C/4-1b	blade	medial	final series	15.72	10.99	1.91	0.45	OTU
Str. 74	P6D/1-11	blade	medial	final series	18.12	8.64	1.77	0.37	N/A
Str. 74	P6D/4-1	blade	medial	final series	15.84	10.18	2.3	0.54	CHY
Str. 77	P6F/15-2	blade	medial	final series	15.1	8.32	1.95	0.38	N/A
Str. 77	P6F/2-1	blade	proximal/medial	final series	23.74	12.39	1.93	0.87	CHY
Str. 77	P6F/26-2	blade	medial	final series	19.5	9.04	2.22	0.41	N/A
Str. 77	P6F/36-2	blade	medial	final series	26.47	12.03	2.2	1.18	SMJ
Str. 77	P6F/39-2	blade	complete	initial series	29.9	8.15	1.8	0.57	N/A
Str. 77	P6F/39-3	blade	medial	final series	26.25	6.82	2.25	0.57	N/A
Str. 77	P6F/41-2	blade	proximal/medial	final series	17.39	9.51	3.15	0.72	IXT
Str. 77	P6F/41-3	blade	medial	final series	22.43	10.14	2.87	0.9	CHY
Str. 77	P6F/44-3	blade	medial	final series	28.78	7.93	2.19	0.7	N/A
Str. 77	P6F/44-4	blade	proximal/medial	final series	21.22	9.5	2.53	0.78	N/A
Str. 77	P6F/44-5	blade	medial	final series	29.84	10.07	2.61	1.32	CHY
Str. 77	P6F/48-1	blade	proximal/medial	final series	15.02	4.52	1.13	0.1	N/A
Str. 77	P6F/48-2	blade	complete	final series	26.1	10.12	2.68	0.9	IXT
Str. 77	P6F/58-1	blade	medial	final series	14.73	15.66	4.13	0.89	IXT
Str. 77	P6F/6-1	blade	proximal/medial	final series	33.43	20.46	5.69	4.56	IXT
Str. 79	P6A/8-4	blade	medial	final series	13.03	7.38	1.98	0.25	N/A
Str. 79	P6H/10-1	blade	proximal/medial	final series	26.2	9.3	2.67	0.81	CHY
Str. 79	P6H/12-5	blade	medial	final series	19.57	11.18	3.33	0.89	CHY
Str. 79	P6H/1-7	blade	medial	final series	26.97	16.02	3.23	1.78	IXT
Str. 79	P6H/2-1	blade	proximal/medial	final series	22.49	13.97	4.09	1.55	IXT
Str. 79	P6H/6-1	blade	medial	final series	22.57	12.96	2.92	0.97	IXT
Str. 79	P6H/8-1	blade	proximal/medial	final series	16.67	5.86	2.01	0.25	N/A

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 80	P6A/11-1	core	lateral/medial	fragment	19.43	30.43	25.52	8.13	IXT
Str. 80	P6A/11-2	blade	medial	final series	13.96	11.24	2.71	0.62	CHY
Str. 80	P6G/1-15	blade	proximal/medial	final series	28.58	7.41	2.79	0.68	N/A
Str. 80	P6G/1-16	blade	medial	final series	14.25	14.05	4.74	1.05	IXT
Str. 80	P6G/1-21	blade	medial	final series	13.71	10.68	2.53	0.52	IXT
Str. 80	P6G/1-8a	projectile point	complete		16.11	7.99	3.02	0.44	N/A
Str. 80	P6G/1-8b	blade	medial/distal	final series	19.79	6.16	2.17	0.28	N/A
Str. 80	P6G/1-9a	blade	proximal/medial	final series	26.89	14.15	3.03	1.61	IXT
Str. 80	P6G/1-9b	blade	medial	final series	16.9	13.79	3.13	0.92	CHY
Str. 80	P6G/2-12	blade	medial	final series	25.8	9.49	0.97	0.35	N/A
Str. 80	P6G/2-13	blade	medial	final series	20.75	10.31	1.78	0.48	N/A
Str. 80	P6G/2-1a	blade	medial	final series	35.07	8.86	2.92	1.29	CHY
Str. 80	P6G/2-1b	blade	medial	final series	31	10.89	2.24	1.03	N/A
Str. 80	P6G/2-1c	blade	medial	final series	27.78	7.26	2.14	0.55	N/A
Str. 80	P6G/3-1	blade	medial	final series	27.86	9.61	3	0.83	OTU
Str. 80	P6G/3-7	blade	medial	final series	20.71	5.9	3.09	0.53	N/A
Str. 81	P8A/3-6a	blade	medial	final series	21.84	11.21	2.72	0.8	IXT
Str. 81	P8A/3-6b	blade	proximal/medial	final series	52.89	12.25	3.15	2.73	IXT
Str. 81	P8A/3-6c	projectile point	complete		20.95	9.68	3.01	0.58	N/A
Str. 81	P8B/1-1a	blade	medial	final series	17.99	9.44	2.27	0.56	CHY
Str. 81	P8B/17-8	debitage		undiagno stic	6.62	5.31	2.14	0.1	N/A
Str. 81	P8B/22-1	blade	medial	final series	12.27	9.33	2.9	0.42	IXT
Str. 81	P8B/3-2a	blade	medial	final series	30.03	15.22	3.34	1.82	IXT
Str. 81	P8B/3-2b	blade	medial	final series	26.26	12.49	3.7	1.47	IXT
Str. 81	P8B/5-2	blade	medial	final series	8.71	3.11	1.11	0.03	N/A

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 81	P8B/6-1a	blade	medial	final series	16.9	13.59	2.95	0.93	IXT
Str. 81	P8C/13-1a	blade	proximal/medial	final series	14.96	10.03	2.5	0.45	N/A
Str. 81	P8C/13-1b	blade	proximal/medial	final series	40.64	10.75	2.43	1.41	IXT
Str. 81	P8C/13-5	flake		lateral rejuv.	30.39	12.61	3.72	1.37	IXT
Str. 81	P8C/14-10a	blade	proximal/medial	final series	33.67	7.99	2.87	0.88	N/A
Str. 81	P8C/14-10b	blade	medial	final series	15.06	11.13	2.25	0.53	IXT
Str. 81	P8C/14-10c	blade	medial	final series	9.96	13.17	2.21	0.34	N/A
Str. 81	P8C/14-10d	blade	medial	final series	10.72	10.53	2.43	0.29	N/A
Str. 81	P8C/14-3	blade	proximal/medial	final series	27.32	6.93	1.72	0.42	N/A
Str. 81	P8C/14-7	blade	medial	final series	18.68	14.78	2.3	0.8	IXT
Str. 81	P8C/1-8	blade	proximal/medial	final series	34.41	12.35	2.12	1.49	CHY
Str. 81	P8C/18-2	blade	medial	final series	20.61	13.26	3.29	0.87	IXT
Str. 81	P8C/20-4	blade	medial	final series	10.73	10.9	2.63	0.35	N/A
Str. 81	P8C/23-5a	blade	medial	final series	13.64	7.79	2.66	0.29	N/A
Str. 81	P8C/23-5b	blade	proximal/medial	final series	29.78	10.01	2.49	1.06	CHY
Str. 81	P8C/24-2	core	complete	exhauste d	34.55	15.76	12.67	9.37	?
Str. 81	P8C/27-3	blade	proximal/medial	final series	42.64	13.56	3.03	2.68	IXT
Str. 81	P8C/29-6	blade	proximal/medial	final series	35.66	12.61	2.32	1.31	IXT
Str. 81	P8C/29-7	blade	medial	final series	19.2	15.06	2.02	0.74	N/A
Str. 81	P8C/30-2	debitage			11.2	12.39	3.26	0.32	N/A
Str. 81	P8C/34-1	blade	medial	final series	18.14	8.65	2.59	0.49	N/A
Str. 81	P8C/35-1	blade	medial/distal	final series	25.75	9.83	3.37	0.99	N/A
Str. 81	P8C/35-2	blade	medial	final series	7.3	7.07	1.01	0.07	N/A
Str. 81	P8C/4-1	blade	proximal/medial	final series	28.58	14.08	3.41	1.81	IXT
Str. 81	P8C/42-1	blade	proximal/medial	final series	31.58	11.07	2.36	1.07	CHY

Str. No	Field No	Object Type	Part	Descp.	L (mm)	W (mm)	Th (mm)	Wt (g)	Chem Source
Str. 81	P8C/4-4	blade	distal	final series	13.87	10.62	3.65	0.62	N/A
Str. 81	P8C/44-5	projectile point	proximal/medial		18.56	13.95	2.42	0.85	IXT
Str. 81	P8C/45-1	core	medial/lateral	fragment	18.98	11.8	3.88	0.82	IXT
Str. 81	P8C/45-3	blade	proximal/medial	final series	27.42	11	2.48	0.8	IXT
Str. 81	P8C/45-4	blade	proximal/medial	final series	24.43	6.95	3.05	0.64	N/A
Str. 81	P8C/46-1	blade	proximal/medial	final series	13.92	12.69	2.87	0.67	CHY
Str. 81	P8C/46-2	core debitage		undiagno stic	14.7	6.79	7.28	0.5	N/A
Str. 81	P8C/46-3	blade	proximal/medial	final series	43.79	12.43	2.07	1.55	PAC
Str. 81	P8C/46-4	blade	proximal/medial	final series	16.12	10.3	2.68	0.5	N/A
Str. 81	P8C/46-5	blade	proximal	final series	11.07	6.05	1.73	0.11	N/A
Str. 81	P8C/48-5a	blade	proximal	final series	11.97	11.83	3.73	0.57	OTU
Str. 81	P8C/48-5b	blade	medial	final series	12.56	9.29	2.47	0.36	N/A
Str. 81	P8C/54-1	blade	medial	final series	10.96	11.88	2.52	0.97	N/A
Str. 81	P8C/57-1	blade	medial	final series	23.08	13.3	3.17	1.14	IXT
Str. 81	P8C/58-2	projectile point	complete		25.03	13.42	2.91	0.91	IXT
Str. 81	P8C/62-2	blade	medial	final series	23.34	13.96	2.65	1.11	IXT
Str. 81	P8C/64-3	debitage			11	7.28	2.68	0.25	N/A
Str. 81	P8C/64-5	blade	proximal	final series	10.68	10.93	2.34	0.38	N/A
Str. 81	P8C/69-1	blade	medial	final series	16.38	6.51	1.41	0.2	N/A
Str. 81	P8C/69-2	blade	proximal/medial	final series	12.91	4.95	1.46	0.14	N/A
Str. 81	P8C/73-1	blade	medial	final series	25.68	17.1	2.81	1.62	IXT
Str. 81	P8C/84-4	blade	medial	final series	19.23	8.12	2.69	0.54	N/A

APPENDICES B:
IMAGE PERMISIONS

Re: Image Permission

Arlen Chase <Arlen.Chase@ucf.edu>

Thu 9/3/2015 2:53 PM

To:mseidita <mseidita@knights.ucf.edu>;

Cc:Diane Chase <Diane.Chase@ucf.edu>;

You have permission to use the image. Pleas make appropriate citation in the caption.

On Sep 3, 2015, at 2:29 PM, "mseidita" <mseidita@knights.ucf.edu> wrote:

Drs. Chase,

In chapter 5 of my thesis I reproduce a portion of figure 43 from the 1988 Santa Rita Corozal monograph. I have cropped the image to show Platform 2 its associated structures and neighboring structures. If you grant permission to reproduce this image please respond to this email giving permission for the images use so that I may include it in Appendices B.

Thank you,

Max Seidita, BA

Master's Candidate
Graduate Research Assistant
Department of Anthropology
University of Central Florida
Email: mseidita@knights.ucf.edu

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