

OBISIDIAN SOURCE FREQUENCIES AS A SOCIAL ATTRIBUTE AT SAN FELIPE AZTATAN, MEXICO

A Thesis presented to the Faculty of the Graduate School
University of Missouri

In partial Fulfillment
Of the Requirements for the Degree

Master of Arts

By
DANIEL E. PIERCE

Dr. Todd VanPool, Thesis Supervisor

DECEMBER 2012

The undersigned, appointed by the Dean of the Graduate School, have examined the thesis entitled

OBISIDIAN SOURCE FREQUENCIES AS A SOCIAL ATTRIBUTE AT SAN FELIPE
AZTATAN, MEXICO

Presented by Daniel E. Pierce

A candidate for the degree of Master of Arts

And hereby certify that in their opinion it is worthy of acceptance.

Dr. Todd VanPool

Dr. Jeffrey Ferguson

Dr. Christine VanPool

ACKNOWLEDGEMENTS

I would like to thank my committee for assisting me in my research. Dr. Ferguson, for helping me through my XRF analysis and subsequent interpretation, Dr. Chris VanPool for her invaluable insight into theoretical application, and especially Dr. Todd VanPool for helping me with all aspects of this project, and continually providing suggestions as to how to make this research stronger. I believe I have chosen the perfect committee for this project and the insight of all committee members have ultimately led to the completion of this research. I would also like to thank Dr. Michael Glascock for offering direction and advice for geochemically sourcing studies; Dr. Michael Ohnersorgen for introducing me to this exciting research area and providing me initial direction in this project as well as logistical support; and the department of Anthropology at UM-Columbia and the W. Raymond Wood Opportunities for Excellence in Archaeology Fund for providing me with partial funding for travel to Mexico to conduct my analysis.

Finally two individuals have been invaluable for the completion of this project. I would like to give special thanks to my good friend and colleague, Mauricio Garduno Ambriz of the Instituto Nacional de Antropologia y Historia in Tepic, Nayarit for providing artifacts, data, assistance, conversations, and inviting me into his home and family. Last but not least, I would like to thank my research assistant and wonderful

wife, Megan Pierce. Without her assistance in data collection this project would have never seen the light of day. Her constant support has given me the motivation required to finally complete this process.

To all of these people, and the countless others who have helped me in this project, I thank you.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	ii
LIST OF FIGURES	vi
LIST OF TABLES.....	vii
ABSTRACT	viii
Chapter	
1 INTRODUCTION	1
2 BACKGROUND	6
Development of Aztatlan Tradition	
San Felipe Aztatan	
Previous Obsidian Provenience Research	
3 METHODS AND ANALYTICAL BACKGROUND	24
Excavation Methods and Background	
Establishment of Chronologies	
Analytical Method	
4 RESULTS	38
Correspondence between Color Group and Geochemical Source	
Changes in Obsidian Source Selection through Time	
Changes in Artifact Morphology through Time and by Source	
Correlation of Source and Excavation Area	

5	DISCUSSION AND CONCLUDING REMARKS	66
6	REFERENCES	76

LIST OF FIGURES

Figure		Page
1	Map of Coastal Aztatlan Settlements (courtesy of M. Garduno)	7
2	San Felipe Aztatan Contour Map (Garduno and Gamez 2005)	26
3	Map of Sources (Glascock et al. 2010).....	41
4	Source Frequency Change over Time	46
5	Calle Morelos Source Distribution over Time	49
6	Calle Hidalgo Source Distribution over Time	49
7	Source Frequency per Excavation Area	64

LIST OF TABLES

Table	Page
1. Obsidian sources identified at San Felipe Aztatan (Glascock et al. 2010).....	41
2. Geochemical source correlated with color groups	42
3. XRF results compared to color groups	43
4. Chi-square analysis. Source/level relationship	46
5. Chi-square analysis. Collapsed source/ level relationship	48
6. Frequency of artifact types by source	52
7. Chi-square analysis. Source/ artifact type	53
8. Chi-square analysis. Source and cortex amount	56
9. Chi-square analysis. Cortical flakes per level	57
10. Chi-square analysis. Collapsed level and cortex association	59
11. Summary statistics for weight per source group	61
12. ANOVA test. Mean weight per source groups	61
13. Summary of two-tailed t-test for mean weight difference	61
14. Chi-square analysis. Correlation between source frequency and excavation area.....	61

OBISIDIAN SOURCE FREQUENCIES AS A SOCIAL ATTRIBUTE AT SAN FELIPE AZTATAN, MEXICO

Daniel Pierce

Dr. Todd VanPool, Thesis Supervisor

ABSTRACT

This research uses a combination of color sorting and XRF geochemical sourcing to identify patterns in volcanic sources of obsidian artifacts at post-classic San Felipe Aztatan in Nayarit, Mexico. Despite nearby sources being easily accessible, more sophisticated lithic reduction techniques seem to have been used only for more distant sources. With no substantial qualitative differences between obsidian sources, purely social factors likely resulted in the temporal and spatial distributions patterns at San Felipe Aztatan. I argue that the restricted access to distant sources, such as Pachuca, created elevated value of obsidian blades and thus created, maintained and legitimated elite identities. At San Felipe Aztatan, the limited area in which Pachuca obsidian is found may indicate an area of elite residence or elite activity, while its limited temporal distribution may reflect the peak of trade and influence of the Aztatlan tradition before the expanding Tarascan Empire.

This research may have greater application for other sites within the Aztatlan tradition. If obsidian source can be utilized to identify social stratification, we may be able to understand the spatial and social organization of specific sites as well as the complex dynamic trading relationships between sites.

Chapter 1

Introduction

The following research focuses on obsidian exchange in the Aztatlan trading system as reflected at San Felipe Aztatan, a site in northern Nayarit, Mexico. The Aztatlan complex was a trade-oriented tradition centered in Western Mexico. Once thought to be a product of Mixteca-Puebla colonization (Evans 2004), researchers are beginning to acknowledge that the underlying trading and cultural relationships far predate such influence (Garduno and Gamez 2005; Ohnersorgen et al. 2012; Sauer and Brand 1932). The trading network grew through time, to eventually stretch from West Mexico to the Northern Arid Zone into the American Southwest (Kelley 2000).

Aztatlan traders traded shell, copper, and cloth far from their western Mexican homeland. Obsidian, the focus of this research, was also central to the Aztatlan tradition as reflected by its far reaching trade. Scholars have noted the expansive trade networks but the complexities and specific trade routes and partners of this system with West Mexico remain enigmatic. This research provides data regarding this trade and illustrates how it may have changed over time as various sites gained and lost economic prominence as access to specific obsidian sources was controlled.

Obsidian has been found at nearly every Mesoamerican archaeological site. Obsidian debitage is found in tombs across Mesoamerica in addition to temple

dedications, and offerings. It has been used for utilitarian, ritual, and ideological purposes. Obsidian has many properties to facilitate the creation of a variety of tool forms, including knives, lance and projectile points, prismatic blades, general bifacial tools, and utilized flakes. In addition to being used for a great number of daily activities including agriculture, hunting, food preparation, it was also used in a variety of non-utilitarian contexts including body decoration such as ear spools and labrets, miniature human effigies, carved animal figurines, beads, and as pieces of masks. Ceremonially, obsidian was also important for ritual such as human and animal sacrifice. Its ideological association with that act of bloodletting is especially important. Obsidian was seen as a type of blood originating from the earth in and of itself (Evans 2004).

The significance of the obsidian trade in Mesoamerica mustn't be underestimated. For example, the control of Pachuca obsidian and trade thereof likely played a key role in the rise to power of the great Mesoamerican city of Teotihuacan (Evans 2004). Obsidian may have also been used as a secondarily traded item to augment the already growing wealth of Teotihuacan. The great profit from the exportation of the coveted Pachuca obsidian lay in prestigious elite items received in return from around Mesoamerica.

In this project, I macroscopically examined over 1,500 obsidian artifacts to identify obsidian color groups based on color and texture. I then correlated these sources to type and reduction stage, and identified changes in source use over time. Each color group was treated as an independent assemblage and then compared with other color groups to identify changing frequencies, as well as differences in reduction techniques. I

also geochemically sourced 13% of the total artifact assemblage to establish correlations between color groups created through color sorting and specific geochemical sources. The results indicate that the growth of the Aztatlan system resulted in differential access to obsidian sources made possible by the shifting social relationships institutionalized by ideological constructs. Obsidian preference shifted from a local source available to all households prior to the Aztatlan system, to focus more heavily on traded, exotic obsidian from more distant sources with the growth of the Aztatlan trading relationships. These sources produce visually similar obsidian and variation is only discernible under specific lighting conditions. For this reason, it is presently unclear why one source was preferred over another. One possible reason is the arbitrary status associated with specific sources irrespective of utility value. Though certainly not the only possible explanation, this hypothesis is the focus in this paper.

Finally, I consider spatial differences in frequencies of lithic sources within San Felipe Aztatan. Four separate areas have been excavated. These units likely reflect household refuse (albeit some in the form of moundfill). However, the relative frequencies of each lithic source vary from location to location, which I argue, reflects social factors such as differential economic status of the household as opposed to random differences in source selection.

My analysis finds that the rise of the Aztatlan system is associated with a preference for traded obsidian that is not substantially better than the local obsidian in terms of workability. The continued exchange of obsidian indicates that its trade was not based on utilitarian desire for good obsidian, but instead reflects social factors beyond the

need to acquire obsidian tools. As a result, social status and relationships are likely reflected in the patterns of obsidian consumption and discard. Although, it is unclear if the obsidian trade in and of itself is the driving force behind the Aztatlan trade system, my research offers a possible explanation for at least the trade of obsidian at San Felipe Aztatan and has implications for other Aztatlan regional centers.

A Neo-Marxist interpretation offers great insight into the source distribution within San Felipe Aztatan. This theoretical perspective differs greatly from traditional Marxist models in multiple ways. Most importantly, rather than focusing on the modes of production and the control thereof, Neo-Marxism identifies ideology as the prime catalyst for social formations. In this research, I suggest that the selection of obsidian sources reflects status differences and access to Aztatlan trade relations. This was likely encoded in Aztatlan ideology. Given that various sources have little qualitative difference, value based differences are nothing more than ideological constructs. I argue that elites used access to distant source as a way to separate themselves from common people. As has been argued by Matthews et al. (2002) in their discussion of the creation of the Georgian elite, this control over exclusive resources led to and legitimated control over those with little to no access to distant sources by those who did. However, the arbitrary value placed on specific sources was created by the elites themselves and self-perpetuated the dialectic conflict between the haves and have-nots. In this way, the arbitrary ideological value placed on obsidian source became more valuable than the functionality of the obsidian itself.

In Chapter 2, I will offer detailed background information into the area of coastal West Mexico and briefly describe a cultural history of the region. Though the visual sourcing method of color sorting is controversial, previous research has recognized its utility. Of most relevance, Ohnersorgen et al. (2012) have utilized this method of visual sourcing at another Western Mexico Aztatlan center; Chacalilla. By discussing the successes of this research, I hope to justify the use of visual sourcing as an analytical tool. Chapter 3 will detail the specific methods utilized during initial INAH excavations as well as my current lithic analysis. Chapter 4 features the results of statistical tests that will demonstrate the statistical associations between various attributes of each lithic artifact. As well, I will provide results of my XRF analysis to test the accuracy of the color sorting method. In the final chapter, I discuss the implications of the associations identified in Chapter 4. Particularly, I will address these associations from a Neo-Marxist perspective to explain how a seemingly meaningless attribute (obsidian source) can be used to organize and stabilize a society through the common perpetuation of ideology.

Chapter 2

Background

The obsidian artifacts come from the San Felipe Aztatan site, an Aztatlan regional center and potential production center for obsidian blades (Garduno and Gamez 2005). It is on the northern Nayarit coastal plain, which is part of a larger physiographic province extending from San Blas on the central Nayarit coast northward approximately 200 km to Mazatlan in southern Sinaloa (Garduno 2007:37; Scott and Foster 2000). This coastal plain is between 5 km to 35 km wide and is bordered in the east by the Sierra Madre Occidental and in the west by Mexico's coastal estuary known as Las Marismas Nacionales, which extends up the Pacific coastline. The area is ecologically lush with a wealth of terrestrial and marine resources coming from different micro-environments, including large rivers, low volcanic hills, and fertile alluvial sediments (Scott and Foster 2000). Historically, these rivers were an important corridor of transportation, trade, and communication that connected the coastal plains to the highlands of western Jalisco. These rivers drain into Las Marismas Nacionales of western Nayarit, where they form large wetlands and waterways. This area has a rich refugia containing a plentiful assortment of various floral and faunal resources corresponding with the numerous microenvironments.

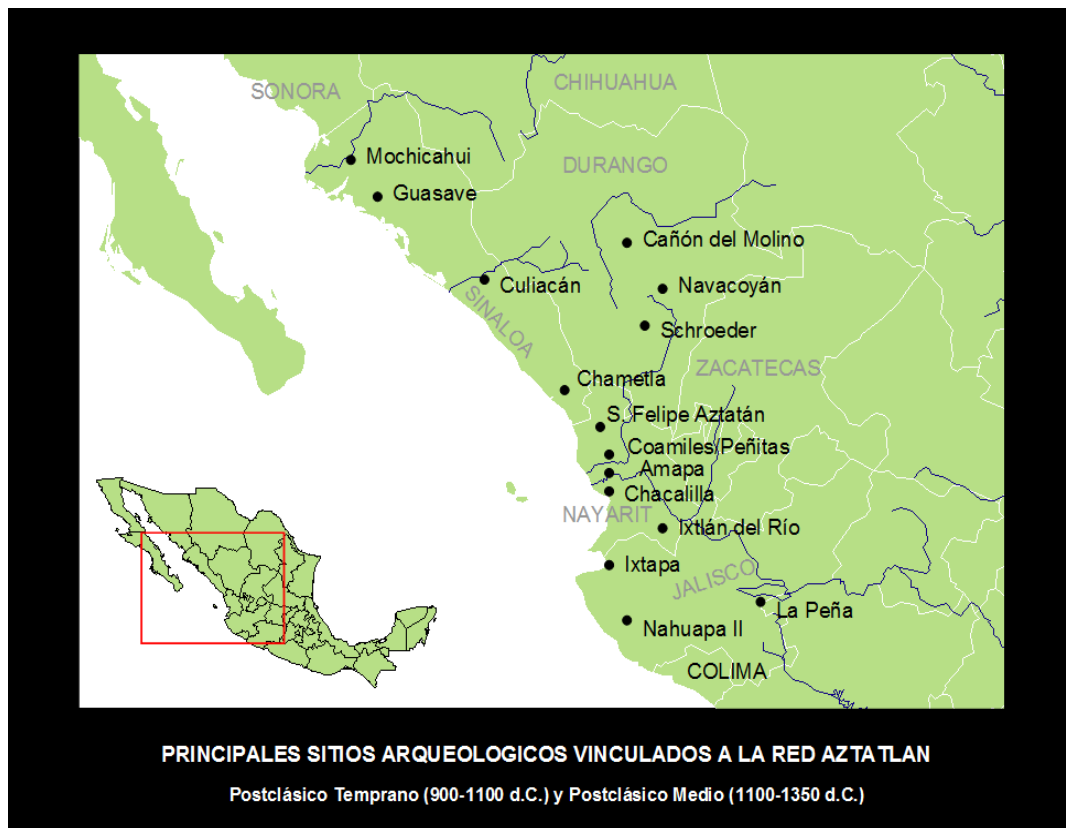


Fig. 1 Map of coastal Aztatlán settlements (map courtesy of M. Garduno)

Despite the gradual decline of the Aztatlán trading tradition at the end of the Middle Postclassic period (approximately AD 1350), the area continued to sustain large populations until Spanish contact. This is a testament to the rich ecological resources and fertility of the plain itself, as well as the strength of the trade system, which enabled access to distant resources. Spaniards noted dense populations along the coast (Sauer 1934) with at least three major political provinces (Centispac, Aztatlán, and Chametla) (Anguiano 1992; Meighan 1971, 1976).

The Development of the Aztatlan Tradition

The western coasts of Nayarit and Jalisco were occupied continuously from as early as the Late Archaic period (ca. 2500-1200 BC) (Mountjoy 2000; Scott and Foster 2000). By the Early and Middle Formative periods (ca. 1200-300 BC), small hamlets appeared along the river systems as people capitalized on the rich resources and environmental conditions there (e.g. increasing reliance on agriculture) (Beekman 2010; Beltran 2000). Ceramic decorative elements also reflected potential influence from better known Early Formative groups at Capacha, Colima even further south (Kelly 1980).

During the Middle Formative period into the Early Classic (800 BC-ca. AD 400), sociocultural complexity increased, perhaps reflecting the influence of the broader Shaft Tomb Tradition that spread over much of western Mexico. The Shaft Tomb tradition was characterized by elaborate burials with rich grave goods (Covarrubias 1957). Many details of the tradition are still unclear, in part because the shaft tombs themselves are often the focus of looting, but most authors suggest that political complexity increases during this time (Ohnersorgen et al. 2012). The Shaft Tomb tradition was widespread, but other cultural traditions such as the Tuxcacaueso were also present throughout the region, suggesting the different regional traditions developed and perhaps even vied with one another for prominence (Beekman 2010; Mountjoy 2000). The few sites that have been systematically surveyed and excavated indicate differences in size and architecture, which suggests the initial emergence of regional settlement hierarchies (Gamez and Garduno 2001; Garduno et al. 2000; Mountjoy 1970, 2000). As part of this increased

cultural elaboration, we see an increased diversification of sites, indicating more craft specialization as certain sites emerge as independent production centers (e.g. site specific ceramic decoration, and obsidian source utilization).

The Classic period (AD 400-700/800) is poorly understood, but shows little evidence of settlement hierarchies or expansive regional integration, in large part because of the decline of the Shaft Tomb Tradition (Ohnersorgen et al. 2012). The development of the intense centralization of the Teuchitlan tradition in western highland Jalisco may have later stunted the growth of regional centers in the coastal plain in the late Post-classic.

However, during the Early and Middle Post-Classic periods (ca. AD 900-1350), the Pacific coasts of southern Sinaloa, Nayarit, and northern coast of Jalisco emerged as the core of the far-reaching Aztatlan tradition (Evans 2004). The Aztatlan tradition is characterized by diagnostic artifacts, architecture, and symbolism that extended across much of western and north-western Mexico (Ekholm 1942; Foster 2001; Glassow 1967; Mountjoy 2000, 2001) and even into the southwestern United States (VanPool et al. 2008). Common cultural features associated with the Aztatlan include flat Mazapan style figurines, elbow pipes, incised spindle whorls, cylindrical stamps, obsidian prismatic blades, shell jewelry, copper items, and urn burials (Mountjoy 2001; Scott and Foster 2000). Distinctive pottery reflects stylistic tendencies that clearly parallel the Postclassic International Style (also called the Mixteca-Puebla style) (Nicholson and Quinones-Keber 1994; Smith and Heath-Smith 1980).

Several important regional centers arose during the Early and Middle post-classic periods. These settlements, including Amapa (Meighan 1976), Chacalilla (Ohnersorgen 2004, 2007), Coamiles (Duverger 1998; Garduno 2006), and San Felipe Aztatan (Gamez and Garduno 2003; Garduno 2007; Garduno and Gamez 2005), feature many mounds, platforms, plazas, and ball courts. Smaller secondary centers have also been identified by Mountjoy (2000).

Aztatlan-produced items, presumably originating at these centers, were traded as far as northwestern Mexico and the southwestern United States (Beekman 2010). Currently, multiple projects are under way to gain a better understanding of the complex social and economic systems.

This analysis specifically focuses on craft specialization and trade as evidenced through the distribution of obsidian from various sources at one of the regional centers. Apparently similar obsidian blade production is evident in Amapa (Meighan 1976) as well as at Chacalilla, and the Banderas Valley site (Ohnersorgen et al. 2012).

The Early and Middle Post-Classic is typically divided into the Cerritos (AD 900-1100) and Ixcuintla (AD 1100-1350) phase. Both of these are represented in this lithic assemblage as indicated by ceramic crossdating, but the culture history of these phases remains poorly understood in West Mexico. Fortunately, archaeologists have a better understanding of the phases in nearby Amapa (Meighan 1976), which appears to be roughly similar to the culture history in San Felipe Aztatan (Gaduno, personal communication).

Architecturally, the Cerritos phase in Amapa is the first time that we see the standard Mesoamerican mound and plaza construction. Importantly, many forms of artistic expression and technology increased in complexity from the previous Amapa phase. For instance, we see the first evidence of body ornaments, pottery stamps, and metal artifacts including needles, bells, and other items. The Cerritos phase also features a greater abundance of decorative ceramic types. During the end of this phase, elaboration in ceramic stylistic design increased. This increase in embellishment allows us to use ceramic typology to identify temporal deposits through the principle of association, which basically states that if two artifacts are found in the same strata of the site in their primary context, they likely date to the same approximate time. This phase also features the inception of Mazapan style mold made figurines.

Many of the attributes of the Cerritos phase continued during the Ixcuintla phase. Pottery decoration included more animals relative to earlier motifs. Flat Mazapan figurines became more standardized at this time as well. During this phase, chert use decreased and we also see an increase in obsidian microblades and drills (Meighan 1976). Given that prismatic blades can be created by a limited set of methods, blade production technology changes little, but changes in style may be observed through differential source utilization as I have done here. Metal artifacts continue through this phase and we see the first indications of copper body adornment such as finger rings.

During both the Cerritos and Ixcuintla phases, we see an explosion of cultural changes as evidenced through various forms of technology and expression. This explosion is so profound in fact, that it is unlikely to have developed simply through

external influence. A likely explanation is an apparent population boom that would have incorporated Postclassic (AD 900-1350) Mesoamerican features into less technologically and socially complex West Mexico at the onset of the Post classic (Meighan 1976). Due to the relatively sparse research in this area, however, little evidence exists to promote or refute this idea. This population boom would have certainly created power and far reaching relationships to facilitate the spread of goods and ideas to and from the coastal plains, further stimulating the influence of the Aztatlan tradition.

The Aztatlan tradition continued to thrive into the Middle Post-Classic. Though we are not certain what led to the decline of this far reaching trade tradition, Garduno (personal communication) has speculated that the developing Tarascan empire inhibited further growth and ultimately led to the decline of the Aztatlan system through the Tarascan control of northern, central and western Mexican trade routes (Pollard 2000).

Obsidian reflects an interesting avenue for studying the Aztatlan system. Prismatic blades were used to create a variety of lithic cutting tools. These blades are incredibly sharp and efficiently created with minimal waste once the core is prepared. The technology is certainly more complex than generalized lithic reduction and often requires trained specialists. It is readily available throughout the region, but we know it to have been traded extensively even to settlements that had access to nearby sources. The necessity of specialized craftsmen for blade production and the possible absence of such craftsmen in specific sites may have also played a role in the necessary trade of prismatic blades. Regardless of the reason for trade, trade does not appear to be driven by demand for useful blades, given the abundance of blades from various local sources as

well as distant ones. Rather, the obsidian trade may be more likely a byproduct of the general Aztatlan emphasis on trade itself or perhaps even a formalized way to establish the system as traders exchanged items that were already readily accessible in each of the trading centers, as we have seen at Teotihuacan. Possibly, the obsidian trade may have even simply been “along for the ride” with the complex trade system. If this were the case, the focus may have been on other items and the obsidian trade may have been little more than a byproduct. In the Aztatlan tradition, this complex trade system may have resulted in the increased status of the merchant class such as found in later cultures as in the great economic center of Tula (Kristin-Graham 1993) with the Toltec Pochteca. In understanding the provenance of the traded obsidian we can then begin to understand the trading relationships between these regional centers and the people living at San Felipe Aztatan.

San Felipe Aztatan

San Felipe Aztatan is on the Rio Acaponeta near the modern day city of Acaponeta in Northern Nayarit. San Felipe Aztatan was once possibly the largest Aztatlan regional center (Garduno and Gamez 2005) and likely had numerous smaller villages subject to tribute. The inhabitants primarily cultivated corn, beans, and squash, but supplemented their diet with ducks, turkey, and other fowl. They also hunted deer and rabbit, and harvested flounders, other fish, and oysters (Anguiano 1992)

The site, first discovered by Sauer and Brand (1932), was initially called *Loma de la Cruz* and is now believed to represent the remains of the ethnohistorically documented capital town of the Aztatlan province (Anguiano 1992). As with much of the other

Aztatlan regional centers, little is known of its cultural past. Excavations have been limited to salvage projects by the Instituto Nacional de Antropología y Historia (INAH) in the past decade in response to modern development (Gamez and Garduno 2003; Garduno 2007; Garduno and Gamez 2005). To my knowledge, this project is the first systematic attempt to understand any cultural attribute for the San Felipe Aztatan site to date.

The site was officially recorded in 1987 by INAH. It was reported as spanning 63 ha. Initial mapping identified 18 structures and mounds. After they were granted access to additional portions of the settlement, INAH archaeologists recorded an additional 33 structures of various sizes within the urban center and 59 more mounds distributed south of the urban center (Zepeda and Fajardo 1999). The largest of the mounds is *Loma de la Cruz*, which stands 9 meters high and measures 100m x 60m (Garduno 2007). This large mound is the central structure to the site and perhaps the entire river basin (Perez et al, 2000). Its only rival in the Aztatlan complex, which is the comparable but smaller pyramid *Montosa* at the Guasima site further to the North. Notably both of these pyramids have the same basic structure and east-west orientation. This may indicate an Aztatlan standard in monumental architecture that reflects religious and cosmological principles (Garduno 2007).

The large mound is thought to be the centerpiece of the entire area and is surrounded by several smaller but substantial structures. The associated artifacts and features indicate that it was built during the Cerritos phase in at least three distinct parts (Garduno and Gamez 2005). At the bottom is a rectangular base with an average

elevation of 1.6 meters. This large base extends 100m long and 60m wide, and is oriented on an east-west axis. On its western end is a large, 9m high pyramid mound. On its east end is a smaller mound thought to be an altar of sorts extending another 0.4m from the base. Between these two structures is an area that may have served as a gathering plaza (Garduno and Gamez 2005). The configuration of *Loma de la Cruz* (and that of *La Montosa* at Guasima further to the north) seems conducive to use as a temple or ritual space. The east west orientation strengthens this hypothesis as these monuments could have been used as solar markers, potentially marking solstice activity, rather than elite residential structures.

In addition to the massive *Loma de la Cruz*, seven large platform mounds rise between 2 meters and 5 meters in elevation and many more are less than 2 meters high (Garduno and Gamez 2005). The majority of the occupation appears to be from the Cerritos (ca. AD 900-1100) and Ixquintla phases (ca. AD 1100-1350). Moundfill contained ceramics associated with these phases, but ceramics from early phases are also represented indicating a long history of occupation reaching back to the Late Formative, and a handful of Late Postclassic artifacts have also been recorded (Ohnersorgen et al. 2012). Most of the obsidian samples analyzed here date to the Cerritos and Ixquintla phases based on their association with temporally distinct ceramic types, although earlier periods are also represented.

Since its official documentation in 1987, construction has dramatically impacted the site as heavy machinery was used to level terrain for farmland (Garduno, personal communication). Stones and fill are also being harvested to construct dams, dikes, and

other structures. Public services in modern day San Felipe Aztatan have increased recently and have similarly caused destruction through the building of wells, septic tanks and houses (Garduno and Gamez 2005). For this reason, Garduno and Gamez (2005) caution us not to underestimate the original size and abundance of these mounds and platforms as they were likely much greater in the past. The INAH excavation targeted several of the largest remaining mounds, including *Loma de la Cruz*.

Previous Obsidian Provenience Research

Obsidian is quite plentiful in West Mexico. The plate tectonics produced by the convergence of the Sierra Madre Occidental and the Trans Mexican Volcanic Belt have created an active volcanic zone across southeastern Nayarit, northwestern Jalisco, and southern Zacatecas (Ohnerson et al. 2012). To date, 26 geochemically distinct obsidian sources have been identified in the region (Glascock et al. 2010). Most recent research has focused on the source areas of northwestern Jalisco and Durango (i.e. Darling 1993, 1998; Darling and Hayashida 1995; Esparza 2008; Jimenez and Darling 2000; Trombold et al. 1993; Weigand 1989; Weigand and Spence 1982), but scant research has focused on the relationship between these sources and distribution of obsidian artifacts on the west coastal regions.

Along the west coast of Mexico, obsidian was the most common lithic material and was used for the production of flaked stone artifacts including prismatic blades. Prismatic blades are produced using a unifacial technology that is highly efficient in terms of raw material use and results in an exhausted core with minimal waste. Of great

value, Motolinia, a 16th century Spanish observer, left an account of prismatic blade production he had witnessed firsthand. His descriptions have been invaluable in understanding prismatic blade production techniques (Hester et al. 1971). Based on these descriptions, many have attempted to understand and replicate traditional prismatic blade production techniques (e.g Clark 1982, 1985; Hirth 1999; Taube 1991). However, none have made such an impact on lithic analysis as Don Crabtree. One of the first researchers to use personal flintknapping knowledge as well as historical documentation, Crabtree (1968) used experimental methods to provide the most widely accepted reconstruction of the techniques used by the people of ancient Mesoamerica to make prismatic blades. Based on their small platforms and uniform size, Crabtree (1968) started from the premise that they must be made using pressure flaking; the amount of precision and force necessary to produce these long parallel-sided blades in a predictable manner would be virtually impossible to consistently create through normal percussive techniques (Crabtree 1968:451). The cores are prepared for pressure flaking through bipolar percussion, making a clean, flat top to the core. After the initial ridges are created along the outside of the core, pecking or grinding is often used to prepare the flakes. They are then driven off uniformly from the core by exerting downward and outward force using a chest crutch or similar pressure flaking tool. The force will follow the previously prepared vertical ridges on the exterior of the core. After one flake has been removed, more flakes can be removed by using the resulting vertical ridges created during previous flake removals. Minimal core maintenance is required and as can be expected, little is wasted of the core.

At Chacalilla, for example, over 99.5% of the 3,849 chipped stone artifacts are of obsidian (Ohnersorgen 2007). At San Felipe Aztatan, 1501 of the 1562 (96.1%) lithic artifacts are obsidian. Polyhedral cores have been recovered from several Aztatlan sites indicating similar local production. However, few cores have been recovered relative to the abundant blades. Future study may shed light on the cause for the disparity between cores and the abundance of blades, given the recent discovery of at least fourteen cached cores at San Felipe Aztatan (Garduno, personal communication).

Obsidian began to be traded in the Early Formative and became a defining component of the Aztatlan tradition (Mountjoy 2000). Obsidian is typically sourced using various geochemical methods, but macroscopic analysis can be useful in some cases (Braswell et al. 2000; Stark et al. 1991). Ohnersorgen et al. (2012) have demonstrated that many of the volcanic sources in western Mexico produce obsidian of distinct hues that can be differentiated through simple macroscopic analysis with an accuracy of up to 95%. Their methods of visual sorting and subsequent geochemical sourcing were used in this project and will be described below. Color sorting, though not as failsafe as geochemical sourcing can be useful, and Ohnersorgen et al. (2012) have determined that numerous sources can be visually sorted. They further find that these sources are associated with temporally distinct stratigraphic layers at Chacalilla indicating changing frequencies of obsidian from each source through time (Gamez and Garduno 2001; Garduno et al 2000; Mountjoy 2000).

Briefly, Ohnersorgen et al. (2012) collected obsidian artifacts (n=75) from the large Aztatlan trading center of Chacalilla, and compared the distribution to smaller

samples from San Felipe Aztatan (n=30), El Plantano (n=71), and the Banderas Valley site (n=81).

Each obsidian artifact was classified into one of seven categories that were believed to reflect different geochemical sources: 1) dark opaque green, 2) clear grayish green, 3) pale-medium gray, 4) black, 5) dark opaque gray, 6) other, and 7) indeterminate. Ninety-eight percent of the Chacalilla obsidian analyzed fell into the first three categories. Though the sample sizes were much smaller at other sites, the general distribution seemed to be similar. Ohnersorgen et al. (2012) found that 10 of the 30 lithic artifacts from San Felipe Aztatan are from the Pachuca source in the central Mexican state of Hidalgo. Though not in this proportion, the present research confirms that a significant portion of the San Felipe lithics do in fact come from Pachuca.

The 257 artifacts from the four sites were sent to the archaeometry laboratory at the University of Missouri Research Reactor (MURR) to verify visual color sorting. The samples were analyzed using NAA (neutron activation analysis) and XRF (X-ray fluorescence spectrometry). Twenty seven of the samples from San Felipe Aztatan and Chacalilla were analyzed through both NAA and XRF to confirm results. Nearly all of the artifacts in the total sample (250 of 257) were assigned to a known source of western or central Mexico (Ohnersorgen et al. 2012). These sources include eight from Jalisco, two in Nayarit, one in Zacatecas, and one in Hidalgo (Glascock et al. 2010). Despite a wide array of potential sources, three sources, Ixtlan del Rio, La Joya, and Volcan las Navajas dominate the assemblage.

In the sourcing analysis conducted by Ohnersorgen et al. (2012) the obsidian artifact samples were tested for visual color sourcing accuracy. For the 75 Chacalilla samples, three colors were identified: opaque dark green, clear grayish green, and pale medium gray, which correlate with the Volcan las Navajas, La Joya, and Ixtlan del Rio sources respectively. At Chacalilla, a heavy reliance on the obsidian they associated with Ixtlan del Rio (pale medium gray) is associated with Formative/Early Classic period contexts. During the Ixcuintla phase, however the color group associated with the La Joya (clear grayish green) source seems to become more popular. The analysts, however, offer no statistical analysis to confirm these observations.

The visual groupings created by Ohnersorgen et al. corresponded to a single source 92% of the time. Errors made in visual color sorting were typically made with artifacts that were larger and bigger “chunks”, which made it difficult to see the true color due to their lack of transparency (Ohnersorgen, personal communication). Other errors were made on darker pieces that could not be easily identified as a distinct color group.

With such accurate color sorting, Ohnersorgen et al. (2012) then attempted to identify sources for all 3,833 obsidian artifacts from Chacalilla under the assumption of strong correlation between color groups and distinct sources. Of the total sample, 98% were assigned to one of three sources: La Joya, Ixtlan del Rio, and Volcan las Navajas.

Each artifact was also coded for artifact type, which was thought to reflect of the stage of reduction. This categorization of artifact type had been previously developed and used in similar projects in Mexico (Clark 1985; Clark and Bryant 1997; Stanley et al. 1986). After coding for artifact type, correlations could be drawn between obsidian

sources and stage of production. These two variables were directly correlated at Chacalilla. For example, the color group which has been associated with La Joya obsidian comprises two-thirds of all of the prismatic blades in Chacalilla. This abundance implies that this obsidian was being reduced elsewhere and imported in finished form. The first color group statistically identified as Volcan las Navajas, shows a different pattern indicating production and export due to over abundances of production debitage and polyhedral cores coupled with a lack of finished blades presumably indicating the finished products were traded to other settlements. (Ohnersorgen et al. 2012). This pattern indicates a trade network that likely existed between sites in which specific cities controlled production of obsidian blades from a specific source. At San Felipe Aztatan, I have found similar patterns of blade versus debitage of color group 2 (La Joya) and color group 1 (Volcan las Navajas) lithics, however, blades from other sources are also found in large quantities, indicating a more extensive trade network at San Felipe Aztatan than has been observed at Chacalilla.

Glascok et al. (2010) have also commented on the relative quality of the various West Mexican sources. Several sources produce obsidian of such poor quality that they were not used for lithic tools, but 13 of the 26 identified sources were categorized as excellent quality (Glascok et al. 2010). These obsidian sources are widely dispersed and provided West Mexican people with ready access to good quality obsidian. The trade of obsidian is therefore not focused on the differing quality or different access, in general. Instead, it appears to be focused on creating trade networks simply for the purposes of trading other materials and establishing cooperative relationships and alliances between

sites (Kelley 2000). As has been witnessed ethnographically around the world (the Kula Ring of the Trobriand Islands for example [Malinowski 1920;1922]), often unnecessary trade develops as a kind of costly signaling as a way to show social status and create powerful trading partners with whom alliances can be created. Though typically, these signals (such as the Kula necklaces) are readily visible, ideological differences based on attributes other than visual difference cannot be discounted. For example, a wealthy man could easily buy an imitation Rolex watch which would be indistinguishable from a real one except to a professional jewelry dealer, but he would rather buy the real watch because it not only showcases his wealth to others, but it affects his own self-image of elevated status as well.

In this analysis, I have found similar patterns of obsidian source usage and have identified differential abundances of distinct obsidian sources within the site. These abundances likely reflect differential usage of trade networks facilitated through social relations. Future research may indeed indicate intrasite variation which could possibly identify differential access to exotic goods through social status. This could be achieved through alternative analysis considering architectural differences, faunal remains, and ceramic analysis. This type of socio-economic patterning of lithic assemblages has been observed at numerous sites in the New World (Blanton et al. 1996; Feinman et al. 2006; Haviland 1970). With the well-known social complexity of the Aztatlan tradition and the dominance of San Felipe Aztatan as a regional center, the general patterns of obsidian source distribution that I have identified fit patterns described by Ohnersorgen et al. (2012) and build upon it by adding a temporal and social element.

In identifying obsidian source and type distributions spatially distributed throughout the sites, I have drawn correlations between abundances and distinct features and areas of the site. These correlations may be further explored to evaluate social differentiation within the site. In using a Marxist perspective, we can then learn more about the site in general through the relationships that existed among the different levels of the Aztatlan hierarchy as reflected through differential access to exotic trade goods. Unfortunately, the San Felipe Aztatan project has currently only excavated four areas and future excavations will be severely limited due to modern urban development.

Beyond this initial project, it will also be beneficial to compare my results to nearby Chacalilla to possibly establish how these sites and others may have interacted. Using the obsidian analysis at Chacalilla as a model, I have begun to elucidate the complex social systems inherent at San Felipe Aztatan based on distribution of exotic goods, namely distantly sourced obsidian.

Chapter 3

Methods and Analytical Background

The research addresses two distinct issues: differences in artifact morphology by source, and differences in source frequencies through time. The methodology therefore focuses on recording information relevant to these topics. I begin the following discussion by first describing the excavation strategies used to collect the materials and then identifying the variables I measured.

Excavation Methods and Background

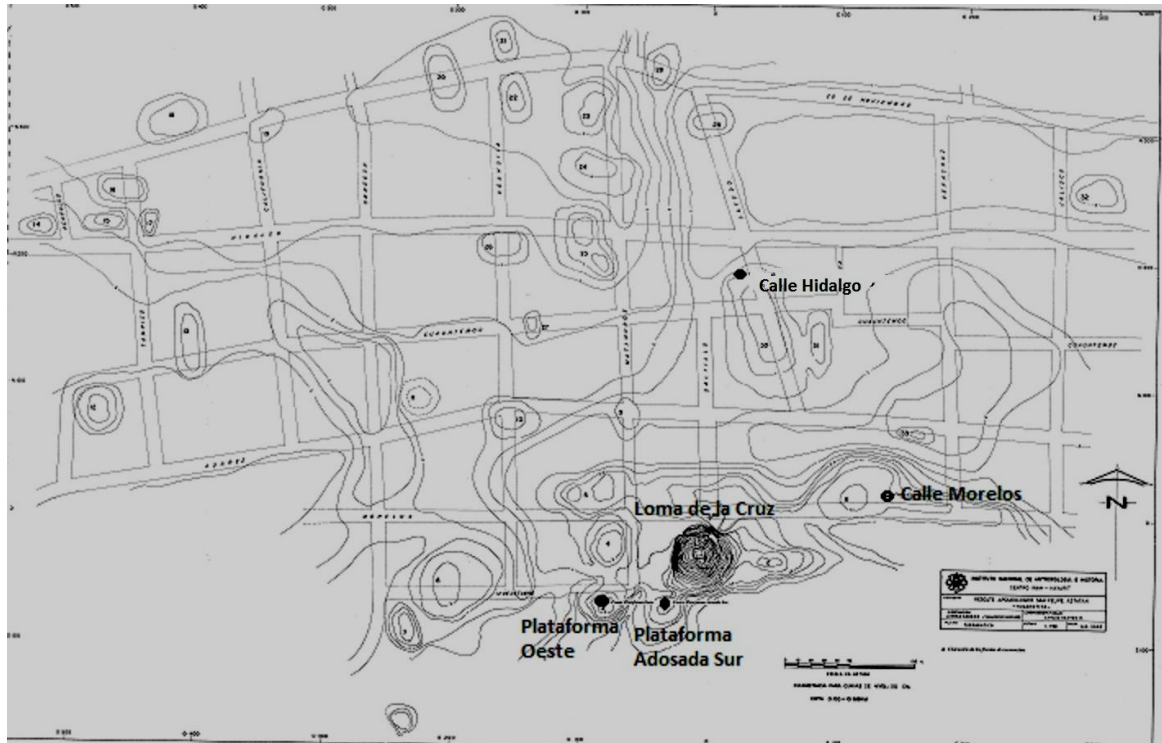
The field work was conducted from November, 2002 to December, 2002 under the direction of Mauricio Garduno Ambriz and Lorena Gamez Eternod of the Instituto Nacional de Antropologia e Historia (INAH). The field crews were INAH archaeologists and local laborers. Excavations were generally completed in arbitrary levels within natural stratigraphic units. When identified, features were excavated separately from general fill. All excavated fill was screened using one quarter inch mesh and artifacts were bagged according to stratigraphic level within each excavation unit.

Four distinct areas were excavated: 1) Frente Calle Morelos (front of Morelos street), 2) Frente Calle Hidalgo (front of Morelos street), 3) Plataforma Adosado Sur (attached southern platform), and 4) Plataforma Oeste (western platform)(Figure 2). Plataforma Adosado Sur and Plataforma Oeste are both focused on mound structures

including *Loma de la Cruz*, while Frente Calle Morelos and Frente Calle Hidalgo focused on habitation areas. All four areas produced both lithic and ceramic artifacts in part because the mounds were using household debris as well as general soil as fill (Garduno and Gamez 2005).

The lack of continuous stratigraphic units prevented the use of consistent excavation levels among the areas. Levels for each area were defined using natural stratigraphic breaks (typically reflected by changes in soil color and texture) and obvious changes in material culture. In situations where little change could be observed or extensive stratigraphic mixing occurred, levels were reduced to arbitrary 10-20 cm levels.

The excavation areas were chosen through non-random stratified sampling based on the likelihood of intact subsurface deposits and the limited impact of modern construction on underlying deposits. Below is a brief description of each excavation area.



Frente Calle Morelos

Frente Calle Morelos is on the western periphery of San Felipe Aztatan in an area that is not associated with any known features. The excavation unit is currently surrounded by urban lots used to grow fruit trees including mango, guava, lemon, and tamarind that are part of modern family garden areas. Ceramic crossdating indicates that most of the materials date to the Cerritos (AD 900-1100) phase although Mazatlan (AD 1100-1350) artifacts were recovered in the upper levels (Garduno and Gamez 2005). A total of 4 sets of dis-contiguous units of various sizes were excavated, creating a total

excavation area 9 square meters. All units were excavated until sterile soil was encountered, typically at about 2.5 m deep.

Plataforma Oeste

Plataforma Oeste is a well preserved platform currently used as a vegetable garden. The rectangular platform mound is oriented on an east-west axis in a manner similar to nearby *Loma de la Cruz*. This platform is 2m high by 25m long. A small secondary mound is to the east (Garduno and Gamez 2005). A single 4x4m unit was excavated and was later enlarged with a 1x1m unit off the SW corner. Cultural deposits again were about 2 m deep.

Frente Calle Hidalgo

Frente Calle Hidalgo is on a platform north of *Loma de la Cruz*. Recently, it has been used to raise chickens and kitchen gardens and was selected for excavation due to the rich cultural material exposed during the construction of a household septic tank. The topography of the land indicates a slight slope from south to north. Excavations started with a 2x2m unit that was then enlarged with a 1x1m unit to the north. Cultural deposits extend to a depth of about 2 m.

Plataforma Adosada Sur

Plataforma Adosada Sur was a 1x1 m unit excavated in a bean field on the south side of *Loma de la Cruz*. The excavators hoped to define the mound fill and distinguish

the pre-occupational topography beneath the structure. Seemingly, the natural topography was sloped sharply to the south. The leveling of the pre-mound topography was first identified at approximately 2.5 meters. Culturally sterile soil was reached at 4 meters in depth.

Establishing Chronologies

Ceramic crossdating is commonly useful for establishing the temporal affiliation of archaeological remains. Gamez and Garduno (2005) utilized this method to broadly chronologically define excavation layers and levels, although some stratigraphic mixing affects the resulting temporal resolution. My research uses this ceramic data to determine trade patterns associated with various time periods, in an admittedly general sense.

Obviously, the 4 excavation locations are not contiguous and the excavation levels have imperfect correspondences among them (e.g., level 1 from Plataforma Adosada Sur is not identical to level 1 from Frente Calle Hidalgo). Also, some areas consist of at least some moundfill which would certainly result in some stratigraphic mixing. Furthermore, I do acknowledge that there is a possibility that different excavation areas may actually reflect different occupation episodes. The lack of ceramic data more succinctly identifying distinct temporal types within each stratigraphic layer only confounds this issue. However, these levels likely still reflect the same basic chronological sequence as evidenced by the same general variation in ceramic assemblages, and they do reflect the same general chronological patterns in that the most recently deposited levels of all of the units tend to be at least roughly contemporaneous

and are more recent than the lower levels in all of the units. Given this, I am still able to identify significant changes in raw material use through time on an ordinal scale. If anything, the imperfect correspondence among the excavation units obscures differences through time as materials from slightly different times are lumped together. Given the strong temporal patterns I identify in the results chapter (Chapter 4), excessive “time averaging” does not appear to be a significant problem for this research, and the temporal patterns I do identify are perhaps even more distinct than my research currently demonstrates. I will discuss this further in Chapter 5.

Analytical methods

The obsidian artifacts, which are permanently curated at the INAH office in Tepic, Nayarit were analyzed in an apartment in San Blas, Nayarit by Megan Pierce and myself. Analysis was conducted in June and July 2011. The obsidian was originally grouped with each level separated into different bags. During the analysis, each artifact was given its own unique artifact number to link it with its provenience and the data we collected. Once numbered, the artifacts in each bag were separated into color groups, and measures of the various attributes discussed below were taken.

The attributes recorded were: 1) color group, which was tested to associate with distinct geochemical sources; 2), artifact form, which was recorded using the framework previously discussed in Chapter 3, and 3), flake weight, length, width, cortex coverage, and type which are variables that Odell (2004) previously identified as among the “minimal set of attributes” typically recorded for lithic assemblages. The final set of

variables are of more limited utility in the current analysis, but were recorded for completeness and to serve as the basis of future comparative analyzes. The analytic importance and method of recording each variable is presented below. In all cases, my analytic focus is on characterizing the assemblage of artifacts for each level, as opposed to focusing on characterizing individual artifacts. In other words, I have organized my data collection to allow for a statistical approach aimed at detecting differences among excavation levels and units, as opposed to attempting to focus on the technological or functional significance of individual artifacts.

Artifact Source/Color Group: To identify source, I color sorted each artifact into distinct color/texture groups using the assignments made by Ohnersorgen et al. (2012) with slight alterations to better represent the San Felipe assemblage. Prior to traveling to Mexico, I went to the University of Missouri- St. Louis archaeology laboratory to discuss this project with Dr. Ohnersorgen. The samples used by Ohnersorgen et al. (2012) that had been geochemically sourced at MURR were curated there, and I was able to familiarize myself with the various color/ sources by reviewing Dr. Ohnersorgen's sample extensively. By doing this, I became confident that I could reliably recreate his color groups.

Color sorting of the San Felipe Aztatan's obsidian was done simply by holding each artifact up to the sunlight. As natural sunlight came through the transparent volcanic glass, various hues were visible that are indicative of source group. Only natural sunlight was used and analysis was only done on clear days. I concluded analysis by 4

p.m. every day to ensure consistent sunlight for all analyses. Color group 1 is defined as a dark opaque green. Color group 2 is a clear grayish green. Color group 3 is a pale medium gray. Color group 4, was identified by Ohnersorgen as “black”, but was not represented in the San Felipe Aztatan analysis. This group was excluded from the current analysis because upon analysis, a slight hue was nearly always visible. In these few circumstances, the artifact was classified as “indeterminate (color group 7). Color group 5 was a darker opaque gray. Color group 6 was a smoky dull greenish grey. Color group 7 was reserved for indeterminate sources. Often this color group was used for pieces which no hues were observable due to shape or thickness. Color group 8 was a yellowish green/brown. The color group 9 category was reserved for artifacts of miscellaneous describable hues that did not fit into the other pre-determined color categories and likely reflect various sources rather than a single one. These colors were then described during the analysis. However, few artifacts fit into this category relative to other color groups. I have opted to leave this color category in the analysis despite its ambiguity. Though this group likely represents multiple rarer sources, it can be valuable in indicating even more pronounced differences in source use comparative to the other known sources of this study, given that these artifacts did not fit into the other color groups based on appearance.

I acknowledge that the color groups won’t perfectly correspond with specific sources. However, Ohnersorgen et al. (2012) have established a 92% success rate in defining distinct color groups that correlate with specific geochemical sources. Ideally a 100% success rate would be achieved, but given the limitations of the study and the

generalizations rather than specifics that this study yields, a slightly lower success rate may be sufficient. As will be discussed in Chapter 4, I conducted a similar analysis evaluating the correspondence between source and color groups, and found that the color variation in this assemblage does reflect variation in sources at San Felipe Aztatan.

Artifact Group/Type code: General artifact morphology was recorded using the five types used by Ohnerson et al (2012) as modified from by Clark (1985), Clark and Bryan (1997), and Santley et al. (1986). The original system identifies 70 different technological groups that reflect different stages of production, but is excessive for this sample given that the resulting group frequencies would have been unnecessarily small with many groups not being represented at all. This in turn would make the interpretation of group frequencies ambiguous at best. Instead, I used a collapsed version first proposed by Ohnerson et al (2012). By using similar coding, my results can be comparable and future analytical work can be done collaborating results from both sites. The collapsed coding system split all lithics into five technological types: 1) finished prismatic blades, 2) byproducts related to polyhedral core preparation (identified through flake size and morphology); 3) byproducts of prismatic blade production or the reduction and/or maintenance of polyhedral core (again size and morphology were key characteristics as often blade production and core maintenance will produce smaller thinner flakes); 4) miscellaneous debitage (relating to mainly non-prismatic industries), and 5) formal tools, including items such as bifaces, projectile points, scrapers, and worked or notched blades. This coding system is heavily weighted towards the prismatic blade industry, which

dominates the assemblage at San Felipe Aztatan. Notably, types 2, 3, and 4 are all classified as debitage. This being the case, misidentification of types may be a non-issue.

Additional Variables- The remaining variables were measured for sake of completeness as recommended by Odell (2004) and Andrefsky (2005). The data will provide the basis for this and future analyses, although many of the variables may be much more useful for non-prismatic flakes.

Weight- The weight of each artifact was measured using a digital scale to the nearest 1/10 g. Artifact weight will allow the identification of variation in reduction intensity, reduction stage, and reduction techniques. For example a large number of small flakes may indicate high intensity reduction compared to an assemblage of a small number of large flakes. Andrefsky (2005) indicates that all else being equal, larger flakes tend to be produced early in the reduction sequence, although this is not necessarily true of unifacial flake technology such as prismatic blades. Also, larger flakes are typically products of generalized hard hammer reduction (Andrefsky 2005: 130). Given that the great majority of this lithic assemblage is prismatic blade debitage, weight is might reflect the presence or absence of local production of the prismatic blades. Smaller flakes are likely to be produced from prismatic cores as they are prepared and broken flakes are discarded. In contrast, traded prismatic blades will arrive on site in finished form as larger blades. These may of course be broken, but weight, in conjunction with other variables, will

likely allow me to differentiate between the local production/reduction of lithic materials and traded prismatic blades produced elsewhere.

Length and width- Length and width allow for the measurement of flake size, which in turn may reflect stage of production and reduction technique. As mentioned above, all else being equal, larger flakes often occur earlier in the reduction process. Long, narrow prismatic blades are also distinctive in terms of their length/width ratios, especially relative to the comparatively broad and short flakes associated with generalized core reduction. Furthermore, hard hammer percussion tends to produce relatively longer, bulkier flakes than soft hammer reduction, although there is broad overlap and the differences are not diagnostic at the level of individual flakes (Andrefsky 2005, Cotterell and Kaminga 1987). Length was the longest line perpendicular to the platform, measured from the most proximal point of the platform to the most distant point of detachment. With flakes which have no discernable platform or termination, the length measurement was the longest axis. The width measurement was taken perpendicular to the length measurement. Both length and width were measured to the nearest mm using digital calipers

Amount of cortex- The amount of cortex is another useful indicator of stage of production. Cortex is defined as the chemically or mechanically weathered surface on rocks (Andrefsky 2005:254). The amount of cortex on the dorsal side of a flake may represent the production stage of a tool (Andrefsky 2005; Johnson 1989; Morrow 1984;

Sanders 1992; Walker and Todd 1984; Zeir et al. 1988). Generally, as a tool is progressively flaked, the amount of cortex on both the cores and the dorsal surface of the flake will decrease, as greater amounts of the exterior surface of the stone is flaked away. Therefore, high proportions of flakes with substantial cortex likely reflect early stages of reduction relative to assemblages with fewer cortical flakes. Cortex can also reflect cobble size. Small cobbles will produce more cortical flakes relative to larger cobbles when reduced using the same reduction techniques (Andrefsky 2005; 117). This is because the amount of surface area compared to total volume will be greater in smaller cobbles. Therefore, larger cobbles will produce proportionately more non-cortical than cortical flakes as compared to smaller cobbles. By recording how much cortex there is on each flake through visual assessment, I can test whether there were substantial differences in cobble size. Amount of cortex was recorded using the four rank scale utilized by Andrefsky (2005:106). In this ordinal scale, the score of 3 is given to the flake if the entire dorsal surface is covered in cortex. If over half of its dorsal surface is covered in cortex but less than 100% it is given the score of 2. The score of 1 is given to any flake that has some cortex but less than 50%. Finally a zero is given to flakes with no dorsal cortex present.

Presence of Bulb of Force- The bulb of force is defined as “ the bulbar location on the ventral surface of a flake that was formed as a result of the Herzian cone turning toward the outside of the objective piece” (Andrefsky 2005:253). Identifying the bulb of force when present allows one to identify the ventral surface. The presence and nature of bulbs

of force also indicate certain types of reduction, such as bipolar reduction and hard hammer reduction. Bipolar reduction can result in multiple bulbs of force on opposite ends of the ventral surface, hard hammer reduction tends to produce pronounced bulbs of force, and soft hammer reduction produces more diffuse bulbs of force (Andrefsky 2005). Although prismatic blades are made using pressure flaking, and tend to exhibit very diffuse bulbs of force, if they are present at all, core preparation is often completed using hard hammer and soft hammer percussion, as a result, the presence of a bulb of force on non-prismatic blade lithics may indicate hard hammer reduction, which we know to be more prevalent in earlier stages of production.

Type of flake (pr/me/di/co)- The type of flake (i.e. proximal, medial, distal, or complete) was recorded to measure the degree of flake fragmentation, which might in turn reflect the intensity of reduction and use of reduction technology (Andrefsky 2005; Sullivan and Rozen 1985). These data were not used in the current study, but can be used to explore different use patterns based on source in the future. The type of flake (i.e., proximal, medial, distal, and complete) was determined by the presence/ absence of various aspects of flake morphology. Complete flakes have an identifiable platform and complete margins. Proximal flakes have an identifiable platform but broken margins. Distal fragments have the point of most distant detachment (e.g. feather termination) but no identifiable platform. A medial flake has neither an identifiable platform nor a point of final detachment. Angular shatter was consistently coded as medial. I have made this

distinction if there was no discernible ventral/dorsal surface, striking platform and termination point.

Comments- Finally, I have also included pertinent comments for the anomalous artifacts, it was important to record other important observations as well. Comments included descriptions of uncommon source colors, description of formal tools, and potential refitting.

By considering many different variables, I have been able to address multiple issues and rule out some possible explanations for the source distribution which is present at San Felipe Aztatan. While more potential hypotheses remain, this study and the data collected is intended to use color sorting and subsequent source distribution as an avenue for understanding social and temporal diversity within the site. When more data becomes available, future analysis could certainly corroborate or refute the results presented here. In the following chapter, I present the results of my multiple lines of analysis which confirm a non-random distribution of obsidian sources at the site.

Chapter 4

Results

This project addresses three related yet complimentary issues: differences in source frequencies through time, differences in artifact morphology by source, and differential distributions of obsidian source across the San Felipe Aztatan landscape. Below, I outline my results. I begin by discussing the relationship between the defined color groups and geochemically identified sources. Then I consider changes in source frequencies through time. Next, I consider the changes in artifact morphology through time and by raw material type, and end with a consideration of differences in source and artifact morphology among the four excavation proveniences.

Correspondence between Color Groups and Geochemical Sources

Archaeologists are rightly suspicious of obsidian provenance studies based on macroscopic analysis, because of questionable replicability and the likelihood of misidentifying sources (Braswell et al. 1994, 2000; Levine nd; Moholy-Nagy and Nelson 1990). Some sources have so much variation that pieces from the same source might appear macroscopically distinct while obsidian from different sources might be macroscopically identical (Moholy-Nagy and Nelson 1990). However, some have demonstrated the potential accuracy of color sorting given the correct conditions (Aoyama 1991; Braswell et al. 1994, 2000; Carpio Rezzio 1993; McKillop 1995;

Sanchez Polo 1991; Tykot 2003). For example, Braswell et al. (2000) have demonstrated the potential efficacy of this method in areas of low obsidian variability. However, many caution us too be wary of such methods in areas where we find more diversity in sources (Braswell et al. 2000:278; Tykot 2003:64). Similarly, my study addresses these challenges and tests the validity of color sorting in the diverse area of West Mexico, and while acknowledging its limitations, I find this method to be of benefit even in areas of many diverse sources.

Ohnersorgen et al. (2012) demonstrated that the West Mexican obsidian sources are in fact macroscopically distinct, in that there is a nonrandom association between their defined color groups and known geochemical West Mexican sources. This association is not perfect, but it is statistically meaningful, in that sources can be correctly differentiated 92% of the time. This in turn facilitates macroscopic provenance analysis, in that it allows for the replicable and moderately reliable identification of geochemical source using color and texture, given this projects limitations. The potential of using a macroscopic approach is particularly compelling in this case because of the difficulty of securing INAH permission to transport samples for analysis in the United States (Braswell et al. 2000). However, I was able to gain permission to analyze a substantial sample of the artifacts at University of Missouri Research Reactor (MURR) to both evaluate the reliability of Ohnersorgen et al.'s (2012) color/source associations and to ensure that the macroscopic approach was sufficiently robust to allow me to complete the sourcing study using macroscopic analysis. I conducted geochemical sourcing analysis using XRF of 195 of the 1,476 (13.14%) obsidian artifacts that were color sorted to

evaluate the relationships between color groups and volcanic source. Rather than limiting my study to the three distinct colors used by Ohnersorgen et al. (2012), I analyzed samples from all of the color groups. Obsidian samples were selected to maximize the variation represented within each color groups (i.e., I selected obsidian samples that reflected the entire range of color and texture variation, as opposed to the “typical” member of each group). Therefore, my sample likely reflects the maximum variability within each color group. Of the 195 sampled, 181 could be confidently associated to a single source, and an additional 12 artifacts were chemically consistent with several sources rather than a single one. Thus, color groups have been identified to a single source more than 84% of the time, in my XRF study. The correspondence between color group and geochemical source is not as strong as Ohnersorgen’s, but it again reflects a non-random association between color and geochemical source. A random sample of the assemblage likely would have produced an even greater correspondence between color groups and geochemical sources because the less common color variants that I intentionally selected would have been comparatively rarer.

The nonrandom association between color groups and sources indicate the utility of color sorting even in an area of great obsidian variability such as West Mexico (Tables 1 and 2; Figure 2). Given the strong correlation (though in no way perfect) we can assume that the strong statistical results presented here likely do in fact reflect the pattern of obsidian usage based on source at San Felipe Aztatan. In fact, it is possible if not likely that the true accuracy of color my color sorting is higher than indicated by the

geochemical sourcing data due to my preferential selection of variable and ambiguous obsidian flakes for XRF analysis.

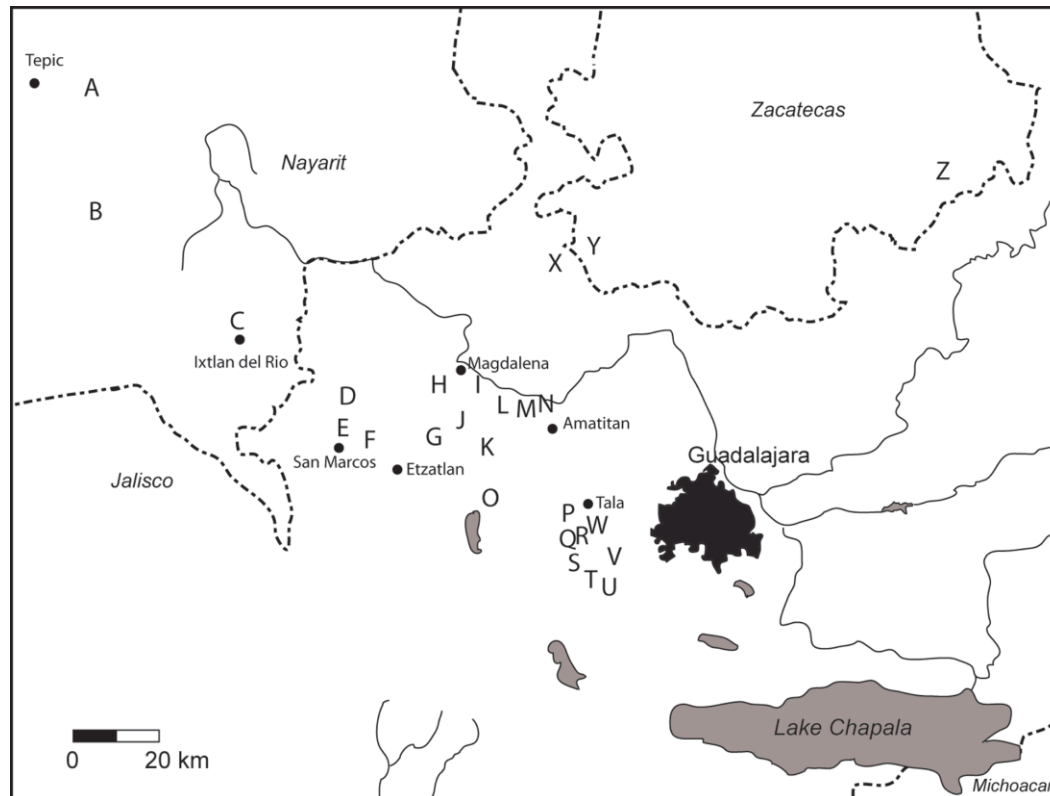


Figure. 3. Map of sources. The sources are as follows: A – Volcan Las Navajas (2 subsources); B – San Leonel; C – Ixtlan del Rio; D – Llano Grande; E – Osotero; F – Hacienda de Guadalupe; G –San Juanito de Escobedo; H – La Quemada; I – Cinco Minas/Magdalena; J – La Joya; K – La Providencia; L – Santa Teresa; M – Tequila; N – La Pila; O – La Mora/Teuchitlan; P – Huaxtla; Q – Boquillas; R – La Primavera; S – San Juan De Los Arcos; T – Ahuiscolco; U – Navajas; V – Ixtepete; W – San Isidro; X – La Lobera; Y – Huitzila; and Z – Nochistlan *San Felipe Aztatan is located to the northwest of Tepic, just off of the map. Pachuca is located off map to the east. (Map taken with permission from “Glascok, M.D., P.C. Weiland, R. Esparza Lopez, M.A. Ohnorsorgen, M. Garduno Ambriz, J. B. Mountjoy, and J.A. Darling (2010) Geochemical Characterization of Obsidian Sources in Western Mexico: The sources of Jalisco, Nayarit, and Zacatecas. In *Crossing the Straights: Prehistoric Obsidian Source Exploitation long the Pacific Rim*, edited by Y.V. Kuzmin and M.D. Glascok, pp. 201-217.”

Table 1. Obsidian sources identified at San Felipe Aztatan (Table modified from Glascok et al 2010)

Map ID	State	Source	Description	Quality
		Volcan Las Navajas		
a	Nayarit	Navajas	Glass has a murky green color with minimal inclusions	excellent
c	Nayarit	Ixtlan del Rio	Glass has a dull gray color with streaky appearance	excellent
e	Jalisco	Osotero	Glass comes in multiple colors with a high proportion of red	medium

			and brown	
j	Jalisco	La Joya	Glass is usually dark green in color and has excellent fracturing properties	excellent
q	Jalisco	Boquillas San Juan de los	Glass is black	medium
s	Jalisco	Arcos	Glass is black	excellent
*	Hidalgo	Pachuca	Glass is goldish green with excellent fracturing properties	excellent

Color groups 3 and 5 are both seemingly from the same chemical source, Ixtlan del Rio. Similarly, color groups 2 and 6 both often represent La Joya. For this reason, I have collapsed these two color groups into groups 3 and 2 respectively. For the purposes of assessing reliability of color sorting, color group 9 has also been dropped, given that it is a miscellaneous color category. However, it has been retained for analytical purposes for my statistical analysis. Given that identifying the specific geochemical source associated with these artifacts is not as important as knowing which sources these artifacts do not come from (i.e. VNN, IXR, LJ, PCH), this group can offer valuable information despite its ambiguity. It will become apparent that the distribution of the various sources represented in color group 9 reflects similar patterns as other distinct geochemical sources. Table 3 reflects these collapsed color-source associations.

Table 2. Geochemical source correlated with color group

Geochemical source	color source groups								total
	1	2	3	5	6	7	8	9	
Volcan las Navajas	41	0	0	0	1	0	0	0	42
La Joya	4	52	0	0	11	0	3	4	74
Pachuca	0	10	1	0	1	0	11	1	24
Ixtlan del rio	0	1	28	14	0	0	0	0	43
Osotero	0	0	1	0	0	0	0	2	3
San Juan de los	0	0	6	0	0	0	0	0	6

Arcos									
Boquillas	0	0	2	0	0	0	0	0	2
unknown source									
group	0	0	1	1	0	0	0	0	2
totals	45	63	39	15	13	0	14	7	196

Table 3. XRF results compared to color sorting

Geochemical Source	Color Groups				Totals
	1	2	3	8	
Volcan las Navajas	41	1	0	0	42
La Joya	4	63	0	3	70
Pachuca	0	11	1	11	23
Ixtlan del Rio	0	1	42	0	43
Osotero	0	0	1	0	1
San Juan de los Arcos	0	0	6	0	6
Boquillas	0	0	2	0	2
unknown source group	2	0	0	0	2
totals	47	76	52	14	189

As is illustrated, color group 1 (dark opaque green) has a near perfect correlation with the Volcan las Navajas source. The weakest correspondence is color group 2 (clear grayish green), which is almost entirely La Joya obsidian (83%), but does not include Pachuca obsidian (14%) and a small amount of Ixtlan del Rio (1%) and Volcan las Navajas (1%). Color group 3 (pale medium gray) also reflects more than one volcanic source, but is primarily associated with Ixtlan del Rio (81%). It also includes all of the obsidian from San Juan de los Arcos (12%), Osotero (2%), and Boquillas (4%), as well as a small amount of the Pachuca obsidian. Color group 8 (yellowish green/brown) is primarily Pachuca (78%) but it also includes some La Joya (22%) obsidian. Thus, the most likely confusion is between La Joya and Pachuca obsidians. However, the

confusion is relatively limited (color group 2 contains mostly La Joya while color group 8 contains mostly Pachuca) and the presence or absence of a correspondence between color groups 2 and 8 might provide insights into the likelihood of errors; strata containing color group 2 but not color group 8 likely contains little or no Pachuca obsidian, strata containing color group 8 but not color group 2 likely contains little or no La Joya obsidian, and strata containing both color groups likely contain a mix of Pachuca and La Joya obsidian. In summary then, the strong correspondence between the color groups and the specific sources allow me to use macroscopic dating and a statistical framework to determine changes in source preference through time and across space. Further, I know what errors are likely to occur and can be controlled for in my interpretation. I wish to stress that the analyzed samples were selected arbitrarily to ensure that the full range of variation within each color group was represented. The correspondence between the “typical” members of each color group is therefore almost certainly stronger than reflected in Table 2, given that the sample intentionally included the comparatively rare “border” cases where confusion is most likely to occur. Given the association between color and sources indicated here, subsequently, each color group will be identified by its associated geochemical source in this report.

Changes in Obsidian Source Selection through Time

Source frequency change over time. For my first topic of analysis, I wanted to see if the pattern of source distribution is static or if it changed over time. I first looked at source/color in association with excavation levels. The excavations went as deep as 350

cm in some excavation units (level 20). For ease of analysis, I have collapsed these levels into 20 cm increments. Table 4 displays the frequencies of artifacts from each source found within each level. The first color group, which likely represents the closest geographical source at Volcan las Navajas, seems to be represented in all levels, while other sources seem to be abundant primarily in later levels. As other sources become more prevalent, Volcan las Navajas (Color group 1) becomes less. Figure 4 illustrates this change in source frequencies over time for these 5 source groups.

There is a statistical correlation between source and excavation level. This association is represented by the greater amounts of color group 1 flakes at earlier times (deeper stratigraphic levels) with other sources becoming dominant later. I conducted a Chi-square analysis to determine if the shifts in relative abundances are meaningful (Table 4). The null hypothesis is that the expected values are the same as the observed values ($H_0: E=O$). The Chi-square value is 375.8, which exceeds the critical value of 51.0 for 36 degrees of freedom and an alpha of .05. The residuals values indicate that 17 of the 50 combinations were significantly different than expected. The first color group (likely Volcan las Navajas) is overrepresented in lower levels, but underrepresented in the most recent levels.

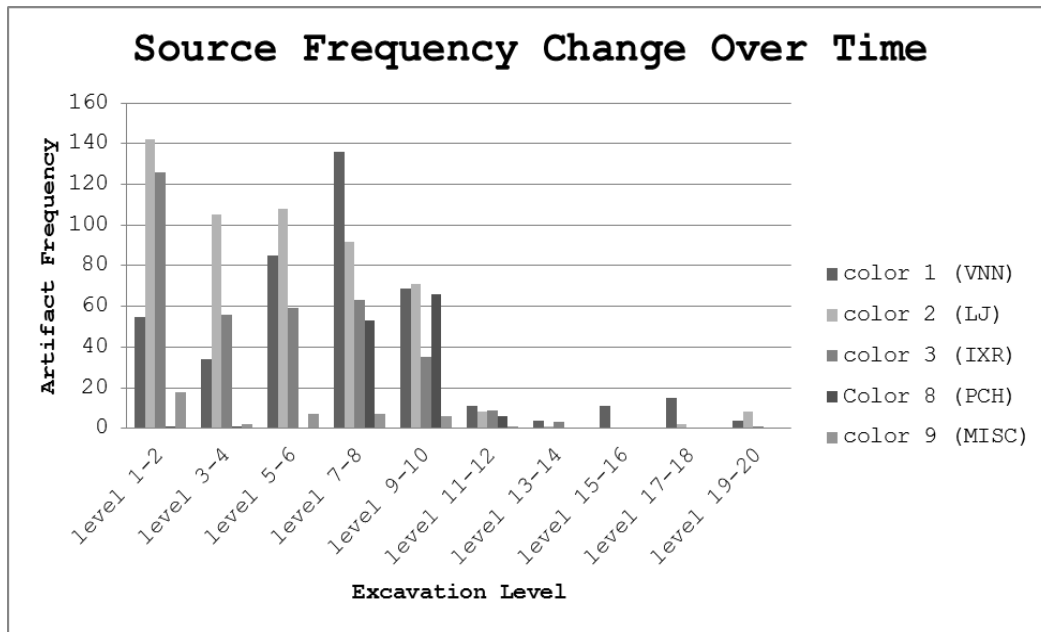


Figure 4. Source Frequency Change over Time

Table 4. Chi-square analysis. Source level relationship (bolded values are significant)

Color Group	Level	Observed	Expected	Chi-square	Adjusted Residuals
Color group 1 (VNN)	1 to 2	55	97.91	18.81	-4.34
	3 to 4	34	56.69	9.08	-3.01
	5 to 6	85	74.15	1.59	1.26
	7 to 8	136	100.49	12.55	3.54
	9 to 10	69	70.71	0.04	-0.20
	11 to 12	11	10.02	0.10	0.31
	13 to 14	4	2.29	1.28	1.13
	15 to 16	11	3.15	19.57	4.42
	17 to 18	15	4.87	21.10	4.59
	19 to 20	4	3.72	0.02	0.14
Color group 2 (LJ)	1 to 2	142	124.01	2.61	1.62
	3 to 4	105	71.79	15.36	3.92
	5 to 6	108	93.91	2.11	1.45
	7 to 8	92	127.27	9.77	-3.13
	9 to 10	71	89.56	3.85	-1.96
	11 to 12	8	12.69	1.73	-1.32
	13 to 14	1	2.90	1.25	-1.12
	15 to 16	0	3.99	3.99	-2.00
	17 to 18	2	6.16	2.81	-1.68

	19 to 20	8	4.71	2.29	1.51
Color group 3 (IXR)	1 to 2	126	81.29	24.60	4.96
	3 to 4	56	47.06	1.70	1.30
	5 to 6	59	61.56	0.11	-0.33
	7 to 8	63	83.42	5.00	-2.24
	9 to 10	35	58.71	9.57	-3.09
	11 to 12	9	8.32	0.06	0.24
	13 to 14	3	1.90	0.63	0.80
	15 to 16	0	2.61	2.61	-1.62
	17 to 18	0	4.04	4.04	-2.01
Color group 8 (PCH)	19 to 20	1	3.09	1.41	-1.19
	1 to 2	1	29.33	27.36	-5.23
	3 to 4	1	16.98	15.04	-3.88
	5 to 6	0	22.21	22.21	-4.71
	7 to 8	53	30.10	17.42	4.17
	9 to 10	66	21.18	94.84	9.74
	11 to 12	6	3.00	3.00	1.73
	13 to 14	0	0.69	0.69	-0.83
	15 to 16	0	0.94	0.94	-0.97
Color group 9 (MISC)	17 to 18	0	1.46	1.46	-1.21
	19 to 20	0	1.11	1.11	-1.06
	1 to 2	18	9.47	7.69	2.77
	3 to 4	2	5.48	2.21	-1.49
	5 to 6	7	7.17	0.00	-0.06
	7 to 8	7	9.72	0.76	-0.87
	9 to 10	6	6.84	0.10	-0.32
	11 to 12	1	0.97	0.00	0.03
	13 to 14	0	0.22	0.22	-0.47
	15 to 16	0	0.30	0.30	-0.55
	17 to 18	0	0.47	0.47	-0.69
	19 to 20	0	0.36	0.36	-0.60
				Chi-square value	375.83
				critical value (df=	
				36, alpha= .05)	51.00

As previously stated in the background chapter, the Aztatlan tradition changed power and trade relations in Western Mexico, particularly in the coastal regions and

Marismas Nacionales (Scott and Foster 2000). If it is true that earlier times are typified by lack of social complexity and thus lack of trade with other sites, then we can expect to find more of the local sources in earlier times. As San Felipe Aztatan grew in prominence, it may have established trade networks with other surrounding communities that had better direct access to other obsidian sources. For this reason, we see the first source which is seemingly the proximal Volcan las Navajas, slowly drop out of the record at more recent levels. It seems as though an important shift took place in production and trade around the level 9-10 time period. This is best illustrated by further collapsing of the levels as illustrated in Table 5. Here we can see that the first color group source does in fact occur at significantly greater frequencies at the lower (earlier) levels.

Table 5. Chi-square analysis. Collapsed source level relationship (bolded residual values are significant)

Color Group	Level	Observed	Expected	Chi-square	Adjusted Residuals
Color 1 (VNN)	1 to 10	379	399.95	1.10	-1.05
	11 to 20	45	24.05	18.25	4.27
Color 2 (LJ)	1 to 10	518	506.54	0.26	0.51
	11 to 20	19	30.46	4.31	-2.08
Color 3 (IXR)	1 to 10	339	332.04	0.15	0.38
	11 to 20	13	19.96	2.43	-1.56
Color 8 (PCH)	1 to 10	121	119.80	0.01	0.11
	11 to 20	6	7.20	0.20	-0.45
Color 9 (MISC)	1 to 10	40	38.67	0.05	0.21
	11 to 20	1	2.33	0.76	-0.87
Chi-square value				27.51	
critical value					
(df=4, alpha .05)				9.49	

Although the temporal patterns seem profound, it is important to consider alternative patterns. Admittedly, this time of “time averaging” across all units relies on a few assumptions. First, to average time into levels across units, we are assuming that corresponding levels at each excavation area are contemporaneous. Secondly, we are assuming that the levels do generally represent a real chronology. If there has been significant stratigraphic mixing, for example, chronology based on the principle of superposition may be misleading and inappropriate. Fortunately, there are ways to test how appropriate these assumptions may be.

I have compared the source distribution of two excavation areas (Calle Morelos and Calle Hidalgo) in Figures 5 and 6. The other two excavation areas have been excluded from this illustration due to small sample size (Plataforma Oeste n=35, and Plataforma Adosada Sur n=37).

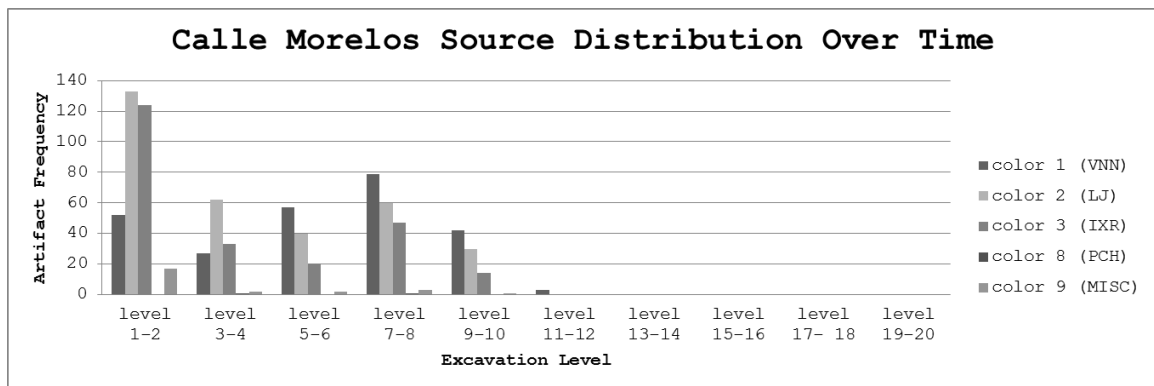


Figure 5. Calle Morelos Source Distribution Over Time. n=850

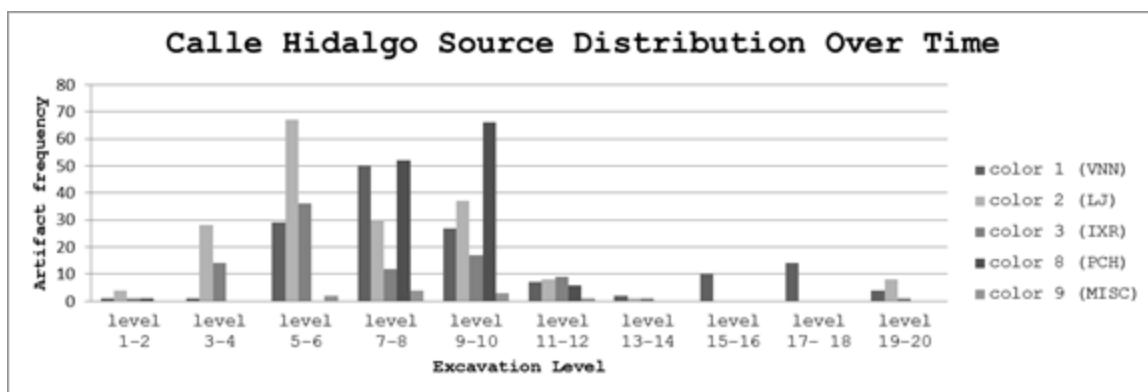


Figure 6. Calle Hidalgo Source Distribution Over Time. n=554

Upon looking at these two graphs, a few important observations can be made. At Calle Hidalgo, we see lithics for the color group likely associated with Volcan las Navajas in moderate frequency early, which is not found at Calle Morelos. By levels 9-10, there is a steady increase of more distantly sourced obsidian at both areas. We also see a gradual decline in flake abundance at both excavation areas after levels 7-8. However, a resurgence of lithics occurs at Calle Morelos at the uppermost levels. Certainly, the distributions over time are not the same for these two areas. But, generally, the overall pattern is similar in both areas with two exceptions. First, the color group associated with Pachuca is virtually unique to Calle Hidalgo. Secondly, while lithics in general are mostly absent at the upper 2 levels at Calle Hidalgo, they are abundant at Calle Morelos. Despite these differences, the general trend of early vs. late levels remains similar to the total distribution trend. So in this case, time averaging may still be an appropriate way to understand general trends for San Felipe Aztatan if used with caution. Importantly, this type of generalization was used on an ordinal scale only.

There may be multiple reasons for the differences in distribution between the two areas. Possibly, stratigraphic mixing may have deemed stratigraphy a poor temporal indicator after all. Unfortunately this cannot be definitively tested until more data becomes available. Future ceramic analysis could irrefutably tell us if stratigraphy is truly temporally related by associating ceramics as temporal markers with specific excavation levels.

While stratigraphic mixing may be present, it seems unlikely to have presented a significant amount of disruption to the general source frequency patterns, due to the general similarities between the two distributions. If the impact of mixing is minimal, I think a more likely scenario may be at play. Color group 8, which statistically represents Pachuca obsidian, is virtually absent from all other excavation areas other than Calle Hidalgo. Therefore, likely, functional differences between the excavation areas have resulted in different use patterns. If this is the case, then the abundance at Calle Morelos at levels 1-2 differs from the decrease at Calle Hidalgo due to either functional differences between the two areas or a shift in activity loci over time; either of which may give credence to the hypothesis of obsidian source as a social attribute.

Changes in Artifact Morphology through Time and by Source

Table 6 presents the frequencies of 5 tool types within the 5 main source groups identified using color. Type 1 is defined as finished prismatic blade fragments. Type 2 is defined as byproducts of core preparation. Type 3 artifacts are byproducts of blade

production and maintenance of the core, and Type 4 is general debitage. Type 5 is formal tools. Types 2, 3, and 4 are all debitage types of some form whereas types 1 and 5 reflected “finished” products. Prismatic blades are the most common artifact type, with manufacturing debitage also plentiful. Formal tools are the least common. There appears to be differences in tool frequency by source, though. Color group 1 (the nearby Volcan las Navajas source) is dominated by debitage, whereas the other sources are primarily prismatic blades. A Chi-square test determined if these differences in abundance are meaningful (Table 7). The null hypothesis for the analysis is that the expected values are the same as the observed values ($H_0: E=O$). The Chi-square value is 1044.97, which exceeds the critical value of 26.30 for 16 degrees of freedom and an alpha of .05. The analysis of adjusted residuals indicates that 16 of 25 combinations were significantly different than expected (Tables 6 and 7). Importantly, the first color group has significantly more debitage (2nd, 3rd, and 4th types), and far fewer prismatic blades (type 1) than expected.

Table 6. Frequency of artifact types by source (bolded values are significant)

Morphological type	Source Group					total
	color 1 (VNN)	color 2 (LJ)	color 3 (IXR)	color 8 (PCH)	color 9 (MISC)	
(1) prismatic blades	5	479	281	122	34	921
(2) byproducts of core prep	272	14	30	1	2	319
(3) byproducts of blade production and maintenance of co	62	32	24	1	0	119
(4) debitage	78	10	10	0	4	102
(5) formal tools	3	1	10	0	1	15
total	420	536	355	124	41	1476

The general preponderance of the debitage from Volcan las Navajas (Color group 1) suggests local reduction and the production of non- blade flaked stone artifacts. Given

that first color group's obsidian dominates earlier levels, this suggests in turn that this obsidian was not reduced using prismatic blade technology. The general absence of debitage from the other sources suggests this material arrived at the site as prismatic blades, presumably through trade. Given that these artifacts become common only in the upper (more recent) levels, lithic tool use may have shifted from the local reduction of Volcan las Navajas obsidian to the importation of finished prismatic blades made from more distant raw material.

Table 7. Chi-square analysis. Source/Artifact type (bolded residual values are significant)

Source	Tool type	Observed	Expected	Chi-square	Adjusted Residuals
color 1	Prismatic Blades	5	262.07	252.17	-15.88
VNN	Core prep byproducts	272	90.77	361.82	19.02
	Blade prep byproducts	62	33.86	23.38	4.84
	General debitage	78	29.02	82.64	9.09
	Formal tools	3	4.27	0.38	-0.61
color 2	Prismatic blades	479	334.46	62.47	7.90
LJ	Core prep byproducts	14	115.84	89.53	-9.46
	Blade prep byproducts	32	43.21	2.91	-1.71
	General debitage	10	37.04	19.74	-4.44
	Formal tools	1	5.45	3.63	-1.91
color 3	Prismatic blades	281	221.51	15.97	4.00
IXR	Core prep byproducts	30	76.72	28.45	-5.33
	Blade prep byproducts	24	28.62	0.75	-0.86
	General debitage	10	24.53	8.61	-2.93
	Formal tools	10	3.61	11.33	3.37
color 8	Prismatic blades	122	77.37	25.74	5.07
PCH	Core prep byproducts	1	26.80	24.84	-4.98
	Blade prep byproducts	1	10.00	8.10	-2.85
	General debitage	0	8.57	8.57	-2.93
	Formal tools	0	1.26	1.26	-1.12
color 9	Prismatic blades	34	25.58	2.77	1.66
MISC	Core prep byproducts	2	8.86	5.31	-2.30
	Blade prep byproducts	0	3.31	3.31	-1.82
	General debitage	4	2.83	0.48	0.69
	Formal tools	1	0.42	0.82	0.90

Chi-square value	1044.97
critical value (df=	
16, alpha= .05)	26.30

It is also possible that the differences in reduction strategies are the result of differences in initial cobble size. If Volcan las Navajas has only small cobbles, they may have been inappropriate for polyhedral core production. This could account for the abundance of reductive flakes not associated with polyhedral production, and the relative few prismatic blades. This is unlikely though for several reasons. First, despite potential slight qualitative variation within sources, Glascock et al. (2010) have indicated that the Volcan las Navajas source is characterized by large bedrock outcrops where cobbles up to 30 cm in length are often found. This is comparable to the other sources and certainly large enough for the production of prismatic blade cores (Crabtree 1968). Second, the flakes from color group 1 (likely associated with Volcan las Navajas) are not smaller than flakes from the other sources, as might be expected if cobble size was initially smaller.

Second, cortex patterns do not appear to reflect small Volcan las Navajas obsidian cobbles. As discussed in greater detail above, the amount of surface area compared to total volume will be greater in smaller cobbles. The premise is that small cobbles will produce more flakes with cortex (Andrefsky 2005:117).

Table 8 displays the frequencies of the four cortical levels as defined above in association with each of the 4 identified sources and the miscellaneous group (group 9). Non-cortical flakes are heavily represented while cortical flakes (defined as any flake with cortex on the dorsal surface) in general constitute only a small minority of the

assemblage. Of the cortical flakes, the majority are from color group 1. A Chi-square analysis reflects that these abundances are meaningful (Table 8). The null hypothesis is that the expected values of cortex are the same as the observed values given the frequency of cortical flakes ($H_0: E=O$). The Chi-square value is 25.07, which exceeds the critical value of 21.03 for 12 degrees of freedom and an alpha of .05. The residual values indicate that there are more source 1 (seemingly the Volcan las Navajas source) flakes with cortex covering 1 to 50% and 51 to 99% of their dorsal surfaces than expected by chance. When combined with the differences in flake morphology/tool type presented in Table 7, the presence of the color group 1 flakes and the absence of similar cortical flakes from other sources indicate the likely local reduction of that color group's obsidian, which seems to be Volcan las Navajas, and the importation of the prismatic blades from other areas.

Though significant, it must be noted, that cortical flakes are less common than non-cortical flakes. So, though it is likely that some generalized reduction was taking place with Volcan las Navajas, given its association with color group 1, the possibility of cobble size being the sole explanation of the over-representation of non-blade lithics of this source seems unlikely. Furthermore, if the extraction of obsidian from the initial sources resulted in complete cortex removal at the source location, little cortex will be represented in the assemblage regardless of cobble size. Regardless, the extremely limited number of cortical flakes relative to the total number of flakes suggests that cobbles were of a sufficient size to allow the removal of many interior flakes. Therefore,

it still seems most likely that the difference is caused by different reduction strategies as opposed to substantial differences in initial cobble size.

Table 8. Chi-square analysis. Source and Cortex Amount (bolded values are significant)

Source	Cortex	Observed	Expected	Chi-square	Residual value
Color 1	No cortex	409	419.03	0.24	-0.49
VNN	<50% cortical	9	4.27	5.24	2.29
	50%-99%				
	cortical	7	2.85	6.06	2.46
	100% cortical	2	0.85	1.54	1.24
Color 2	No cortex	542	534.83	0.10	0.31
LJ	<50% cortical	2	5.45	2.18	-1.48
	50%-99%				
	cortical	0	3.63	3.63	-1.91
	100% cortical	1	1.09	0.01	-0.09
Color 3	No cortex	354	352.30	0.01	0.09
IXR	<50% cortical	3	3.59	0.10	-0.31
	50%-99%				
	cortical	2	2.39	0.06	-0.25
	100% cortical	0	0.72	0.72	-0.85
Color 8	No cortex	127	124.63	0.05	0.21
PCH	<50% cortical	0	1.27	1.27	-1.13
	50%-99%				
	cortical	0	0.85	0.85	-0.92
	100% cortical	0	0.25	0.25	-0.50
Color 9	No cortex	40	41.22	0.04	-0.19
MSC	<50% cortical	1	0.42	0.80	0.89
	50%-99%				
	cortical	1	0.28	1.85	1.36
	100% cortical	0	0.08	0.08	-0.29
Chi-square value				25.07	
Critical Value (df=12, alpha= .05)				21.03	

Continuing with Cortex analysis, Table 9 indicates that cortical flakes are seemingly over-represented in lower levels. This certainly fits the hypothesis as stated earlier of local production of the color group 1 (likely Volcan las Navajas) obsidian,

which has the higher frequency of cortex demonstrated above, at earlier times. Table 9 presents a Chi-square analysis that indicates a statistical correlation between amount of cortical flakes and excavation level, with more cortical flakes at earlier times relative to non-cortical flakes. The null hypothesis for this analysis is that the expected values are the same as the observed values ($H_0: E=O$), and the Chi-square value is 51.77, which exceeds the critical value of 40.11 for 27 degrees of freedom and an alpha of .05. The residuals values indicate that 4 of the 40 combinations were significantly greater than expected.

Table 9. Chi-squared analysis. Cortical flakes per level (bolded values are significant).

Level	Cortex	Observed	Expected	Chi-square	Residual Value
levels 1-2	No cortex	348	346.05	0.01	0.11
	<50% cortical	4	4.91	0.17	-0.41
	50%-99% cortical	2	2.34	0.05	-0.22
	100% cortical	0	0.70	0.70	-0.84
levels 3-4	No cortex	195	197.46	0.03	-0.18
	<50% cortical	5	2.80	1.72	1.31
	50%-99% cortical	1	1.34	0.08	-0.29
	100% cortical	1	0.40	0.89	0.95
levels 5-6	No cortex	266	262.96	0.04	0.19
	<50% cortical	1	3.73	2.00	-1.41
	50%-99% cortical	2	1.78	0.03	0.17
	100% cortical	0	0.53	0.53	-0.73
levels 7-8	No cortex	349	349.96	0.00	-0.05
	<50% cortical	5	4.97	0.00	0.01
	50%-99% cortical	2	2.37	0.06	-0.24
	100% cortical	2	0.71	2.34	1.53
levels 9-10	No cortex	244	241.45	0.03	0.16
	<50% cortical	2	3.43	0.59	-0.77
	50%-99% cortical	1	1.63	0.25	-0.50
	100% cortical	0	0.49	0.49	-0.70
levels 11-12	No cortex	31	32.26	0.05	-0.22
	<50% cortical	2	0.46	5.19	2.28
	50%-99% cortical	0	0.22	0.22	-0.47

levels 13-14	100% cortical	0	0.07	0.07	-0.25
	No cortex	7	8.80	0.37	-0.61
	<50% cortical	1	0.13	6.13	2.47
	50%-99% cortical	1	0.06	15.01	3.87
	100% cortical	0	0.02	0.02	-0.13
levels 15-16	No cortex	10	10.77	0.06	-0.23
	<50% cortical	0	0.15	0.15	-0.39
	50%-99% cortical	1	0.07	11.77	3.43
	100% cortical	0	0.02	0.02	-0.15
levels 17-18	No cortex	17	17.60	0.02	-0.14
	<50% cortical	1	0.25	2.25	1.50
	50%-99% cortical	0	0.12	0.12	-0.34
	100% cortical	0	0.04	0.04	-0.19
levels 19-20	No cortex	12	11.73	0.01	0.08
	<50% cortical	0	0.17	0.17	-0.41
	50%-99% cortical	0	0.08	0.08	-0.28
	100% cortical	0	0.02	0.02	-0.15
Chi-square value				51.76	
Critical value					
(df=27, alpha= .05)				40.11	

The strength of the association between level and cortex amount is even better illustrated by collapsing the excavation levels (Table 10). I have here collapsed the levels into two equal units (1-10 and 11-20) and have collapsed the cortex codes to cortical vs. non-cortical flakes. The null hypothesis for this analysis is that the expected values are the same. The critical value is 5.99 for 2 degrees of freedom and an alpha of .05. The Chi-square value of 9.921 exceeds this critical value, thus the null hypothesis is rejected. The adjusted residuals indicate lower levels do in fact have more cortical flakes than expected. The differences in cortex suggests larger cobble size for color group 1 (Volcan

las Navajas) obsidian and indicates a change in obsidian reduction and trade patterns through time.

Table 10. Chi-squared analysis. Collapsed level and cortex association (bolded residual value is significant)

Level	Cortex	Observed	Expected	Chi-square	Adjusted Residuals
1-10	Non-cortical	1402	1397.87	0.01	0.11
	Cortical	28	32.13	0.53	-0.73
11-20	Non-cortical	77	81.13	0.21	-0.46
	Cortical	6	1.87	9.17	3.03
Chi-square value=				9.921	
Critical value (df=2, alpha=.05)=				5.99	

The two preceding tables indicate a statistical correlation between amount of cortical flakes and excavation levels. This association is represented by the greater amounts of cortical flakes at earlier times relative to non-cortical flakes. In more recent times, cortical flakes are found less frequently relative to non-cortical flakes. The null hypothesis for this analysis is that the expected values are the same. The critical value is 5.99 for 2 degrees of freedom and an alpha of .05. The Chi-square value of 9.921 exceeds this critical value, thus the null hypothesis is rejected. The residuals values indicate that 1 of the 4 combinations was significantly greater than expected.

Finally, flake weight can be used to help evaluate the proposition that Volcan las Navajas cobbles are too small for prismatic blade reduction. Flake weight is an excellent proxy for flake size (heavy obsidian flakes must necessarily be larger than lighter obsidian flakes). Large and small flakes can be made from large cobbles, but no flake can

be larger than the parent core, because flaked stone reduction is a reductive technology. Thus, small Volcan las Navajas cobbles would prevent a large number of large flakes relative to the prismatic blades. However, the first color group flakes are not smaller than flakes from the other groups, as would be expected if cobble size was initially smaller. Field visits could ultimately confirm the proposition of no effect of cobble size on the distribution of blades vs. non-blades in Western Mexico. Currently, however, we must rely strictly on published resources (i.e. Glasscock et al. 2010), and analysis such as is presented here.

I have also looked at source group and mean weight. I have considered each source group as an independent sample and compared them against each other to find significant differences. The summary statistics for each source group are shown in Table 11. I have first computed a single factor ANOVA test to evaluate the null hypothesis is that mean flake weights for the all of groups are equal. At 4 degrees of freedom, the F critical value is 2.37, which is exceeded by the F value of 9.79. The results, shown in Table 12 indicate that there is a difference between groups in mean lithic size. However, in analyzing this variation, only 2.55% of the variation comes from between groups, while over 97% is a result of intra-group variation. Of the between group variation, the majority can be attributable to the characteristics of the debitage from the color group likely associated with Volcan las Navajas. However, contrary to the pattern expected if the Volcan las Navajas cobbles were smaller, the flakes from this group weigh more than the other sources, indicating that the initial cobble size was more than adequate for the production of prismatic blades.

Table 11. Summary statistics for weight per source group

Color group	Count	Average Weight	Standard Deviation
color 1	427	2.16	2.72
color 2	545	1.24	1.82
color 3	359	1.43	3.42
color 8	128	1.22	0.95
color 9	42	2.36	3.53

Table 12. ANOVA test. Mean weight per source group

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	255.6208	4	63.9052	9.789712	8.10797E-08	2.377876
Within Groups	9765.577	1496	6.527792			
Total	10021.2	1500				

To see which source groups are significantly different, I have conducted paired t-tests for each possible combination of source groups (Table 13). These tests indicate that color group 1 (Volcan las Navajas) is different than all other groups except group 9 (which is a collection of various undefined sources). Importantly, this test indicates that significant differences exist between flake sizes independent of cobble size. Most likely, these differences can be attributable to reduction techniques

Table 13. Summary of two tailed t-test for mean weight difference

	<i>t- stat</i>	<i>t- crit</i>	<i>significance</i>
1 v. 2	6.016757	1.96332	different
1 v. 3	3.2318	1.963469	different
1 v. 8	5.979593	1.96435	different
1 v. 9	-0.36452	2.012896	no difference
2 v. 3	-1.00272	1.964797	no difference
2 v. 8	0.119853	1.966327	no difference
2 v. 9	-2.04276	2.016692	different
3 v. 8	1.058842	1.965046	no difference
3 v. 9	-1.61476	2.008559	no difference
8 v. 9	-2.06429	2.016692	different

If we are to consider flake length, it becomes apparent that if Volcan las Navajas is truly associated with color group 1, it was certainly capable of producing large enough cobbles for prismatic blade production. Of the entire assemblage, only one complete prismatic blade was recovered. This blade is 3.5 cm long and from the color group associated with the Ixtlan del Rio source. Two of the complete flakes from the color group likely associated with VNN are in fact longer than 3.7 cm. and several (n=14) of the fragmented flakes from the this color group are as long or longer, with the longest flake measuring 5.3 cm. Furthermore, one of the five prismatic blades identified from this group is larger than the only complete blade found (3.8cm). Given that the length of the flake is constrained by the size of the parent core, many if not all of the unaltered obsidian cobbles used at San Felipe Aztatan were sufficiently large to make prismatic blades, despite source. I have therefore concluded that cobble size is not a factor in the ultimate reduction strategies from obsidian from different sources.

Correlation of source and excavation area

Finally, I want to examine if the sources occurred in different proportions in the various excavation areas. To test this, I have conducted a Chi-square analysis comparing the expected frequencies of the four source groups by each excavation unit (Table 14). The null hypothesis for this analysis is that the expected values are the same as the observed values ($H_0: E=O$), and the Chi-square value is 241.82, which exceeds the critical value of 21.03 for 12 degrees of freedom and an alpha of .05. Adjusted residuals indicate that 7 of the 24 combinations are statistically significant, demonstrating that

there is proportionally more artifacts from certain sources at specific locations (i.e. Pahuca obsidian at Calle Hidalgo) and significantly less of other sources in other areas. Notably, 126 of the 128 group 8 artifacts seemingly from the distant Pachuca source in Hidalgo are found at the Calle Hidalgo area. Presently, it is unclear why this anomaly exists.

Table 14. Chi-square analysis. Correlation between source frequency and excavation area (bolded residual values are significant)

Color group	Excavation Area	Observed	Expected	Chi-square	Adjusted Residuals
Color 1 VNN	calle hidalgo (1)	144	157.94	1.23	-1.11
	calle morelos (2)	261	242.83	1.36	1.17
	plataforma adosada sur (3)	12	10.44	0.23	0.48
	plataforma oeste (4)	10	15.79	2.13	-1.46
Color 2 LJ	calle hidalgo (1)	185	206.39	2.22	-1.49
	calle morelos (2)	329	317.33	0.43	0.66
	plataforma adosada sur (3)	14	13.64	0.01	0.10
	plataforma oeste (4)	30	20.64	4.25	2.06
Color 3 IXR	calle hidalgo (1)	92	132.79	12.53	-3.54
	calle morelos (2)	241	204.16	6.65	2.58
	plataforma adosada sur (3)	10	8.77	0.17	0.41
	plataforma oeste (4)	16	13.28	0.56	0.75
Color 8 PCH	calle hidalgo (1)	126	47.34	130.67	11.43
	calle morelos (2)	2	72.79	68.85	-8.30
	plataforma adosada sur (3)	0	3.13	3.13	-1.77
	plataforma oeste (4)	0	4.73	4.73	-2.18
Color 9 MISC	calle hidalgo (1)	13	15.54	0.41	-0.64
	calle morelos (2)	28	23.89	0.71	0.84
	plataforma adosada sur (3)	1	1.03	0.00	-0.03
	plataforma oeste (4)	0	1.55	1.55	-1.25
Chi-square value				241.82	
Critical Value (df=12, alpha .05)				21.03	

Garduno and Gamez (2005) have hypothesized that all four of these excavation units represent household trash. Likely, if this is household refuse, it should then reflect differences in households and the availability of various obsidian resources to specific households. However, the excavation areas Plataforma Adosada Sur and Plataforma Oeste may simply be moundfill and out of context from the original households from which the soil originated. This moundfill is apparently Cerritos phase in origin based on ceramic analysis conducted by Garduno, which is similar to the other excavation units. As a result, if we are to accept that color group 8 generally represents the Pachuca source, it appears that all households reflected in the current excavations had access to traded obsidian but that certain areas/individuals at the site had greater access to obsidian from the more distant Pachuca source. As I discuss in the final chapter, this likely reflects the presence of social differentiation and the use of obsidian to reinforce the increased social inequality associated with the Aztatlan system.

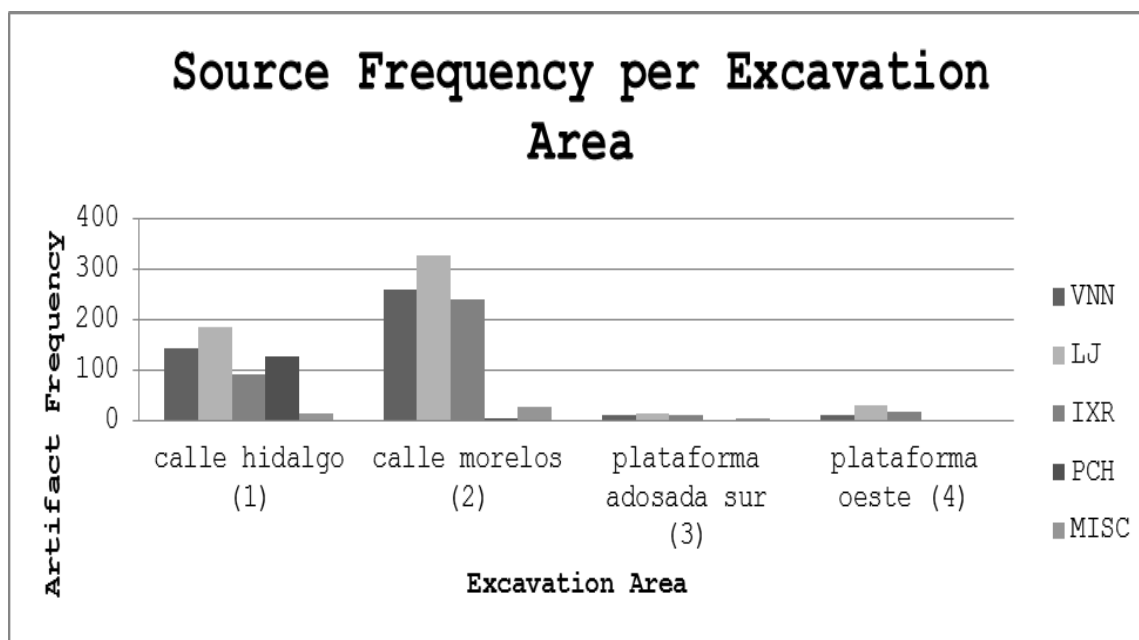


Fig 7. Source Frequency per Excavation Area.

Chapter 5

Discussion and Concluding Remarks

The preceding research has focused on three related issues: changes in trade relations as they are reflected in obsidian sources through time, differences in artifact form through time and by raw material source, and differences in the raw materials represented at the four excavation areas. The correspondence between color group and geochemical source are not perfect, but is reliable enough to allow strong patterns to be identified. In fact, any difficulty in sourcing and stratigraphic mixing would tend to decrease the strength of the differences such as the shift from color group 1, which is likely associated with the closest obsidian source Volcan las Navajas, to the other presumably more distant sources during later times. Further, reduction strategies shifted from what appears to be the local production of tools using non-prismatic reduction strategies to the general importation of prismatic blades made elsewhere. The implications of this are profound. I believe that the earlier group 1 materials that statistically represent Volcan las Navajas, reflect a period prior to the development of the extensive trade networks that typify the Aztatlán tradition. Currently ceramic analysis is being performed by INAH archaeologists Mauricio Garduno Ambríz to confirm this. In medial levels, the color group 8 (which represents the exotic Pachuca source) occurs in great relative abundance. This certainly indicates the height of the Aztatlán trading system. Subsequently, this color group becomes far less common. This is likely due to

the incursion of the developing Tarascan Empire that may have disrupted the trade relations with central Mexico and is thought to have ultimately led to the decline of West Mexican regional centers and the greater Aztatlan tradition (Garduno, personal communication). Concurrently, other more local sources remain as trade items. If color group 1 truly represents the Volcan las Navajas source, as the XRF analysis indicates, this is likely indicative of the retention of more localized trade networks while Volcan las Navajas was continuously used for domestic production and use as formal tools. This would have maintained the Aztatlan tradition but weakened its greater regional influence.

Artifact form has a significant relationship with the raw material source. This has equally profound effects. By identifying a positive relationship between generalized reduction debitage and color group 1 (likely Volcan las Navajas), I have concluded that this source was consistently accessed for local production of everyday lithics. Conversely, the other more distant sources were accessed solely through trade to produce finer prismatic blades. This would have made other sources more valuable and indicative of not only an extensive trade system but a burgeoning social and economic system based on access to exotic resources. Although it is possible that prismatic blade technology simply did not exist at San Felipe Aztatan and trade for blades was the only way to get them, it seems quite unlikely given the complexity of other artifacts such as ceramics and the social complexity necessary for large mound construction.

Finally, I have found differentiation within the site between excavation areas based on source frequency. I speculate that more affluent households would have access to more distant sources. Therefore, if this is the case, we would expect to find the

Pachuca lithics primarily in a limited number of elite households. This has been confirmed in this study by the concentration of nearly the entire color group 8 obsidian, which seems to reflect Pachuca, in only one excavation unit (Calle Hidalgo). The limited scope of the excavation precludes a full understanding of the distribution of what seems to be Pachuca obsidian, but it does indicate differential access to imported obsidian and, presumably, social inequality. Subsequent study can further clarify the nature and degree of social differentiation using ceramic data and more extensive excavations. If this could be confirmed, we could greatly improve our understanding of the social economy of the Aztatlan tradition.

Still, the pattern that I have identified is robust, and its implications can be evaluated using a Neo-Marxist theoretical model. Briefly, a Neo-Marxist approach to archaeology, not unlike classical Marxism, explores the impact of social conflict and status differences on past cultural structures. Prior to 1960, Marxism was largely ignored in American academia; likely due to its political implications and our fear of anything socialist. However, it has proven to be useful for exploring economic and status conflict in prehistoric, historic, and even modern cultures. The Marxist approach to archaeology began with Marx's study of the political economy (Marx 1906). Based upon the dialectic (the idea that there is conflict between two groups that produces emergent "synthesis"), this way of thinking focuses on the historical reality of the lives of past people, which is reflected in the material record. The ideological constructs thus create a framework for pronouncing the dynamic imbalanced class relationships and conflicts that are inherent in all cultures. So, by agreeing upon an ideology across classes, elite can legitimize their

own superior position, thus reducing the potential of conflict and rejection of the class system.

Neo-Marxism arose as a slight variation of classical Marxism, and focuses on ideology as a legitimating and self-perpetuating tool for elite domination. In this model, ideology (or arbitrary value placed on various obsidian sources in this circumstance), is used as a limiting factor to exclude groups of people for the ultimate perpetuation of the elite class. The exclusive elite access to “valuable” sources limits the ability of the common class to take some of the power back. Given that economic power translates to political power, it is necessary for elites to generate difficult to attain commodities to separate themselves from the common class.

Gramsci (1971) has argued that inscribed meaning (such as arbitrary values) may be sustained even when such values contradict reality. In San Felipe Aztatan, the value of exotic obsidian could remain socially powerful despite having no real value. Nineteenth century slaves in the United States, for example, inadvertently maintained the elevation of white culture by acknowledging its greater value than their own through emulation. However, emulation was done as a social critique of that ordered society. By attaining “white” goods, they were attempting to attain more social capital for themselves, while at the same time legitimating the arbitrary value being imposed upon them by the dominating slave holding class (Matthews et al 2002). We can see this common dialectic issue at San Felipe Aztatan. By trying to acquire exotic lithics to raise one’s own status, one is inadvertently legitimizing their own social domination.

Marxist (and its “neo” variant) archaeology is focused on cultural change and variation rather than stasis and similarities within and between cultures. This change and variation, unlike processual models, is instigated internally due to the dialectic (Fitzhugh 2001; McGuire 2008). This is a fundamental shift from Spencerian versions of evolution. Given their importance in determining and changing social structures, the factions and their conflict can ideally also be seen in the archaeological record. The added emphasis of Neo-Marxism on the ideological constructs coupled with the emphasis on temporal change and internal variation makes this an excellent theoretical model for this project.

Marxists archaeology does not necessarily offer a direct causal relationship for specific cultural attributes, but instead offers a more general causal relationship in which social inequalities are facilitated through various cultural attributes and systems such as ideology. It can point us in the right direction by elucidating which attributes may be most profitable for us to consider to gain a better understanding of a cultural system. Thus, if we can identify which attributes were “valuable” (be they economic, political, or ideological) we can better understand the greater social structure of the society. Marxism is ultimately materialistic in that it assumes the primacy of the archaeological record as a real reflection of the behavior of a culture. Using this, we can then look at the record to shed light on the cultural practices at these Aztatlan sites. Therefore, in identifying obsidian source as a culturally valuable attribute, we can create knowledge about San Felipe Aztatan’s greater social construction.

In Marxist archaeology, there are two ways to look at the material record; the logic of the dialectic, and the theory of social development. The dialectic, put simply, is

the relationship between oppositions. Social development is brought forth through this dialectic. In this sense, these two viewpoints are more of an issue of scope and based strictly on what specific research questions target. Current Neo-Marxist anthropologists often employ the concept of praxis, which assumes human agency is paramount to understanding and explaining human behavior (and behavioral change) (McGuire 2008). This self-reflexivity has been discussed at length by Leone (1984, 1987, 1995) and Saaita (2003). However, the limited information about San Felipe Aztatan doesn't provide the resolution necessary to talk about human agency, except in the most general sense (i.e., the desire of elites to demonstrate their status using Aztatlan goods). Fortunately, this is adequate for the application of a general Marxist perspective, even if additional research will allow for a more nuanced understanding.

Ohnerson et al. (2012) have demonstrated that all sites that he sampled (Chacalilla, San Felipe Aztatan, Coamiles, and the Banderas Valley site) seem to utilize the same generally local obsidian sources (notwithstanding the San Felipe Aztatan site which also features at least some Pachuca obsidian), although only the Chacalilla lithics have been thoroughly analyzed. Significantly, I have found the same patterns at San Felipe Aztatan as were found at Chacalilla. Currently, ceramic analysis is being conducted at a third Aztatlan center, Coamiles, which may further illustrate the use of resources to create and perpetuate the complex social relationships of domination and subservience through resource restriction.

Given the premises of Neo-Marxist archaeology, we can posit that differential distribution of obsidian sources reflect a real conflict within society focused on class

differentiation and power relations between sites. Changing source frequencies over time will reflect changes in perceived value of various sources and changes in availability associated with increased integration of Aztatlan elites during the rise of the Aztatlan system (which would have altered the perceived value of specific sources). These changes may have been facilitated by elites to maintain economic and social control over the common class in order to maintain their high social status. We can then look at the various attributes described above individually and in coordination with each other and construct hypotheses for further analysis. This analysis demonstrates that color group 1 (seemingly Volcan las Navajas) was likely directly procured by the San Felipe population. It was broadly distributed with an emphasis in household production and use. This changed as the rise of the Aztatlan system allowed the trade of obsidian from additional sources.

Given that there is little difference between in the quality of the obsidian from the various sources identified here, the shift from the Group1 obsidian that likely comes from Volcan las Navajas, to the more distant sources reflects cultural factors that transcend a simple desire for good quality obsidian. Through time, individuals with greater wealth and status and would have utilized their status by obtaining obsidian from more distant sources (such as Pachuca obsidian from Hidalgo), specifically as finished products. Access to more distant sources was thus used as class markers. In this way, it was not an issue of which source produced better quality obsidian blades, but rather which source had the most perceived value based on other factors, such as rarity, origin, and cost. Although the general ubiquity of the non-local obsidian appears to indicate that most

people at San Felipe Aztatan had access to more distant sources, the uneven distribution of Pachuca obsidian, which is seemingly represented by color group 8, suggests both that it was valued differently (more) than other sources, and that only a more limited subset had access to it.

However, despite the rising popularity of exotic sources, color group 1, which likely represents Volcan las Navajas, is still continually accessed. This source, therefore, was likely continually used for expedient flake technology and household use, which explains why it never disappears from the record completely. As the trade network seemingly developed around level 9-10 as evidenced by an influx of more costly distant sourced obsidian, the site was likely gaining influence facilitated by economically powerful elites. Prior to these trade networks, the first color group, which seems to be Volcan las Navajas, dominate the record demonstrating a common use throughout the social structure. As the elites gained power/wealth they would have had greater access to exotic trade items. As new obsidian sources were traded in, the higher class would have used them, while lower classes would have resorted to continuing to use the source of color group 1 which appears to be the proximal Volcan las Navajas. In the future, this hypothesis can be tested through subsequent obsidian analysis in conjunction with ceramic, architectural, and bioarchaeological analysis.

Conclusion

This project can lend itself to a greater understanding of the Aztatlan tradition and the intricacies of its social economic systems. Given that trade was such an integral part of the Aztatlan complex, we can speculate that the merchant class achieved greater status

due to their access to exotic goods. Therefore, we can expect a correlation between the rise of extensive trade networks in the Early Postclassic and the increased social complexity of Aztatlan sites. I have illustrated the introduction of these trade networks through this analysis. I have also attempted to identify social differentiation through tool type and source frequencies associated with excavation areas. Thus, as trade increased, finished prismatic blades were seemingly imported rather than domestically produced. This, of course, relates to increased social complexity as indicated by differential access to specific valued sources by various household areas.

Likely, the elites had access to “higher quality” obsidian. This “higher quality” was certainly not an issue of qualitative or functional differences. Rather, it was of perception only. By excluding the lower classes from certain trade networks, they effectively made the traded obsidian more valuable due to its limited dispersal within San Felipe Aztatan. What was considered valuable, likely changed over time due to availability, supply and possibly ideology (although presently this is purely speculation).

Ultimately, more analysis could be helpful in substantiating such claims. Evidence of differential diet would also be useful and could be observed through faunal analysis in household middens of commoners and elites alike. As was expressed in previous studies (e.g. Feinman et al. 2006), identifying elite households through changes in architectural elements could correlate with materialistic differences in household debitage and clustering of specific tool types (i.e. certain obsidian sources). I hypothesize that the patterns are out there for such complex societies as were prevalent in the Aztatlan tradition. The question simply is: can we identify them? In this project, I am taking the

first step to identifying the social differentiation and the dialectic relationships that certainly existed within this Aztatlan regional center. And I look forward to future work to be conducted in the area to confirm these suspicions.

Future studies could also benefit from addressing these issues at other local sites. Given the known association through trade of the various coastal sites, the same patterns should emerge. Furthermore, I understand the excavations at San Felipe Aztatan were limited to just four excavation areas. In the future, more excavation units in other areas of the site may assist in understanding the anomalous pattern of source distribution over the site between areas. Identifying elite household or ritual areas may assist in defining various socially stratified populations. If correlated with the obsidian data presented here, a valuable method can be created for locating elite areas. If we can establish that specific sources are associated with exclusive social groups, we can then identify these groups strictly based on obsidian source frequencies saving valuable time and resources by deeming source frequency in and of itself an important reflection of social status.

Researchers have only recently focused on the socio-economic organization of the Aztatlan tradition. In general, the coastal plain has been long ignored by researchers resulting in a few culture histories and little more than salvage excavations by INAH. However, due to the extensive trade networks and great influence of the Aztatlan tradition, it is important to understand the cultural aspects of this area. Now more than ever, due to the rapid destruction of San Felipe Aztatan as well as other regional sites, we must focus our attention to these sites and create a comprehensive understanding of Aztatlan social systems before they are gone forever.

References Cited

Andrefsky, William Jr.

2005 *Lithics: Macroscopic Approaches to Analysis*. 2nd edition. Cambridge Manuals in Archaeology, Cambridge University Press.

Anguiano, M.

1992 *Nayarit: Costa y Antiplanicie en el Momento del Contacto*. Universidad Nacional Autonoma de Mexico, Mexico City.

Aoyama, K.

1991 Litica. In *Investigaciones arqueologicas en la region de La Entrada*, vol. 2, edited by S. Nakamura, K. Aoyama, and E. Uratsuji, pp. 39-203. Servicio de Voluntarios Japoneses para la Cooperacion con el Extranjero y el Instituto Hondureno de Antropologia e Historia, San Pedro Sula.

Beekman, Christopher S.

2010 Recent Research in Western Mexican Archaeology. *Journal of Archaeological Research* 18: 41-109.

Beltran Medina, J.C.

2000 Sitio Arqueologico El Malinal de Higuers Blanca. *UNIR* 24-25:4-12. Universidad Autonoma de Nayarit, Tepic.

Blanton, Richard E., Gary M. Feinman, Stephen A. Kowaleski, and Peter N. Peregrine

1996 A Dual Processual Theory for the Evolution of Mesoamerican Civilization. *Current Anthropology* 37:1-14.

Braswell, G. E., E.W. Andrews V, and M. D. Glascock

1994 The Obsidian Artifacts of Quelepa, El Salvador. *Ancient Mesoamerica* 5:173-192.

Braswell, G.E., J.E. Clark, K. Aoyama, H.I. McKillop, and M.D. Glascock

2000 Determining the Geological Provenance of Obsidian Artifacts from the Maya Region: A Test of the Efficacy of Visual Sorting. *Latin American Antiquity* 11:269-282.

Carpio Rezzio, E. H.

1993 Obsidian at Balberta. In *The Balberta Project: The Terminal Formative - Early Classic Transition on the Pacific Coast of Guatemala*, edited by F. J. Bove, S. Medrano B., B. Lou P., and B. Arroyo L., pp. 83-106. Memoirs in Latin American Archaeology, No. 6. University of Pittsburgh, Pittsburgh.

- Clark, J.E.
 1982 Manufacture of Mesoamerican prismatic blades, an alternative technique. *American Antiquity* 42:355-376.
- 1985 Platforms, Bits, Punches, and Vises: A Potpourri of Mesoamerican Blade Technology. *Lithic Technology* 14:1-15.
- Clark, J.E., and D.D. Bryant
 1997 A Technological Typology of Prismatic Blades and Debitage from Oje de Agua, Chiapas, Mexico. *Ancient Mesoamerica* 8:111-136.
- Cotterell, Brian and Johan Kamminga
 1987 The Formation of Flakes. *American Antiquity* 52 (4): 675-708.
- Covarrubias, Miguel
 1957 *Indian Art of Mexico and Central America*. Alfred A. Knopf. New York.
- Crabtree, Donald
 1968 Mesoamerican Polyhedral Cores and Prismatic Blades. *American Antiquity* 33 (4): 446-478.
- Darling, J.A.
 1993 Notes on Obsidian Sources of the Southern Sierra Madres Occidental. *Ancient Mesoamerica* 4:245-253.
- 1998 *Obsidian Distribution and Exchange in the North-Central Frontier of Mesoamerica*. Unpublished PhD. Dissertation, Department of Anthropology, University of Michigan, Ann Arbor.
- Darling, J.A., and F. M. Hayashida
 1995 Compositional Analysis of the Huitzila and La Lobera Obsidian Sources in the Southern Sierra Madre Occidental, Mexico. *Journal of Radioanalytical and Nuclear Chemistry* 196:245-254.
- Duverger, C.
 1998 Coamiles, Nayarit: hacia una periodizacion. En *Antropologia e Historia del Occidente de Mexico*, vol 1. pp 609-628. Memorias de la XXIV Mesa Redonda de las Sociedad Mexicana de Antropologia. Universidad Nacional Autonoma de Mexico y Sociedad Mexicana de Antropologia, Mexico City.
- Ekholm, G.F.
 1942 Excavations at Guasave, Sinaloa, Mexico. *Anthropological Papers of the American Museum of Natural History* 38(2). New York.

Esparza Lopez, Rodrigo

- 2008 Los Yacimientos de Obsidiana de el Pedernal-La Mora: Una Explotacion Constante durante el Desarrollo de la Tradicion Teuchitlan. In *Tradicion Teuchitlan*, edited by P.C. Weigand, C. Beekman, and R. Esparza, pp. 143-166. El Colegio de Michoacan y el Secretaria de Cultural del Estado de Jalisco, Zamora and Guadalajara.

Evans, Susan Toby

- 2004 *Ancient Mexico & Central America*. Thames and Hudson Ltd. London.

Feinman, Gary M., Linda M. Nichols, and Helen R. Haines

- 2006 Socioeconomic Inequality and the Consumption of Chipped Stone at El Palmillo, Oaxaca, Mexico. *Latin American Antiquity* 17(2):151-175.

Fitzhugh, Ben

- 2001 Risk and invention in human technological evolution. *Journal of Anthropological Archaeology* 20: 125-167.

Foster, M.S.

- 2001 Guasave and Related Sites (Sinaloa, Mexico). In *Archaeology of Ancient West Mexico and Central America: An Encyclopedia*, edited by S.T. Evans and D.L. Webster, pp. 304-306. Garland Publishing, New York.

Gamez, Lorena, and Mauricio Garduno Ambriz

- 2001 *Salvamento Arqueologico Autopista Entronque San Blas, Nayarit-Mazatlan, Sinaloa (tramo Nayarit)*. Materiales Arqueologicos/ Informe Tecnico Final. Archivo Tecnico del Centro INAH Nayarit, Tepic.

Gamez, Lorena and Mauricio Garduno Ambriz

- 2003 *Rescate Arqueologico CECYTEN, Plantel 06 San Felipe Aztatlan, Municipio de Tecuala (Nayarit)*. Reporte tecnico de los trabajos de sondeo/ Analisis de materiales arqueologicos. Archivo Tecnico del Centro INAH Nayarit, Tepic.

Garduno Ambriz, Mauricio

- 2006 *Investigaciones arqueologicas en Cerrro de Coamiles, Nayarit*. Reporte tecnico final de la primera temporada de campo (2005). Archivo Tecnico del Centro INAH Nayarit, Tepic.
- 2007 Arqueologia de rescate en la cuenca inferior del rio Acaponeta. Diario de Campo (*Boletin Interno de los Investigadores del Area de Antropoogia, CONACULTA-INAH*) 92: 36-52.

- Garduno, Ambriz, Mauricio, and Lorena Gamez Eternod
 2005 *Programa Emergente de Rescate Arqueologico en San Felipe Aztatlan, Municipio de Tecuala (Nayarit)*. Informe Tecnico Final/ Trabajos de Sondeo Arqueologico. Archivo Tecnico Centro INAH Nayarit, Tepic.
- Garduno Ambriz, M., L. Gamez Eternod, and M.E. Perez Rivas
 2000 Salvamento Arqueologico en el franja costera noroccidentl de Nayarit. *UNIR* 23-24:4-12. Universidad Autonoma de Nayarit, Tepic.
- Glassow, M.A.
 1967 The Ceramics of Huistla, a West Mexico Site in the Municipality of Etzatlan, Jalisco. *American Antiquity* 32: 64-84.
- Glascok, M.D., P.C. Weiland, R. Esparza Lopez, M.A. Ohnersorgen, M. Garduno Ambriz, J. B. Mountjoy, and J.A. Darling
 2010 Geochemical Characterization of Obsidian Sources in Western Mexico: The sources of Jalisco, Nayarit, and Zacatecas. In *Crossing the Straights: Prehistoric Obsidian Source Exploitation long the Pacific Rim*, edited by Y.V. Kuzmin and M.D. Glascok, pp. 201-217. Archaeopress, BAR International Series S2152, Oxford, U.K.
- Gramsci, A.
 1971 *Selections from the Prison Notebooks*. Q. Hoare and G.N. Smith (eds and trans). International Publishers, New York.
- Haviland, William A.
 1970 Tikal, Guatemala, and Mesoamerican Urbanism. *World Archaeology* 2(2):186-198.
- Hester, Thomas R.; Robert N. Jack and Robert F. Heizer
 1971 "The Obsidian of Tres Zapotes, Veracruz, Mexico". *Contributions of the University of California Archeology Research Facility* 13: 65-131.
- Hirth, Kenneth G.
 1999 The Conference on Ancient Mesoamerican Obsidian Blade Production. *The Foundation Granting Department: Reports Submitted to FAMSI*. Foundation for the Advancement of Mesoamerican Studies, Inc. (FAMSI).
- Jiminez Betts, P.F. and J.A. Darling
 2000 Archaeology of Southern Zacatecas: The Malpaso, Juchipila, and Valparais-Bolanos Valleys. In *Greater Mesoamerica: The Archaeology of West and Northwest Mexico*, edited by M.S. Foster and S. Gorenstein, pp. 155-180. The University of Utah Press, Salt Lake City.

Johnson, Jay K.

- 1989 The Utility of production trajectory modeling as a framework for regional analysis. In *Alternative Approaches to Lithic Analysis*, ed. Donald O. Henry and George H. Odell, pp. 119-138. Archaeological Papers of the American Anthropological Association.

Kelly, I.T.

- 1980 *Ceramic Sequence in Colima: Capacha, an Early Phase*. Anthropological Papers of the University of Arizona, No. 37. The University of Arizona Press, Tucson.

Kelley, J.C

- 2000 The Aztatlan Mercantile System: Mobile Traders and the Northwestern Expansion of Mesoamerican Civilization. In *Greater Mesoamerica: The Archaeology of West and Northwest Mexico*, edited by Michael Foster and Shirley Gorenstein, pp. 137-154. University of Utah Press, Salt Lake City.

Kristen-Graham, Cynthia

- 1993 The Business of Narrative at Tula: An Analysis of the Vestibule Frieze, Trade, and Ritual. *Latin American Antiquity* 4(1): 3-21.

Leone, M.P.

- 1984 Interpreting Ideology in Historical Archaeology: Using the Rules of Perspective in the William Paca Gardening Annapolis, Maryland. In *Ideology, Power, and Prehistory*, edited by Daniel Miller and C. Tilley. pp 25-36. Cambridge University Press. Cambridge.
- 1987 Rule of Ostentation: The Relationship Between Space and Sight in the Eighteenth Century Landscape Architecture in the Chesapeake Region of Maryland. In *Method and Theory for Activity Area Research*. Edited by S. Kent. pp 605-632. Columbia University Press. New York.
- 1995 A Historical Archaeology of Capitalism. *American Anthropologist* 97:251-268.

Levine, Marc

- Nd *Evaluating a New Technique for Obsidian Provenance Sourcing: Combining "Visual grouping" with Neutron Activation Analysis*. Unpublished manuscript. University of Colorado at Boulder.

McGuire, Randall

- 2008 Marxism. In *Handbook of Archaeological Theories*, edited by R.A. Bently, H.D.G. Maschner, and C. Chippendale, pp. 73-93. Altamira Press, Lanham

McKillop, H.I.

- 1995 The Role of Northern Ambergris Caye in Maya Obsidian Trade: Evidence from Visual Sourcing and Blade Technology. In *Maya Maritime Trade, Settlement, and Populations on Ambergris Caye, Belize*, edited by T.H. Guderjan and J. F. Garber, pp. 163-174. Maya Research Program and Labyrinthos Lancaster, Pennsylvania.

Malinowski, B.

- 1920 "Kula; the Circulating Exchange of Valuables in the Archipelagoes of Eastern New Guinea". *Man* (20): 97-105.
- 1922 *Argonauts of the Western Pacific: An Account of Native Enterprise and Adventure in the Archipelagoes of Melanesian New Guinea*. George Routledge & Sons, Ltd.

Marx, Karl

- 1992 {1906} *Capital: A Critique of political economy*. Penguin Classics, New York.

Mathews, Christopher; Mark Leone; and Kurt Jordan

- 2002 The Political economy of Archaeological Cultures: Marxism and American historical Archaeology. *Journal of Social Archaeology*. 2(1):109-134.

Meighan, C.W.

- 1971 Archaeology of Sinaloa. In *Archaeology of Northern Mesoamerica*, part 2, edited by G.F. Ekholm and I. Bernal, pp. 754-767. Handbook of Middle American Indians, vol. 11, R. Wauchope, general editor. University of Texas Press, Austin.
- 1976 *The Archaeology of Amapa, Nayarit*. (editor). Monumenta Archaeologica 2. The Institute of Archaeology, University of California, Los Angeles.

Moholy-Nagy, H., and F. W. Nelson

- 1990 New Data on Sources of Obsidian Artifacts from Tikal, Guatemala *Ancient Mesoamerica*. 1 :71-80.

Morrow, Carol A.

- 1984 A biface production model for gravel-based chipped stone industries. *Lithic Technology* 13:20-8.

Mountjoy, J.B.

- 1970 *Prehispanic Culture History and Cultural Contact on the Southern Coast of Nayarit, Mexico*. Unpublished PhD. dissertation, Southern Illinois University, Carbondale. University Microfilms, Ann Arbor.

- 2000 Prehispanic Cultural Development along the Southern Coast of West Mexico. In *Greater Mesoamerica: The Archaeology of West and Northwest Mexico*, edited by M.S. Foster and S. Gorenstein, pp. 81-106. The University of Utah Press, Salt Lake City.
- 2001 Aztatlan Complex. In *Archaeology of Ancient West Mexico and Central America: An Encyclopedia*, edited by T.S. Evans and D.L. Webster, pp. 57-59. Garland Publishing, New York.
- Nicholson, H.B. and E. Quinones Keber
 1994 *Mixteca-Puebla: Discoveries and Research in Mesoamerican Art and Archaeology*. (editors). Labyrinthos Press, Culver City.
- Odell, George
 2004 *Lithic Analysis*. Plenum Publishers, New York.
- Ohnersorgen, Michael A.
 2004 *Informe Tecnico Final de Proyecto "Investigaciones Arqueologica Preliminar de Chacalilla, Nayarit, Mexico, Temporada 2003"* Manuscript on file, Instituto Nacional de Antropologia y Historia (INAH), Centro INAH Nayarit, Tepic.
- 2007 *La organizacion socio-economica y la interaccion regional de un centro Aztatlan: Investigaciones arqueologicos en Chacalilla, Nayarit*. Informe Tecnico Parcial, Temporada de 2005. Manuscript on file, Instituto Nacional de Antropologia y Historia (INAH), Centro INAH Nayarit, Tepic.
- Ohnersorgen, M. A., M. D. Glascock, J. B. Mountjoy, and M. Garduño A.
 2012 Chemical Analysis of Obsidian Artifacts from the West Coast of Mexico: Implications for Regional and Interregional Economic Organization. Manuscript on file, Department of Anthropology, University of Missouri, Saint Louis.
- Perez, Manuel, Lorena Gamez, and Mauricio Garduno,
 2000 *Proyecto de Salvamento Arqueologico "Entronque San Blas Mazatlan, tramo Nayarit"*. Informe Tecnico. Trabajos de Reconocimiento de Superficie y Excavacion (Julio-noviembre de 1998). Direccion de Salvamento Arqueologico/Centre INAH Nayarit, Mexico.
- Pollard, Helen Perlstein
 2000 Tarascan External Relationships. In *Greater Mesoamerica: The Archaeology of West and Northwest Mexico*, edited by M.S. Foster and S. Gorenstein, pp. 71-80. The University of Utah Press, Salt Lake City, UT.

Saitta, Dean

- 2003 Archaeology and the Problem of Men. In *Essential Tensions in Archaeological Method and Theory*. (eds) T. VanPool and C. VanPool, pp. 11-16. University of Utah Press, Salt Lake City, UT.

Sanchez Polo, R.

- 1991 *Las navajas de obsidiana de Kaminlajuyu'/San Jorge: un estudio tecnologico funcional*. Unpublished licenciatura thesis, Escuela de Historia, Area de Arqueologia, Universidad de San Carlos Borromeo de Guatemala, Guatemala.

Sanders, Paul H.

- 1992 *Archaeological Investigations along the Pend Oreille River: Site 45PO149*. Center for Northwest Anthropology, Project Report 18. Pullman: Washington State University.

Santley, R.S., J.M. Kerley, and R. Kneebone

- 1986 Obsidian Working, Long-Distance Exchange, and the Politico-Economic Organization of Early States in Central Mexico. In *Research in Economic Anthropology, Supplement 2*, edited by B. L. Isaac, pp. 101-132. JAI Press, Greenwich.

Sauer, C.O.

- 1934 *The Distribution of Aboriginal Tribes and Languages in Northwestern Mexico*. Ibero-Americana 5. University of California Press, Berkeley.

Sauer, C.O., and D.D. Brand

- 1932 *Aztatlan: Prehistoric Mexican Frontier on the Pacific Coast*. Ibero-Americana 1. University of California Press, Berkeley.

Scott, S.D. and M.S. Foster

- 2000 The Prehistory of Mexico's Northwest Coast: A View from the Marismas Nacionales of Sinaloa and Nayarit. In *Greater Mesoamerica: The Archaeology of West and Northwest Mexico*, edited by M.S. Foster and S. Gorenstein, pp. 107-135. The University of Utah Press, Salt Lake City, UT.

Smith, M.E. and C.M. Heath-Smith

- 1980 Waves of Influence in Postclassic Mesoamerica? A Critique of the Mixteca-Puebla Concept. *Anthropology* 4:15-50.

Stark, B.L., L. Heller, M.D. Glascock, J.M. Elam, and H. Neff

- 1991 Obsidian-artifact source analysis for the Mixtequilla region, south-central Veracruz, Mexico. *Latin American Antiquity* 3:221-239.

Sullivan, Alan and Kenneth Rozen

1985 Debitage Analysis and Archaeological Interpretation. *American Antiquity* 50:755-779.

Taube, Karl

1991 Obsidian Polyhedral Cores and Prismatic Blades in the Writing and Art of Ancient Mexico. *Ancient Mesoamerica* 2: 61–70.

Trombold, C.D., J. Luhr, T. Hasenaka, and M. Glascock

1993 Chemical Characteristics of Obsidian from Archaeological Sites in Western Mexico and the Tequila Source Area: Implications for regional and Pan-regional Interaction within the Northern Mesoamerican Periphery. *Ancient Mesoamerica* 4:255-270.

Tykot, Robert H.

2003 Determining the Source of Lithic Artifacts and reconstructing Trade in the Ancient World. In *Written in Stone*, edited by P. Nick Kardulias and Richard W. Yerkes, pp.59-86, Lexington Books, Oxford, UK.

VanPool, T. L., C. S. VanPool, and G.F.M. Rakita

2008 Birds, Bells, and Shells: The Long Reach of the Aztlatlán Trading Tradition. In *Touching the Past: Traditions of Casas Grandes*, edited by Glenna Nielsen, pp. 5–14. BYU University Press, Provo, Utah.

Walker, Danny N., and Lawrence C. Todd

1984 *Anthropological Salvage at 48FR1398: Castle Gardens Access Road Site, Fremont County, Wyoming*. Laramie: Occasional Papers on Wyoming Archaeology 2.

Weigand, P.C.

1989 The Obsidian mining complex at La Joya, Jalisco. In *La obsidian en Mesoamerica*, edited by G.M. Gaxiola and J.E. Clark, pp. 205-211. Coleccion Cientifica, Serie Arqueologica, No. 176, INAH, Mexico City.

Weigand, P.C., and M.W. Spence

1982 The Obsidian Mining Complex at La Joya, Jalisco. In *Mining and Mining techniques in Ancient Mesoamerica*, edited by P.C. Weigand and G. Gwynne, pp. 175-188. *Anthropology* 6, special issue. State University of New York, Stony Brook.

Zeir, Christain J., Stephen M. Kalasz, Anne H. Peebles, Margaret A. Van Ness, and Elaine Anderson

1988 *Archaeological Excavation of the Avery Ranch Site (5PE56) on the Fort Carson Military Reservation, Pueblo County, Colorado*. Submitted to USDI National Park Service, Rocky Mountain regional. Fort Collins, Colorado: Centennial Archaeology, Inc.

Zepeda, Gabriela and Noe Fajardo

1999 *Puntos basicos para elaborar el anteproyecto de declaratoria de la zona arqueologica de Huachotita, Municipio de Tecuala*. Expediente tecnico. Proyecto INAH-Procede (5th Etapa). Archivo Tecnico del centro INAH Nayarit.