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Late Classic and Epiclassic Obsidian Procurement and Consumption in the southeastern Toluca Valley, Central Highland Mexico

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Late Classic and Epiclassic Obsidian Procurement and Consumption in the southeastern Toluca Valley, Central Highland Mexico

by

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Dedication

To Claudia and Javier Urbano.

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Late Classic and Epiclassic Obsidian Procurement and Consumption in the southeastern Toluca Valley, Central Highland Mexico

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During three seasons of field research, more than 11,000 obsidian artifacts were excavated from two platform mounds at the Late Classic and Epiclassic period site locus of Santa Cruz Atizapan in the Toluca Valley, Mexico. These artifacts were studied using an attribute analysis, chemical sourcing techniques, and use-wear analysis in order to address questions regarding changes in obsidian acquisition and consumption brought about by the demise of the city of Teotihuacan during the Late Classic. However, due to the nature of the varied analytical approaches and unresolved issues concerning artifact provenience, not all of these objects were analyzed for each approach.

Central to this research was an exploration into the availability of local obsidian resources and the degree to which local consumption demands dictated the form and function of imported obsidian artifacts. The results of the research suggest several important patterns of obsidian procurement and consumption at the Santa Cruz Atizapan locus that continued throughout its occupation history: (1) the primary obsidian imported into the site originated at the Ucareo, Michoacan mines, (2) most obsidian objects arrived as finished tools, with only minimal evidence for local manufacture or the importation of large quantities of raw materials, (3) the obsidian tool-kit consisted almost entirely of objects required for performing daily subsistence related tasks and daily ritual activities, (4) most obsidian tools including prismatic blades, were heavily used prior to being discarded; this suggests that they must have been considered something of a rare resource, (5) despite its potential scarcity, access to obsidian tools was not restricted; it occurs in similar patterns in both public and domestic use areas and neither individual tool types nor obsidian sources were found concentrated in specific contexts.

The implications of this data are significant. Most importantly, we must reconsider the primacy often attributed to Teotihuacan obsidian trade networks. This case study demonstrates the potential for populations within the Teotihuacan symbiotic region to establish their own procurement systems, even while heavily entrenched in Teotihuacan religious and, presumably, social and politics systems. On a similar but broader interpretive level, we must begin to challenge the notion that Teotihuacan obsidian, particularly the green Sierra de Las Navajas type, was infused with ideological or political symbolism in all cases. Within the southeastern Toluca Valley it clearly was not. Finally, the need to expand this study to other sites in the region, particularly the northern Toluca Valley, is necessary before we can begin to fully understand the regional obsidian networks in place during the Classic period. Our present understanding of Epiclassic period obsidian developments in the region was supported by this research.

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CHAPTER 1: Introduction

This thesis investigates the nature of obsidian (volcanic glass) procurement and use at the locus of Santa Cruz Atizapan in the southeastern Toluca Valley, Mexico (Figure 1) during a time of great social, political and economic instability in Central Highlands Mexico; the Late Classic (AD 500-650) and the Epiclassic (AD 650-900) periods (Rattray 1996). The Santa Cruz Atizapan locus contains more than 100 artificially constructed platform mounds (known locally as “bordos”) that border the Epiclassic period regional center of La Campana-Tepozoco (Figure 2) on the northwestern edge of the shallow Lake Chignahuapan (Sugiura 1998b, 2000b, 2003). This lake is the southernmost of three large lakes situated in the eastern part of the Toluca Valley that form the headwaters of the Lerma River, the largest river system complex in Mexico (Garcia Payon 1974). During the Epiclassic period, which followed the disintegration of Teotihuacan’s power structure in the neighboring Valley of Mexico, La Campana-Tepozoco was one of nine large centers that developed at strategic entry points into the Toluca Valley. The size and location of these centers suggests they probably controlled the movement of commodities and people into and out of the adjacent valleys (Sugiura 1990).

Although many of the platform mounds at Santa Cruz Atizapan were in use prior to the establishment of the La Campana-Tepozoco regional center they are considered part of the same larger site complex know as INAH 106-110. At present, the La Campana-Tepozoco center is privately owned, making the platform mounds the only component of the complex that has been investigated by archaeologists.

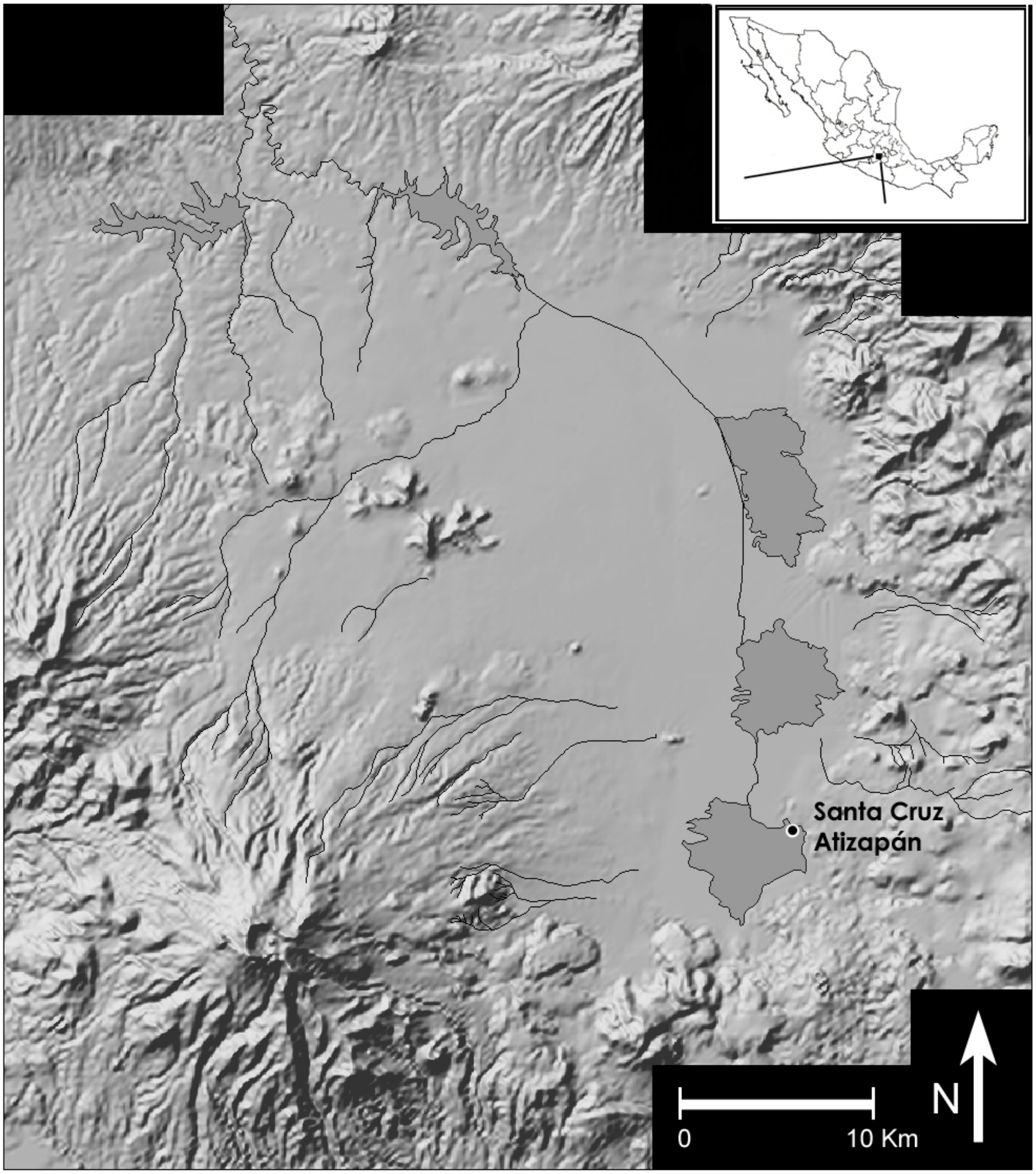


Figure 1: The Santa Cruz Atizapan archaeological site, Toluca Valley, Mexico. (Adapted from a map provided by the Proyecto Arqueologico Santa Cruz Atizapan)

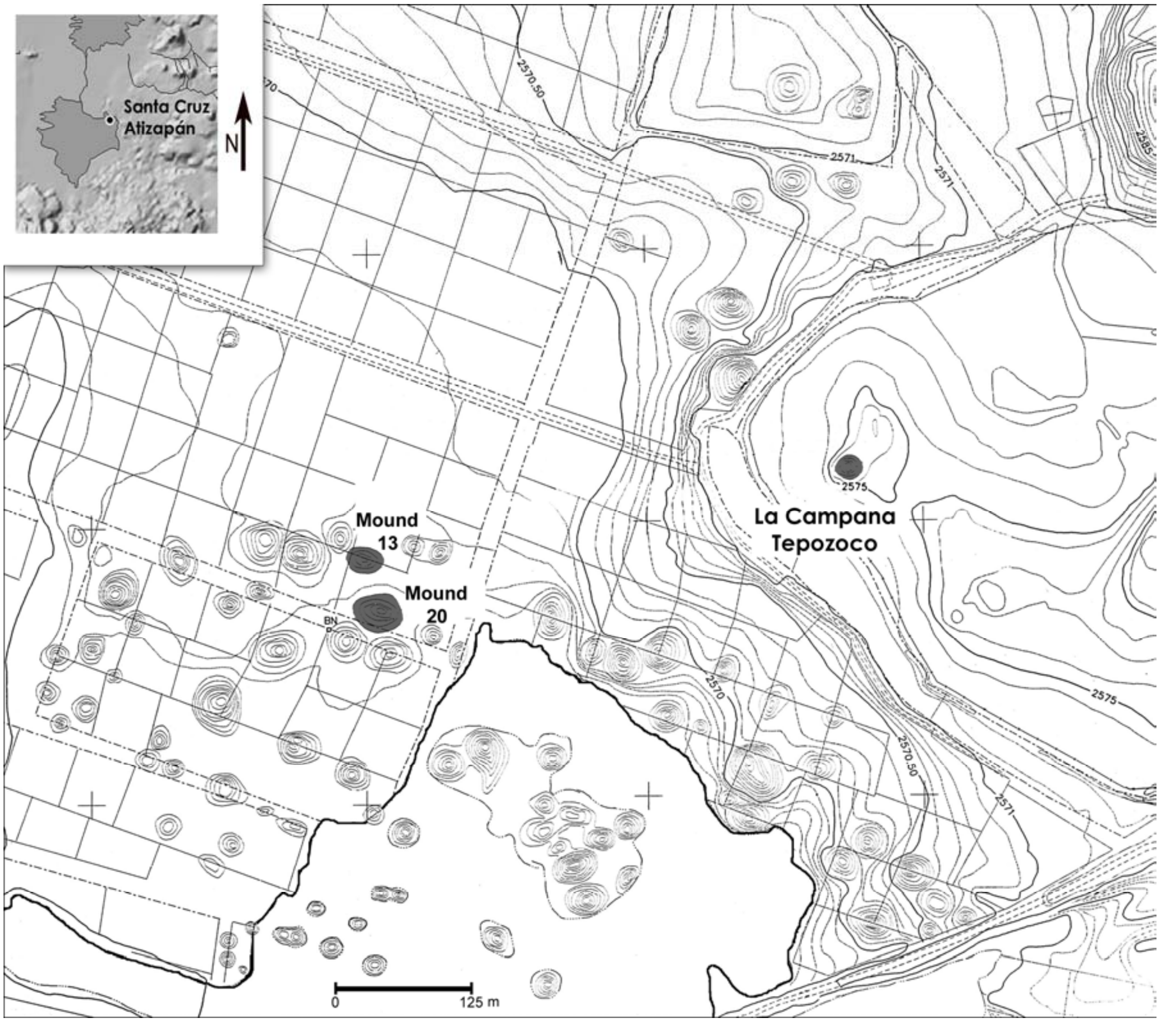


Figure 2: Santa Cruz Atizapan Platform mounds and La Campana Tepozoco regional center. (Adapted from a map provided by the Proyecto Arqueologico Santa Cruz Atizapan)

To understand the impact of Late Classic-Epiclassic political developments on the procurement and consumption of obsidian artifacts in the Toluca Valley, systematic archaeological analyses were carried out on more than 11,000 obsidian objects recovered from two Platform Mounds (13, 20 – Figure 2) of the Santa Cruz Atizapan site during excavations in 1997, 2000 and 2001. Research consisted of a detailed technological analysis, geochemical sourcing, preliminary microscopic use-wear analysis and an exploratory survey in the northern part of the Toluca Valley and adjacent Ixtlahuaca Valley to search for previously undocumented obsidian outcrops

The vast majority of obsidian artifacts recovered during excavations were prismatic blade fragments of varying colors and sizes. This was not unexpected nor surprising because prismatic blade-core technology was the dominant Mesoamerican lithic technology from pre-Olmec times until the Spanish arrival in the early 16th century (Clark 1989b). Bifaces, drills, scrapers, awls, eccentrics and other tools created from modified prismatic blades and larger percussion flakes formed the Santa Cruz Atizapan tool kit. The small number of prismatic blade cores and large flake blanks in the assemblage suggests that most prismatic blades and flake tools were imported into the region and were not produced locally. The previous absence of known, extensive high quality obsidian outcrops in the Toluca Valley further also suggested a need to import obsidian. The obsidian assemblage from Santa Cruz Atizapan thus provides a unique opportunity to examine questions concerning the relationship between production, exchange, and political-economic organization at multiple levels.

RESEARCH QUESTIONS:

The Classic period (AD 250-650) in Mesoamerica's Central Highlands region is defined by the ascendancy and regional dominance of the state of Teotihuacán in the Valley of Mexico (Table 1). Its status as the principal city in Mesoamerica during the

Classic period is evidenced by its extensive monumental architecture (including the Sun and Moon pyramids), its estimated urban population of 60,000 to 100,000 (Cowgill 1997), and its contacts with numerous distant sites (Millon 1988). Teotihuacan power included the control of an extensive regional exchange network, widespread political influence and the diffusion of a distinctly Teotihuacan socio-political and religious ideology and iconography (Cowgill 1997; Kurtz and Nunley 1993; Nicholson 2000; Sugiyama 2000, 2004).

Teotihuacan leaders may have also established several colonies at sites such as Chingu in the Teotihuacan Valley, and at Santa Cruz Azcapotzaltongo and Dorantes in the Toluca Valley (Manzanilla 1998; Sugiura 1993). The city's regional influence on later sites such as Santa Cruz Atizapan may be inferred from the large quantity of Teotihuacan associated decorated pottery, ceramic figurines, and obsidian artifacts recovered from these sites, as well as the presence of Teotihuacan style architecture (Gonzalez de la Vara 1994; Sugiura 1990, 2000b, 2003). Sanders (Sanders et al. 1979) places the southeastern Toluca Valley, and thus the site of Santa Cruz Atizapan, within the Teotihuacan's core symbiotic region. The region would have provided the city a unique lacustrine variety of resources as well as agricultural products that could only be grown in the high altitude, cold temperatures of the valley. Teotihuacan enclaves have also been identified at distant sites in the Maya region (Kaminaljuyu), and the Tuxtla region of Veracruz (Matacapan) (Manzanilla 1998). Enclaves may have served as emissaries, securing the important natural resources required to support an ever-growing urban population or perhaps they served Teotihuacan's elite, maintaining important social or political relationships in these foreign regions. Foreign enclaves within the city of Teotihuacan itself may have served the same purposes (Spence 1992).

Toluca Valley (Classic-Epiclassic phases)		Valley of Mexico Teotihuacan phases	Mesoamerican Cultural periods
	AD 1250		**Postclassic**
		Mazapan	
	AD 1000		**Early Postclassic**
	AD 900	Coyotlatelco	
Atenco			
	AD 750	(Oxtotipac)	**Epiclassic**
Tejalpa			
Tilapa	AD 650	Metepec	**Late Classic**
Azcapotzaltongo	AD 400	Xolalpan	**Middle Classic**
Atizapan	AD 250	Tlamimilolpa	**Early Classic**
	AD 100	Miccaotli	
			Terminal Preclassic
		Tzacualli	
	AD 1		
		Patlachique	
	100 BC		

Table 1. Regional chronologies for the Toluca Valley and Valley of Mexico.

The demise of Teotihuacan's political and economic power near the end of the Late Classic period greatly impacted regional populations in the Central Highlands region. The causes and events that precipitated the city's collapse in the 7th century AD are currently still debated. Despite this uncertainty, it is generally agreed that the disintegration of long distance economic and political networks, as evidenced in the decline of Teotihuacan goods and presence at other sites throughout the region, sealed the city's fate. To understand the potential significance of this collapse throughout Mesoamerica we can look at the major regional centers of Monte Alban in the state of Oaxaca and Tikal in the Maya region. These two major cities maintained strong ties with Teotihuacan and flourished along with it. Yet, within 250 years after Teotihuacan's decline, each of these centers witnessed their own demise. Lopez Luan (1996) has proposed that their economic, political, and social relations with Teotihuacan must have been essential for their own prosperity and ultimately survival.

The breakdown of regional networks must have left Teotihuacan leaders, already relying on imported commodities to feed and house a large population, with very few alternatives. Without the means to obtain even essential subsistence resources the political authority and physical survival of the Teotihuacan state was soon at risk. This internal and external discord soon led to the physical destruction of the city. Monumental architecture along the main Avenue of the Dead, as well as temples and residential compounds throughout the city, were systematically burned, signaling the end of Teotihuacan's reign as Mesoamerica's socio-political, religious and economic center (Millon 1988). Several decades of decline had finally brought Mesoamerica's first superpower to its knees, after more than 500 years of invincibility.

As Teotihuacan lost its regional influence, its population dwindled from an estimated 60,000 – 100,000 during the Late Classic, to less than 30,000 during the subsequent Epiclassic period (Cowgill 1997). Sudden population increases in several surrounding regions would seem to confirm that the Teotihuacan populace migrated out of the city in large numbers once the city's decline appeared imminent. In the Toluca Valley, more than 100 new sites were established during the Late Classic period, including at least six large regional centers (Gonzalez de la Vara 1994; Sugiura 1993). Similar population movements also occurred east of the Valley of Mexico in the Tlaxcala region (Garcia Cook and Merino Carrion 1990), north in the Tula region (Mastache and Cobean 1989), south in the present day state of Morelos (Nalda 1998; Sugiura 2004), and the Chalco area in the southernmost part of the Valley of Mexico itself (Parsons and Whalen 1982; Rattray 1996; Sugiura 1996). The void created by the demise of

Teotihuacan and the migration of 50,000 to 70,000 people out the of the Valley of Mexico forced political as well as economic realignments throughout the Central Highlands region. The rise of the new regional centers in the Toluca Valley and the establishment of new political, social and economic systems are examples of this transformation.

Understanding the dynamics of the Late Classic and Epiclassic periods in the Toluca Valley is important on several levels. As described above, the Epiclassic witnessed radical shifts in political relations, economic networks and ideologies. These shifts no doubt had their beginnings during the Late Classic period and prior to the Teotihuacan collapse. These changes were, in fact, very likely as much the cause as the effect of the city's demise. Previous models of Teotihuacan decline, now in doubt, (e.g. Litvak 1970; Webb 1978) argued that competing Late Classic polities could have cut off trade with the city and blocked important routes into the northern Valley of Mexico. If we can begin to understand the regional restructuring that occurred, we may be able to better understand how Teotihuacan was impacted by its changing environments and why it could not adequately adapt to them. If, indeed, the Toluca Valley was a vital part of Teotihuacan's symbiotic region, as originally claimed by William Sanders (Sanders, et al. 1979), sites such as Santa Cruz Atizapan, which straddle both the Teotihuacan and post-Teotihuacan period, have great potential for illuminating the scope and breadth of these transitions. Equally significant is the fact that these realignments remained in place and defined the next several centuries of central Mexican prehistory. In many ways, this 300 year Epiclassic period sets the stage for the Postclassic events that would follow and continue until Spanish contact in AD 1520.

The Research Problem:

This thesis explores the impact of the changes of the post-Teotihuacan era by focusing on a vital yet non-locally available resource, obsidian. The absence of locally available, large obsidian quarries required Toluca Valley residents to import essential obsidian tools. The importation of obsidian as raw material or finished product must have been a primary concern for valley residents who did not have any locally available material to use as a substitute (Giles 2002; Sugiura 2004). Schist and slate artifacts were also imported into the valley but their sedimentary layering and thus tendency to spall would have made them unsuitable for the precise cutting and piercing tasks possible with obsidian tools .

The current research is based on the original premise that shifts in socio-political or economic networks impacted the acquisition and use of obsidian in the Toluca Valley. If this hypothesis is correct, we should see clear evidence for adaptations in procurement or obsidian use at sites in the valley during the Late Classic and Epiclassic periods. If, however, the data does not demonstrate discernable changes in procurement or use, we are still left to consider why such changes did not occur. In either case, this study will allow us to model the use and procurement of obsidian in this southeast corner of the Toluca Valley during a crucial period of its history. The following questions directed the research undertaken during this project.

1. Was obsidian exclusively imported into the southeastern Toluca Valley from distant sources or were more locally available outcrops also exploited? How did valley residents obtain either raw materials or the finished tools?

    a. Does the assemblage suggest ties to particular geographic regions or exchange networks during early and late occupation of the site?

    b. Did restructured Epiclassic period exchange networks affect the quantity or technology of obsidian imported?

c. Is there any evidence to suggest that obsidian exchange was impacted by the evolving Epiclassic political economy of the region?

2. How was obsidian used and what functions did it serve in domestic and public contexts during the Late Classic and Epiclassic periods?

    a. What were the Late Classic and Epiclassic period tool-kits?

    b. Does the obsidian technology reflect a simple adaptation to a lacustrine mode of life or other broader cultural norms?

    c. Were specific tools used in specialized contexts (i.e. domestic vs. ritual contexts)?

    d. Does the data suggest restricted access to obsidian over time?

3. How does the procurement and use of obsidian at Santa Cruz Atizapan compare to other Classic and Epiclassic period sites?

    a. How does the distribution of obsidian sources compare to that of Teotihuacan, Tula and Xochicalco, large regional centers with varying degrees of control over obsidian quarries? Is there evidence for a connection between these sites and Santa Cruz Atizapan?

    b. Are there demonstrated similarities in technology and access to obsidian between these sites?

    c. What was the ultimate social, political and economic role of obsidian in the lives of the Santa Cruz Atizapan population?

Previous Research

The history of archaeological research in the Toluca Valley is limited when compared to other regions in the Central Highlands. This may be attributable to an early fascination with excavating large monumental sites, in this region as well as in the neighboring Valley of Mexico. Misconceptions regarding the significance of the Toluca Valley in the broader regional dynamics of the Central Highlands also probably deterred the interest of archaeologists. Throughout history, polities in the Valley of Mexico dominated the politics and economics of Central Mexico. As such, peripheral regions nearby have been consistently overlooked, skewing our understanding of regional interactions.

The important role of outlying regions during the height of Teotihuacan rule has thus only begun to be appreciated. In the Toluca Valley, Jose Garcia Payon undertook the earliest archaeological investigations from 1929 to 1935 at the site of Tecaxic-Calixtlahuaca, a large civic-religious center most often associated with the Postclassic period Matlatzinca culture (Garcia Payon 1931, 1974, 1979, 1981). Unfortunately, much of this important work was left either unpublished or incompletely published after Garcia Payon's sudden death (Smith 2003).

A nearly 40 year gap would separate the earliest work of Garcia Payon and the start of the next significant archaeological research project in the valley. During the early to mid 1970's the archaeologist Roman Pina Chan excavated at the site of Teotenango, the largest and most powerful city in the Toluca Valley during the Epiclassic period (Piña Chán 1975, 2000). Survey and test trenching by the "Proyecto Teotenango" revealed a settlement history that began during Late Classic and reached its apex during the post-Teotihuacan Epiclassic period. Similar to Tecaxic-Calixtlahuaca and consistent with other sites during the turbulent Epiclassic period, the city was erected on a hill to provide a substantial defensive barrier against would-be aggressors (Reyes 1975). The analysis of burial offerings at the site also indicated distant trade or tribute networks that brought items such obsidian, silver and gold, as well as pottery to the valley (Tommasi de Magrelli 1978).

In addition to the excavations at the site of Teotenango itself, survey fieldwork by the Proyecto Teotenango also identified several large sites in the region including Dorantes, Ojo de Agua, and sites near the present day municipalities of Santa Cruz Atizapan and Almoloya del Rio. The analysis of ceramic materials from subsequent test excavations at the Ojo de Agua site led archaeologist Yoko Sugiura (Sugiura 1981) to propose several important hypotheses regarding Classic period habitation in the valley. One proposal suggested that the Toluca Valley was one of several destinations for the population emigrating from the deteriorating city of Teotihuacan. She further suggested that the ceramic similarities evident between the two valleys were a result of these population migrations and not trade. Sugiura developed these hypotheses into several research projects in the Toluca Valley that continue to this day. The research presented in this thesis is one outcome of these efforts.

Durbin (1970) completed a dissertation on the prehistory of the valley, but it was predominantly a summary of the Postclassic period. A more recent and complete summary of the history of the Toluca Valley is provided by Gonzalez de la Vara (1994, 1999).

During the mid and late 1990's, the Smithsonian Institution's Toluca Valley Project (Rogers and Walsh 1996) explored Late Postclassic period Aztec households in the Texcaliacac region of the Toluca Valley. Survey fieldwork and the excavation of several small one and two room structures focused on addressing issues of culture contact.

THE PROYECTO ARQUEOLOGICO SANTA CRUZ ATIZAPAN (SCAT)

Nearly 30 years of research in the Toluca Valley by Dra. Yoko Sugiura of the Universidad Nacional Autonoma de Mexico has demonstrated the dynamic and complex nature of human settlement in the valley from the Early Preclassic to the Late Postclassic periods (Sugiura 1990, 1993, 1998a, 1998b, 1998c, 2000a, 2000b, 2001, 2003, 2004; Sugiura and McClung de Tapia 1990; Sugiura and Serra Puche 1983). This research has renewed interest in the culture history of the region and produced corollary studies in archaeology, biology, geophysics, geomorphology, palynology, vulcanology, ethnology, and ethnohistory. The combined research efforts are currently directed towards understanding the valley's Pre-Hispanic lacustrine way of life (Covarrubias 2004).

As an outgrowth of her previous work at the Ojo de Agua site, and as part of her dissertation research, Sugiura initiated the Proyecto Arqueologico Valle de Toluca in 1977 (Sugiura 1990). This project surveyed the entire Toluca Valley and resulted in the identification of nearly 700 archaeological sites dating from the Early Preclassic to the Late Postclassic period. In conjunction with this survey, numerous test pits were excavated at nine sites including the Santa Cruz Atizapan locus. Realizing the importance of lacustrine resources and environments to the region's population, several research projects were ultimately initiated (Sugiura 1998b). In 1993, the research program "El agua, la tierra, el bosque, y el hombre en el Alto Lerma: un estudio multidisciplinario" (Water, Earth, Woodlands, and Man in the Upper Lerma: an interdisciplinary study) commenced with an ethno-archaeological study of the current exploitation of the valley's lakes and marshes. In recent history, beginning almost fifty years ago with the diversion of the Toluca Valley's lake and river waters to support the expanding urban metropolis of Mexico City, lacustrine resources have played lesser and lesser roles in the lives of Toluca Valley residents.

In 1997, the current Proyecto Arqueologico de Santa Cruz Atizapan (SCAT) initiated the next phase of this program through full scale excavations at the platform mounds of Santa Cruz Atizapan that explored the political, ideological, economic, and subsistence dynamics that impacted life in the Toluca Valley during the Late Classic (~AD 500) and Epiclassic periods (AD 650-900). Numerous bachelors and masters theses and dissertations have been written from the data recovered by the various projects. Included are studies of regional lithic industries (Iturbe Robles 1980), regional settlement patterns (Sugiura 1990), the region's culture history to the time of Teotihuacan's collapse

(Gonzalez de la Vara 1994), the construction of canoes in the Lerma basin (Carro 1999; cited in Covarrubias 2004), a preliminary ethno-archaeological study of the lacustrine way of life in the valley (Garcia 1994), relative chronologies developed through preliminary stratigraphic excavations in the valley (Nieto 1998), analysis of macrobotanical materials recovered during the first season of field work at Santa Cruz Atizapan (Mendez 2002), and related studies on architecture (Covarrubias 2004) and ceramics (Giles 2002; Perez 2002). These various studies, along with the obsidian research presented here, are beginning to outline a more complete history of life in the Toluca Valley. No longer a side note in the prehistory of the Central Highlands region, we now understand the importance of the valley and its populace during and after the fall of Teotihuacan. The valley may have deferred political, social and religious authority to Teotihuacan during the Classic period, as did nearly every other region, but it gave rise to several large polities in the Epiclassic period that followed. To what degree these cities were autonomous and in control of key resources such as obsidian are questions we can now begin to address.

ORGANIZATION OF THE DISSERTATION

The text is presented in eight chapters. Chapter one describes the origins of the project and outlines the primary research questions. Chapter two addresses the theoretical issues that underlie the research. Here I discuss the viability and role of lithic studies in understanding past cultural behavior in order to set interpretive boundaries for this research. I also summarize the various theories of material exchange that are currently proposed for the Classic and Epiclassic periods of Mesoamerica. Chapter three provides a summary of the natural contexts and culture history for the Toluca Valley and the Valley of Mexico from the Preclassic period through the Epiclassic period. I also outline two important chronological debates regarding the transition from the Classic period to the

Epiclassic period. The fourth chapter provides an overview of the Mesoamerican obsidian industry. Here I describe the principal Central Highland obsidian sources and summarize the predominant obsidian technologies that circulated in Mesoamerica. I also outline a political history of obsidian control in Mesoamerica as it is currently understood through the use of archaeological data. Chapter 5 begins with a summary of the 1997-2001 Proyecto Arqueologico de Santa Cruz Atizapan excavations. It continues with an overview of the obsidian assemblage recovered from each season and assesses each collection's potential for analysis. The majority of this chapter describes the research methods of the current obsidian study and the critical issues concerned with implementing each analytical approach. The sixth chapter offers the primary data analysis. To address the research questions outlined previously the data is presented along two lines: chronologically, to identify Late Classic-Epiclassic transition patterns, and spatially, comparing obsidian consumption and discard in domestic and public spaces. Both chronological and spatial stratigraphic designations were established using excavation data as well as previous ceramic and architectural analyses (Covarrubias 2004; Giles 2002). To broaden the interpretive utility of the results, in Chapter seven the data are compared with artifacts excavated from the sites of Teotihuacan, Tula and Xochicalco. These sites offer unique comparative opportunities in that each was a regionally powerful city that reached its apex during the Classic or Epiclassic period and likely maintained social, political and economic relations with populations residing in the southeastern part of the Toluca Valley at places such as Santa Cruz Atizapan. Teotihuacan and Tula are particularly interesting in that they are generally assumed to have controlled the procurement, production and trade of obsidian during the Late Classic and Epiclassic periods, respectively. Xochicalco, a regional center during the Epiclassic, appears to have had some link with the Toluca Valley in procuring obsidian from the

Michoacan mines of Ucareo and Zinapecuaro to the north. Chapter 8 summarizes the data of the previous chapters and offers an interpretive framework for understanding obsidian procurement and use within the eastern Toluca Valley. Conclusions offered in this chapter summarize the project and suggest directions for future research.

Chapter 2: Theoretical Framework

Several theoretical discussions guided the research presented in this thesis. At the most basic level of archaeological inference is the question of the degree to which lithic artifacts can be used to interpret past human behavior. This is particularly relevant for esoteric aspects of complex societies, such as ritual, social or political relationships. Equally significant is a review of the various material exchange models that have been applied to ancient Mesoamerican societies. The reorganized political and settlement hierarchies evident during the Epiclassic period in Central Mexico certainly suggests that strategies for material exchange were continually modified either by choice, necessity, force, or possibly all three. Finally, in order to interpret events in the Toluca Valley within the Late Classic and Epiclassic political economy of Central Mexico, center-periphery interaction models are also explored.

LITHIC TECHNOLOGY AND CULTURAL BEHAVIOR

The goal of all archaeological research is, ultimately, the interpretation of past human behavior. A primary obstacle continually confronting archaeologists is, clearly, a scarcity in the variety of cultural materials preserved at archaeological sites. The perishable nature and broken condition of most buried cultural objects and the impact of natural and cultural transformation processes, turn once vibrant and dynamic cultures into sometimes static entities that we often know only through the pottery and stone tools they left behind - archaeologically constituted cultures (Schiffer 1987).

Despite this seemingly meager variety of cultural materials available for research, a great quantity of information has been obtained from ceramic and lithic artifacts. We can attribute this to several important facts. First, ceramics and lithics occur at nearly every site, in every region of the world that postdates the introduction of each respective technology. Secondly, ceramics and lithic tools represent utilitarian as well as special use objects that can inform us about a wide array of subsistence as well as social practices. Third, advancements in the archaeological method and theory of ceramic and lithic analyses continue to illuminate important aspects of ancient societies (e.g., Andrefsky Jr. 1998; Rice 1987)

Gero (1989) states that meanings embedded in objects can lead to social consequences. It follows then, that social prerogatives are often the basis for establishing meaning in the first place. This notion, as expressed in our use of the concept of "style", has formed the crux of archaeological inference since its inception. Normative models, which use typologies and predicted changes in style to construct ceramic and lithic chronologies, as well as establish cultural contacts and exchange, have been in use for the last 70 or 80 years. The degree to which meaning is embedded in the archaeological record is, however, variable and dependent on several factors

Gero lists five factors that will determine the degree and nature of information embedded in stone tools (Gero 1989:93): 1. rarity of raw material, 2. artifact size; 3. artifact longevity, 4. number of production stages; and 5. restrictiveness of production. The scarcity of raw material and the size of artifact are dependant on the energy expended to acquire the material. Artifact size also predetermines the canvass available for embedding social information and its potential visibility. The uses and use life of an object will also determine the amount of information embedded. Objects that express information more often or for long periods of time will be deemed worthy of a greater investment in energy. The reductive nature of flintknapping technologies also permits the embedding of information at each production stage. Therefore, the greater the number of production stages, the greater the opportunity for embedding information. Related to this is Gero's suggestion that attached (to elites or other groups) stone tool specialists will likely invest more stages in manufacture than independent specialists, allowing them more opportunities for inserting information. The assumption here, is that elites or interest groups will demand more elaborate stone tools than those required by the average tool user.

Recent scientific advancements in the identification of ceramic and lithic chemical compositions further provide us with measurable quantitative data that can be used to model the movement of raw materials and finished goods, as well as political or social relations between distant cultural groups (Healan 1997; Moholy-Nagy 1989; Rovner 1989; Trombold, et al. 1993). The discovery that obsidian sources had unique chemical signatures sparked a dramatic increase in the exploration of obsidian quarries over the past 40 years (Cann and Renfrew 1964). Over a 20 year period, beginning in the mid 1960's, nearly every known obsidian quarry in Mesoamerica was sampled and its chemical signature identified (Clark 2003; Cobean 1991; Cobean, et al. 1991). These source samples were then compared to artifacts collected from archaeological sites in order to trace the movement of obsidian.

Complementing these characterization studies, are numerous projects aimed at understanding the organization of mining activities and the technologies used to produce the various obsidian artifact types encountered in the archaeological record (Cobean 2002; Cobean, et al. 1991; Darras 1999; Healan 1997, 2002; Pastrana 1998). Early studies of mines and procurement technologies were undertaken by Alexander Von Humboldt (Humboldt 1814) and subsequently by William H. Holmes (Holmes 1900, 1919) at the turn of the 20th century. The Mexican geologist, Ezequiel Ordoñez undertook perhaps the most extensive analysis of obsidian flows in Central Mexico (Ordoñez 1892, 1895, 1900). These early studies represent some of the earliest investigations of any kind on the prehistory of Mesoamerica (Cobean 2002).

Intensive studies of the heavily used Sierra de Las Navajas obsidian mines north of the Valley of Mexico and the Ucareo-Zinapecuaro mines in the state of Michoacan (Figure 4) have offered insights regarding the degree to which central authorities maintained control and directed the procurement of obsidian resources (Healan 1997; Pastrana 1998). The political and economic consequences of direct or indirect control of mining activities bear particular relevance to the issue of commodity exchange; especially when attempting to interpret the significance of obsidian tool assemblages imported into regions where local obsidian resources appear not to have been available or exploited: the Toluca Valley is one such region.

Technological studies of obsidian have also greatly advanced our understanding of the role of obsidian in ancient economies. For example, studies in object morphology have provided evidence for assessing the factors that impacted the production of obsidian tools; factors such as material availability, market demand, and also the political and economic processes concerned with its procurement and distribution (Hirth 2002). Instrumental to this approach was Don Crabtree's success in reproducing obsidian prismatic blades using techniques interpreted from contact period codices (Crabtree 1968; Clark 1989; also see Clark 1982 for a detailed presentation of ethnohistorical sources). This achievement by Crabtree, and others using similar techniques, encouraged archaeologists to focus not only on the transfer of materials from one region to another, but also on the scale and nature of this movement through the analysis of obsidian reduction stages in assemblages excavated from sites close to and distant from procurement quarries (Barnes 1947; Sheets and Muto 1972). These efforts were solidified with the publication of Sheet's (1975) prismatic core-blade reduction stages, Hester's work at Tres Zapotes (Hester 1972; Hester, et al. 1971), and Clark and Bryant's analysis of the Ojo de Agua, Chiapas, Mexico obsidian, which provides a more detailed assessment of the obsidian reduction stages involved (Clark 1997; Clark and Bryant 1997). The Ojo de Agua work serves as a model for studying the organization of production and commodity exchange at production and consumer sites. Although Crabtree's published technique for prismatic blade manufacture in ancient Mesoamerica has been critiqued and supplanted by a more probable knapping method proposed by Clark (1982), his work still stands as a seminal study in the interpretation of stone tool technologies.

In a similar vein, other experimental studies have also furthered archaeological interpretation on several fronts. Complementing Crabtree's replication studies are those focused on the residuals of the production process, namely debitage. The analysis of small debris lost during the manufacturing process may inform us about economizing behavioral actions such as rejuvenation (Clark and Bryant 1997). The micro evidence for these behavioral decisions is not always evident on the actual tools recovered, but, in some instances, may actually become embedded in the cultural surfaces where knapping activities took place. As such, it has been argued that through the use of proper recovery techniques these economizing behaviors are interpretable in the archaeological record (LaMotta and Schiffer 1999).

Microscopic use-wear analyses of obsidian artifacts can address production and consumption issues, craft specialization, and the role of obsidian in ritual or non-utilitarian contexts through the presence and intensity of use traces, the type of materials worked, the directions of tool use, and the mode of tool prehension (Aldenderfer, et al. 1989). Although use-wear studies have met with some criticism, they have benefited greatly from experimental studies that replicate the wear produced on artifacts. By providing analogous tool wear evidence that may be compared with the actual excavated artifacts such studies can often deflect much of this criticism. However, a tremendous amount of time must be invested in these replication studies in order to produce sufficient traces of wear on the wide variety of natural resources that might have been available at any one site. It is often the case that such experimental studies are also only applicable locally. Natural resources available in one region are rarely identical to those found in another. Despite these constraints, well designed use-wear studies, such as Aoyama's analysis of Copan obsidian, have proved successful (Aoyama 1996, 1999, 2001).

MATERIAL EXCHANGE MODELS

Polanyi et al. (1957) aptly stated that economies are imbedded in social and political matrices. This statement is echoed by Feinman and Nicholas (2004) who also add "cultural matrices" to the social and political. These matrices are expressed and operationalized in the three most fundamental aspects of ancient economies: Production, Exchange and Consumption (White 1959). Hirth (1984) further divides these aspects into the following behavioral components that are archaeologically measurable: resource environment, level of technology; organization of production, spheres of utility and value; and factors of distribution. Determining the roles of social, political and cultural variables in ancient economies then becomes, at least partly, a search for their influence on these components.

The history of lithic research has demonstrated that Production and Consumption components are the most accessible to archaeologists through the direct analyses of artifacts at procurement loci, production sites and ubiquitous consumer sites (see previous section). The identification of Exchange, however, remains the most elusive aspect of ancient economies despite the increased research sparked by the advancements in chemical characterization studies. The journey from raw material, to used and discarded object may take countless paths; many of which will ultimately produce similar patterns in the archaeological record. Because we cannot observe the specific exchange events that transpired in the past, we must rely on this residual archaeological data. This has caused a significant amount controversy and debate over the exchange mechanisms responsible for the movement of objects. The mere definition of exchange and trade has varied from one author to another.

Polanyi once defined trade as, "…a method of acquiring goods that are not available on the spot. It is something external to the group…an organized group activity" (cited in Nelson and Clark 1990). Zeitlin (1979) believes exchange includes, "…all kinds of peaceful, institutionalized interchange of material goods." More specifically, Irwin-Williams (1977) writes that exchange is, "…a form of interaction that creates and reflects specific socioeconomic linkages between individuals, groups, societies, regions, states". Renfrew (1977) offers a cautionary approach, noting that "…in the widest sense; indeed in the case of some distributions it is not established that the goods changed hands at all. Trade in this case implies procurement of materials from a distance, by whatever mechanism." Interpreting exchange has never been a clear-cut process yet, through the years, several important interpretive economic models have been devised to explain the movement of raw materials and finished goods in antiquity.

For decades, studies of material exchange were rooted in the interpretive scheme developed by Polanyi et al. (1957) that cited reciprocity, redistribution and market exchange as the three primary mechanisms by which goods were transferred. Reciprocity was a strategy often utilized by egalitarian societies. Chiefdom societies were commonly engaged in redistribution exchanges, and market systems were the staple of state societies. Polanyi's assertion that each category represented only the primary, and not exclusive, system of exchange in any one society was often ignored and these labels were incorrectly applied in a singular fashion in many archaeological cases (Hirth 1984). It is commonly accepted today that various modes of exchange likely occurred in every society, becoming increasing multifaceted and difficult to sort out with increasing social complexity (Feinman and Nicholas 2004).

A significant critique of Polanyi's model and central place theories in general, is their inability to account for a wide variety of interpersonal exchanges that may have been prompted by individual motivations (Adams 1974; Hirth 1984). Because these models are generally focused on institutionalized exchange mechanisms, their tendency has been to overlook the individual actions in the archaeological record that may reflect entrepreneurism, innovation, debt-carrying or other non-linear and diachronic behaviors. Such interpersonal exchanges might not be easily visible in the archaeological record, but their potential to exist should not be overlooked.

Later attempts at modeling exchange have built on Polanyi's original configuration. Zeitlin (1979) distinguishes between a general reciprocity and balanced reciprocity, and also includes administered exchange. Renfrew expands Polanyi's model into ten modes that encompass a wider and more specific range of exchange options: 1) Direct Access, 2) Reciprocity – home base, 3) Reciprocity – boundary, 4) Down-the-line, 5) Central place – redistribution, 6) Central place – market exchange, 7) Freelance (middleman), 8) Emissary trading, 9) Colonial enclave, 10) Port of trade (Renfrew 1975; cited in Nelson and Clark 1990).

One way to begin investigating exchange networks is to use Plog's (1977) scale of nine attributes that both identify and measure the extent of material exchange: 1) Content, 2) Magnitude, 3) Diversity, 4) Size, 5) Temporal Duration, 6) Directionality, 7) Symmetry, 8) Centralization and 9) Complexity. Content, Magnitude and Diversity record the type, quantity and variety of raw and finished materials exchanged. Size measures the territory covered by the exchange network. Temporal Duration and Directionality are measures of the time and flow direction, while Symmetry is a measure of the amount flowing in each direction. Centralization identifies the stockpiling of goods at a few loci and Complexity measures the patterning of exchange networks linking different sites.

In this study I am not attempting to identify the mechanisms of exchange, but rather the evidence that these mechanism might have changed along with drastic shifts in settlement patterns, economics and politics. A much broader study, incorporating numerous sites in the Toluca Valley and the study of multiple categories of artifacts, is currently underway (Yoko Sugiura, personal communication 2006).

POLITICAL ECONOMY

Studies in political economy are increasing in Mesoamerican archaeology. Once focused on the economic or environmental variables (cultural ecology models) that affected material acquisition or exchange, current research programs now regularly focus on the political and social factors that impacted trade networks or the availability of resources (e.g., Feinman and Nicholas 2004).

Political economies may be inferred from a broad range of archaeological data. In this study I focus on evidence for shifts in obsidian exchange networks to ascertain whether access to utilitarian tools was impacted by larger political shifts. Primary to this issue is the need to establish causal links between political power and the trade of staple non-comestible goods. Santley (1980, 1989a; Santley et al. 1986) believes that controlling the procurement and trade of natural resources such as obsidian was vital to the growth of Pre-Hispanic societies. If this held true, we would expect a direct correlation between the rise and fall of powerful states and the utilization of various obsidian resources. For several regions of Mesoamerica, this appears to have been the case. The Late Classic to Epiclassic period transition in the Central Highlands region stands as a notable exception to this model. The current model of regional obsidian utilization suggests a widespread shift to the Ucareo, Michoacan obsidian source during the Epiclassic period, yet no single polity is believed to have controlled its associated procurement, production or distribution networks.

Zeitlin (1982) wrote that, “Changing socio-political complexities do not have to mean changes in obsidian source utilization.” This would seem to hold true if one considers a progressive increase in socio-political complexity over time. In such a case, the complexity of procurement and exchange networks would also necessarily increase over time and incorporate a wider ranger of materials gathered through multiple networks, including long used obsidian sources. However, the rapid evaporation of a complex regional exchange network, e.g. Teotihuacan, would have likely compelled populations on the fringes of this network to search out alternative sources.

CENTER-PERIPHERY MODELS

Center-Periphery models have their origins in capitalist constructions of the mid-20th century and reflect a strong bias toward economic determinants. Centers are defined as polities that constitute, singularly or in groups, net consumers of resources sustained through a variety of exploitive means. Peripheries are, alternately, polities that must meet the demand of producing a net surplus of goods to provide for a Center.

Initial center-periphery models placed the entirety of decision making in the realm of the Centers, who could obtain desired goods from peripheral regions and dictate the terms of exchange. As noted by Rowlands (1998), the use of center-periphery models did not advance without critique. Marxist objections criticized the lack of peripheral self-determination in these models and in particular, the ability of these peripheral locales to resist economic and presumably political and social exploitation (Brenner 1977; Laclau 1971). The current research explores the decision making ability of societies on the periphery of the Teotihuacan empire during the Classic and Epiclassic periods. The affects on these societies of the Toluca Valley's transition from peripheral region to one that supported nine large sites after the Teotihuacan demise is also explored.

Preliminary analysis of the Santa Cruz Atizapan obsidian data suggested that despite strong cultural ties to Teotihuacan, the distribution of obsidian resources did not fit the expectations of center-periphery interaction models. The lower than expected percentages of green Sierra de Las Navajas obsidian from Classic period contexts lead us to hypothesize that Teotihuacan may not have controlled the primary obsidian trade into the southeastern part of the Toluca Valley. If this is true, then perhaps other resources, decision making policies, or religious doctrine were also free from direct Teotihuacan influence. The overwhelming material evidence linking the Toluca Valley to Teotihuacán may, in fact, represent much more than simply a resignation to imposed decision making by a larger center. It may have served the local populations much more than the large metropolis itself. The continuity and growth of the Santa Cruz Atizapan platform mounds into the post-Teotihuacan era suggests that, although the site was heavily linked to Teotihuacan during its early period, by the end of the Late Classic period it was very much an independent entity relying on broader regional networks to obtain crucial resources. Surpluses moved to Teotihuacan during the Late Classic may have been just that, surpluses. Unlike large sites such as Cholula and Monte Alban in other regions, those in the Toluca Valley continued to grow after Teotihuacan declined. Schortman and Urban (1994) explored similar issues in the Naco Valley of Honduras, a region that has often been considered peripheral to the lowland Maya region. Here they develop various models of center-periphery relations that are both mutually influential and interdependent. Schortman and Nakamura's (1991) study of the Motagua Valley, Guatemala, as well as the La Venta and Florida Valleys of Honduras produced similar results.

CHAPTER 3: Regional Setting

The Central Highlands region of Mexico has, for all of its history, been one of the primary centers of cultural and political development in Mesoamerica. The abundance of water, natural resources, and temperate climate permitted the sustainment of large urban populations who controlled expansive economic networks that, in turn, fostered increased political power. Archaeological research in the Central Highlands has generally focused on the Valley of Mexico (Sanders et al. 1979), the seat of Teotihuacan, Toltec, and Aztec societies. However, the roles of adjacent regions in these complex interrelationships are now being illuminated by major archaeological projects in present day Morelos (Goodfellow 1990; Hirth 1989a, 1989b, 2000, Hirth and Andrews 2002; Hirth and Angulo Villaseñor 1981; Smith 1983, 1992; Smith and Price 1994), Oaxaca (Blanton 1978; Feinman and Nicholas 1990; Flannery 1970; Joyce 1993; Joyce et al. 1995; Joyce and Winter 1996; Winter 2001), and the Toluca Valley (Sugiura 1998b, 2000b, 2003)

NATURAL CONTEXT

Geology and Geomorphology

The Toluca Valley, in the present state of Mexico, forms part of the Central Highlands Plateau region. Geographically it sits directly to the west of the Valley of Mexico and is over 8,000 feet in altitude; it is the highest basin in Mexico (Garcia Payon 1974). The Toluca Valley and Valley of Mexico form part of Mexico's Central Volcanic Belt, which runs from the Pacific Coast to the Gulf Coast. The Toluca Valley is an open valley bordered on its eastern side by the imposing Sierra de Las Cruces mountain range, which separates it from the Valley of Mexico. Its western and southwestern borders are loosely defined by the foothills of the extinct San Antonio and Nevada de Toluca volcanoes. A series of recently active volcanoes create the southern border of the valley. The valley's northern border is generally open and contains hills of El Aguila, La Venta de Canchemi and El Aire; also remnants of once active volcanoes. It is through this northern region that the Lerma River exits the valley on its journey north toward Lake Chapala in the state of Jalisco and, ultimately, the Pacific Ocean.

The most visible volcano in the valley is the Nevado de Toluca, which towers over the southern part of the valley reaching a height of 15,390 feet at its summit. According to Bloomfield and Valastro (1974) the volcano last erupted around 11,500 years BP, depositing the chronologically diagnostic Upper Toluca Pumice layer throughout the valley (Caballero et al. 2002). The Nevado de Toluca was important to Pre-Hispanic communities; as evidenced by the fact that numerous carved stone and incense offerings have been collected from the depths of the Sun and Moon lakes which formed in the volcano's crater (Erreguerena 2000). The substantial supply of non-vesicular and vesicular basalt, pumice and andesite stone associated with this volcanic activity also greatly benefited the regions inhabitants.

Obsidian Resources

Despite the existence of numerous extinct volcanoes in the Toluca Valley, and an abundance of volcanically produced obsidian at archaeological sites, not a single Pre-Hispanic obsidian quarry has been identified in the valley. The non-existence of such quarries has largely been inferred from chemical sourcing studies that indicate that most Central Mexican obsidian artifacts were procured from one of several large quarries located outside the valley (Cobean 2002; Glascock 1998). Geologists have similarly denied the existence of substantial high quality obsidian deposits within the boundaries of the Toluca Valley. The current research examines this assumption. Evidence recently discovered by an archaeologist working in the northern part of the Toluca Valley indicate the possible existence of high quality obsidian deposits (Yoko Sugiura, personal communication 2003). This evidence is described in Chapters 5 and 6.

Hydrology

The 560 kilometer long Lerma River system, which includes the three marshes in the eastern Toluca Valley, represents the regions dominant hydrological feature. The river has its headwaters at the southernmost lake of Chignahuapan where the Santa Cruz Atizapan archaeological site is located. Exiting north of the valley the Lerma River flows northwest through the state of Guanajuato, crossing the Anahuac region of the central plateau as it researches Lake Chapala in the state of Michoacan. The section of the river leaving Lake Chapala on its way to the Pacific Ocean is referred to as the Rio Grande de Santiago. However, the entire river system complex, from its origins in the Toluca Valley to its end at the Pacific, is called the Lerma-Chapala-Santiago complex.

The numerous hot and cold springs that provided fresh water to local residents and fed the Lerma River were extremely important. In the southeastern portion of the valley are the springs of Almoloya del Rio, Preguntas, Tecalco, Texcoapa, Ixcaulapan, Izcahuapita, Viveros (in the ex-hacienda of Texcaltengo), Guadalupe Hidalgo, Jalatlaco, Tilapa, Laguna de Mirasol, Tepozan and Zauco (Garcia Payon 1974; Sugiura 1998c),

Spring water, combined with the rainfall that drained from the surrounding escarpments, and the water that filtering upward from the subsurface aquifer zone at times exceeds the capacity of the Lerma River channel to contain it and move it northward. The formation of three shallow lakes we now recognize as Chignahuapan, Chimaliapan, and Chiconahuapan is the result of this process. During wet periods the three lakes will merge into one large body, but each lake never exceeded more than 1.5 meters in depth at any point in its history (Caballero et al. 2002). Lake Chignahuapan covers an area 3163.6 hectares and stretches from the town of San Mateo Texcalyacac to the current town of Santa Cruz Atizapan (Sugiura 1998c). Descending and flowing to the north the Lerma next connects to Lake Chimaliapan which covers 3903 hectares near the town of San Mateo Atenco. Lake Chiconahuapan is the third and final lake, and it spans a 2502 hectare area from the town of Lerma to the San Nicolas Peralta. In recent history, much of this water has been siphoned from the valley and used to support the increasing populous of the Valley of Mexico. This has affected not only the marshy lake regions but also the springs that were once found over a large part of the valley.

Flora and Fauna

The desiccation of the Toluca Valley's marsh region has greatly impacted the diversity of floral and faunal resources now found in the region (Sugiura 2004). Recent research has shown that up until a few decades ago there was a great variety of resources found in the lake region (Sugiura 1998c; Sugiura and Serra Puche 1983). Among these were various species of fish, crustaceans, insects, birds, and various aquatic and non aquatic plants. The valley's alluvial plain region is also extremely fertile and a diversity of high quality corn has been grown here since antiquity (Garcia Payon 1974). The nearby mountain regions provided still other resources; Pine, fir and oak trees were exploited for construction materials, cooking wood, or were harvested for acorns and pine nuts. Various animals were also been hunted for food. Numerous fruit trees and bushes are also found here including guava, and blackberry. The "capulin" plant also grows wild in this region and the valley was known for its abundance in Pre-Hispanic times. The town of Capulhuac was given its name as a result of the number of capulin plants found nearby. The town's antiquity is evident by its inclusion in numerous Spanish and Aztec period tribute codices. Medicinal and edible herbs and mushrooms were also available in the mountains surrounding the valley (Ryesky 1976).

Environment

By the Late Pleistocene era the three Toluca Valley marshes contained fresh water, making the earliest settlement in the region possible (Caballero et al. 2002). Recent paleoenvironmental data suggests, however, that it was the lake levels that influenced the construction and habitation of artificial platform mounds within Lake Chignahuapan. During the Holocene period there were three episodes of very shallow, slightly alkaline waters. The first two occurred circa 11000-7000 yr BP and 4600-4500 yr BP, respectively. The last of these occurred at between 2000-800 yr BP (circa 200 BC – AD 1100-calibrated dates). Within this period very shallow waters were present after 1400 yr BP (AD 550 calibrated) coinciding with the initial construction of the platform mounds at the Santa Cruz Atizapan locus during the Late Classic period. The rising lake levels beginning at c. 800 yr BP (AD 1100) likely forced the abandonment of the Santa Cruz Atizapan platform mounds

CULTURAL CONTEXTS: REGIONAL PREHISTORIES

Valley of Mexico

Preclassic Period (1100 BC – AD 250)

Early Formative (1100 BC- 800 BC) occupation in the valley is sparse with only a handful of sites located in the southern part of the valley along the shorelines of Lake Chalco-Xochimilco (Parsons 1974). This period may mark the earliest settlement of Cuicuilco, a site that, along with Tlatilco (Figure 3), would slightly precede Teotihuacan as the first large cities in the basin. Cuicuilco, situated partly within the campus of UNAM in the southernmost part of Mexico City, may have covered 25 hectares and supported a population of 500 at this time. Tlatilco was located on the western shore of Lake Texcoco and in the northwestern part of modern day Mexico City.

The number of settlements increased in the Valley of Mexico during the Middle Formative (800 BC–500 BC). Most sites were again located in the southern part of the valley around the existent lake systems. In the northern basin, small hamlets were settled in the piedmont regions. The distribution of sites during the Early and Middle Formative suggests that three factors were influential for selecting early settlements (Parsons 1974),

> "…1) lacustrine resources; 2) land where the water table is fairly close to the surface, but where a natural slope provides adequate drainage; and 3) high rainfall areas below the zone of maximum frost intensity."

Increased numbers of settlements, particularly in the north and central regions characterize the Late Formative period (500 BC – 200 BC) in the Valley of Mexico. The site of Cuicuilco continues to grow and now covers 150 hectares and supports a population of 7500, making it the largest city in the valley. It is not until the Terminal Formative (200 BC – AD 1), however, that Cuicuilco reaches its apex. Although poorly understood, it may have covered 400 hectares and supported 20,000 people. Its dominance was short lived, however, as the city experienced a sudden catastrophic end. Around AD 100, the Xitle volcano erupted and partially covered the city with a layer of lava more than 5 meters thick (Parsons 1974; Schavelzon 1993).

The earliest occupation of Teotihuacan occurred around 150 BC (Millon 1981, 1988, 1993), but by the end of the Terminal Formative its population had grown to 10,000 and the city spanned more than 600 hectares, making it a formidable competitor to Cuicuilco. The ramifications of Cuicuilco's misfortune would become evident during the subsequent period when Teotihuacan grew to unparalleled dimensions, uncontested in nearly every regard.

Classic Period (AD 250 - 650)

The expansion of Teotihuacan and its political, social and economic networks are what define the Classic period in Central Mexico. Its monumental architecture and well-planned layout contrast sharply with the small village and hamlet settlements found in the southern part of the valley. Only three sites larger than 60 hectares existed in the valley during this period (Parsons 1974). The catastrophic end of Cuicuilco and two fortuitous environmental factors made Teotihuacan's growth possible; the agricultural potential of the region and the city's access to natural resources including high quality obsidian outcrops (Millon 1993; Sugiura 1996).

Between AD 100 and AD 650, the city was the dominant socio-political and religious center in Mesoamerica (Hirth and Angulo Villaseñor 1981; Manzanilla 1998). At AD 250, the plan of the city was established and the construction of the monumental Sun pyramid was completed. The majority of the Teotihuacan Valley's population also gravitated towards the city at this time. Archaeological research leads us to believe that the populous was multi-ethnic, separated into various barrios organized according to profession or filial ties (Manzanilla 1996; Spence 1974). Although extensive trade networks may have provided one source of its regional political control, it is estimated that only a small percentage of the populace were full time craft specialists (Millon 1993).

The immigration of rural residents into the city created a shortage of agriculturalists in the immediate surrounding region. To sustain the large urban city, agricultural products and specialized goods were imported from outlying areas including Oaxaca, Eastern Veracruz and Guatemala. More importantly, Teotihuacan also expanded its own political and economic boundaries toward the present-day states of Morelos, Puebla and Tlaxcala (Figure 3). These regions almost certainly supplied Teotihuacan with basic subsistence provisions for maintaining its large population, although it is not always clear whether trade or tribute was the driving mechanism.

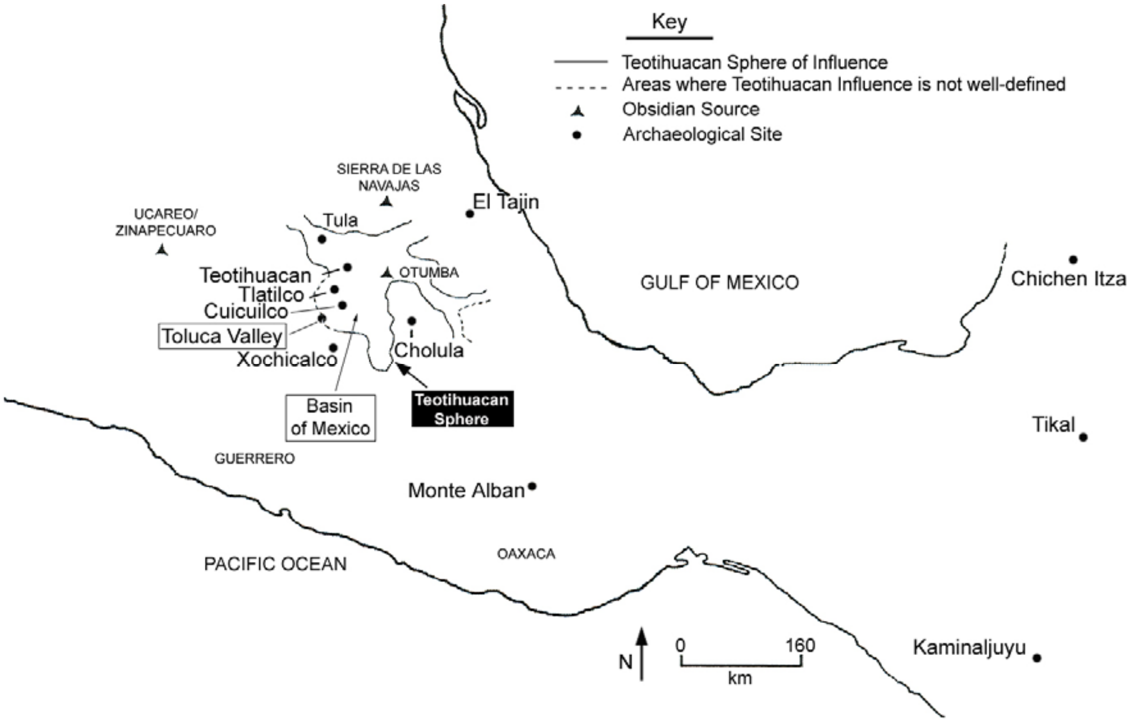


Figure 3: Teotihuacan's sphere of influence in central Mexico

In some regions, Teotihuacan leaders also established colonies in order to maintain direct control over local natural resources (Sugiura 1993). Sugiura includes the Toluca Valley as part of Teotihuacan's Late Classic period symbiotic region. In this capacity the valley would have provided the Teotihuacan populace with large quantities of agricultural products as well as lacustrine flora and fauna. A few sites established in the valley at this time, e.g. Santa Maria Azcapotzaltongo, Santa Cruz Atizapan and Dorantes in Ocoyoaca, demonstrate strong links with the city in ceramic styles, architecture, iconography and mortuary practices. Several of these sites were still occupied during the Epiclassic period and a few witnessed exponential growth as they absorbed many of the residents migrating out from the Valley of Mexico following the decline of Teotihuacan. Sugiura suggests that these initial filial ties between Teotihuacan and Toluca Valley residents might have provided later generations with a known and familiar destination as they migrated out of the Valley of Mexico.

The role of obsidian in maintaining Teotihuacan's political or economic dominance has been debated for many years (Clark 1986; Santley 1983, 1984, 1989b; Spence 1987; Spence 1967, 1977, 1981, 1982, 1984, 1987). Whether for economic reasons (Hirth and Angulo Villaseñor 1981; Santley 1980) or symbolic purposes (Sharer 1983; Spence 1996), we know that obsidian artifacts procured and produced under the direction of Teotihuacan's ruling authority were widely circulated throughout Mesoamerica. It appears that, by AD 250, specialized precinct, regional and local workshops sponsored by the Teotihuacan states produced obsidian tools for local consumption and export (Spence 1981).

Preceding, or perhaps concurrent with, the establishment of extensive material exchange spheres was the exportation of Teotihuacan ideology and religion. Influences have been identified archaeologically in architecture (Talud-tablero style), iconography (Tlaloc imagery), and special use objects (Schist/slate, tri-lobed eccentrics) (Stocker and Spence 1973). DeMarrais et al. (1996) note that ideology can create social, and thus political, power within a society when controlled and materialized in texts, objects, ceremonies, iconography and monuments. The rulers of Teotihuacan may have embarked on a campaign to grow and sustain its regional dominance through the export of their imagery, architecture, ceramic styles and religious iconography throughout central Mexico. Millon (1993) believes that distant sites and Teotihuacan were linked economically, ideological and culturally but not necessarily politically. However, as described above these links may have resulted in political advantages as well. The presence of Teotihuacan-based objects at distant sites may suggest that populations in these regions were co-opting or incorporating Teotihuacan religion and iconography into their own societies or, alternately, it could indicate the presence of religious or political elites who found it politically and economically advantageous to identify and associate with the powerful city. This materialized ideology may have enabled a collective social action that was expressed in the construction of monuments, the undertaking of military campaigns and other efforts that perpetuated their growth.

The post-AD 500 period in the Valley of Mexico witnessed several events that caused the expansive Teotihuacan state to begin its decline and eventual demise circa AD 650. Numerous theories outlining the exact nature of these events have been debated for decades. These include natural disasters, epidemics, ecological degradation, invasions from abroad, obstruction of trade routes by other cities, internal social conflicts and Teotihuacan's own mismanagement of human resources (Litvak King 1970; Lopez Lujan 1996; Millon 1973, 1976; Rattray 1987). Whatever the cause, we now believe that by AD 650 Teotihuacan had ceased to be the major player in the Central Highland region.

The systematic and strategic burning of more than half of the city's temples at this time highlights the severity of the city's demise (Millon 1988). As the city declined, its population gradually decreased from an estimated 150,000 to only 30,000. Much of the population migrated to outlying regions, including the Toluca Valley, Tlaxcala, as well as the Chalco and Texcoco areas in the southern part of the Valley of Mexico (Lopez Lujan 1995; Parsons and Whalen 1982; Sugiura 1993, 1996). Although the city continued to be one of the largest in Central Mexico, its political and economic networks were effectively ruined. This is most evident in the widespread and sudden replacement of Teotihuacan pottery with Coyotlatelco style pottery during the Epiclassic period. As described below, the source and origins of this pottery are still somewhat uncertain. Cities that once maintained strong ties to Teotihuacan, such as Tikal in the Maya region (Figure 3), no longer import obsidian or ceramics from the city. Militaristic symbolism and iconography is implemented at Teotihuacan and other sites throughout the Central Highlands: a direct consequence of the political instability and increased economic competition created by the declining city. Despite the seemingly catastrophic political destruction of the city, some researchers have argued that Teotihuacan continued to be a major force in Central Mexico until circa AD 900 (Diehl 1989; Sanders et al. 1979). If indeed, it was a force during the Epiclassic period, it was under a different authority and at a much smaller political and economic scale.

Epiclassic Period (AD 650-900)

> "Without the overriding influence of a Teotihuacan or Maya civilization, regionalism and competition appear to have prevailed in Early Postclassic Mesoamerica, where polities of city-state scale sparred with one another in their bids for economic and political hegemony over distant regions." (Zeitlin 1982:270).

The demise of the Teotihuacan state as the primary political, religious and economic center in central Mexico created both tremendous uncertainties and opportunities that were left to be settled on local or small-scale regional levels. The period is marked by dramatic shifts in settlement patterns, political disorganization and a struggle for prime natural resources (Nalda 1998). Compared to Classic period settlements, Epiclassic sites were smaller and were situated in locations that were more defensible. Military iconography occurs with frequency during the Epiclassic period, most notably at sites such as Xochicalco in Morelos and Cacaxtla in the state of Puebla (Hirth 2000; Lombardode Ruiz 1995; Lopez Lujan 1996). Clusters of autonomous and semi-autonomous city-states emerged, some controlled by larger urban centers such as Chalco-Xochimilco and Azcapotzalco-Tenayuca in the Valley of Mexico and Teotenango in the Toluca Valley (Parsons and Whalen 1982; Rattray 1987, 1996). Within the Toluca Valley, Teotenango was preceded by smaller centers, such as Santa Cruz Atizapan, that developed within the valley's alluvial plan. New religious centers were also established along with ritual practices that combined aspects of Teotihuacan religion and a new emerging ideology.

Equally contested during this period was the control of natural resources and their associated long distance trade networks. The green Sierra de Las Navajas obsidian, procured and heavily traded by Teotihuacan during the Classic period, became scarce in the Valley of Mexico during this period as most cities began using more locally available gray and black obsidian from the nearby mines of Otumba and Zacualtipan (Rattray 1979, 1987). Teotihuacan residents continued to use Otumba obsidian in abundance but they produced a more restricted variety of tools; primarily straight based bifacial blanks and corner-notched Marcos style projectile points (Rattray 1987: Figure 3). As measured by the complete absence of Teotihuacan controlled resources or traits in other regions, trade networks once maintained by the Teotihuacan state diminished completely during the Epiclassic period.

Toluca Valley

Preclassic Period (1100 BC-AD 250)

Settlement in the Toluca Valley during the Early Preclassic period was concentrated in the west-central region near the present day city of Toluca (Sugiura 2004). Approximately twenty sites were located in this region with a few scattered sites also occurring along the lacustrine zones. These settlements consisted of small domestic units with ceramic styles similar to those in the Valley of Mexico. During the subsequent Middle Preclassic more than 50 sites were occupied in the southern part of the valley and habitation of the lacustrine zones was well established. The sites continued to be rural dispersed settlements but were generally larger than in the preceding period. A few sites grew to more than 30 hectares but the average site covered only 13-15 hectares (Gonzalez de la Vara 1994). The variability in the size of sites may indicate a developing regional hierarchy (Sugiura 1980), but even the largest sites paled in comparison to the contemporaneous cities of Cuicuilco and Tlatilco in the Valley of Mexico. Regardless, this incipient regional hierarchy did not last long.

The Toluca Valley experienced a sudden and dramatic abandonment during the Late and Terminal Preclassic period (Gonzalez de la Vara 1994). The number of sites decreased and the remaining population established new sites in more defensive locations (Sugiura 2004). The region also declined culturally as evident in the poorer quality of pottery manufactured during this time. This may, in part, reflect the end of long established cultural relations with the neighboring Valley of Mexico. In fact, events transpiring in the Valley of Mexico may have precipitated the abandonment of the Toluca Valley. Preclassic period Teotihuacan was beginning to establish itself and grow considerably, absorbing not only the population of its own valley but potentially those from other regions such as the Toluca Valley.

Classic Period (AD 250-650)

For several centuries previous, the Toluca Valley had sustained a gradual decline in population (Sugiura 1998a). This pattern reversed during the Early Classic period (circa AD 250). With the ascent of Teotihuacan, numerous sites were re-established in the Toluca Valley to take advantage of its agricultural potential and abundant lacustrine resources. By the Middle Classic period settlement increased to more than thirty sites. Sugiura (2004) argues that a more complex and well defined socio-political hierarchy was established at this time. At the highest level were large civic-religious centers that were surrounded by numerous smaller low-level sites. These sites were located in the lowland areas along the Rio Lerma and the foothills of the Nevada de Toluca.

Three natural access routes leading from the Valley of Mexico facilitated the increased migration of people in to the Toluca Valley (Sugiura 1996, 1998a). The northernmost route began at the city of Azcapotzalco in the Valley of Mexico and entered the Toluca Valley north of Lake Chiconahuapan. The central route is often only described as the old road from the Valley of Mexico to Toluca. The southernmost route is through the Ajusco Mountains; ending at the present town of Xalatlaco in the Toluca Valley.

By the Late Classic period, circa AD 450, more than seventy sites were concentrated in the north-central alluvial plain region and at the foothills of the Nevado de Toluca. These sites were organized politically into four hierarchical levels (Gonzalez de la Vara 1994). First and second level sites, differentiated by increasing size, lacked evidence of public architecture. Third level sites contained at least one public structure, and at the highest political level were large sites with several public structures that acted as administrative and religious centers. Only four sites in the eastern part of the valley are in this category, including the La Campana-Tepozoco complex associated with the Santa Cruz Atizapan locus. The site of Santa Maria Azcapotzaltongo in the central part of the valley appears to have been the principal site during this period (Sugiura 2004).

Increased settlement in the Toluca Valley also renewed cultural links with Teotihuacan and the Valley of Mexico. Teotihuacan style architecture, ceramics, and decorative motifs are common at this time, as are burial practices, religious offerings and ritual objects associated with the city.

Epiclassic Period (AD 650-900)

The early Epiclassic period continued the migratory trends begun in the Middle and Late Classic periods. Over one hundred sites were established in the Toluca Valley at the end of the Late Classic and this number increased to more than two hundred and fifty during the Epiclassic. Numerous sites occupied during the Classic period continued into the Epiclassic period. During the early Epiclassic, five large regional centers appeared at strategic entry points into the valley. This allowed them to control the movement of trade items into and out of the region. Two centers are in the eastern portion of the valley (including La Campana-Tepozoco), one in the extreme southwest region, one along a main route connecting the valleys of Toluca and Mexico, and the Santa Maria Azcapotzaltongo site, mentioned above. Once the valley's prime real estate was claimed, new migrants were forced to occupy less hospitable regions further north in the valley (Sugiura 1996). As with Epiclassic sites in other parts of Central Mexico, these later sites were situated in more defensible locations.

In response to the turmoil created by the decline of Teotihuacan, the region was reorganized culturally, if not, politically and economically. The introduction of Coyotlatelco pottery is the most visible archaeological shift. As discussed previously, its origins are still debated but, without doubt, the tradition was introduced by the people migrating into the valley at the inception of the Epiclassic period. The present study is concerned with another aspect of this change, the presumed shift away from the import of green Sierra de Las Navajas obsidian by Teotihuacan traders. The comparative distribution of these two classes of objects (i.e., ceramics and lithics) provides some insight into the changes evolving in the Toluca Valley. Sorensen et al. (1989) maintain that workshops in the Valley of Mexico exported a corresponding Coyotlatelco lithic industry along with the widely traded Coyotlatelco style ceramics. Sugiura (1998a), however, states that the majority of obsidian in the Toluca Valley during this period was gray colored and likely imported from the distant Ucareo-Zinapecuaro mines in the state of Michoacan. This Epiclassic period divergence between ceramic and lithic exchange networks could be significant because it suggests a change in the importance of obtaining Valley of Mexico (Coyotlatelco) pottery and Valley of Mexico (Coyotlatelco) produced obsidian tools. More importantly, it suggests that Toluca Valley residents must have diversified economic and, presumably, social and political relations to include areas other than the Valley of Mexico in their interaction sphere.

The unique scenario of Xochicalco, an Epiclassic period regional center in the state of Morelos, highlights this changing environment. Xochicalco, located in the western part of the state, did not participate in the Coyotlatelco red-on-buff pottery tradition and it imported a tremendous amount of obsidian from the Ucareo source (Hirth 1995; Hirth and Andrews 2006; Sorensen et al. 1989). The Toluca Valley would have provided Xochicalco the most direct route from the Zinapecuaro-Ucareo obsidian source. As such, it is quite possible that an obsidian network was established from the Ucareo source, through the Toluca Valley and eventually ending up at Xochicalco. This suggests three possible scenarios: 1) Toluca Valley residents facilitated the movement of this obsidian to Xochicalco, either through control of the finished product or by restricting travel through the valley; 2) Toluca Valley residents obtained their obsidian from Xochicalco or traders tied to that city; 3) Itinerant obsidian traders moved obsidian from Michoacan throughout Mesoamerica without regard to political or cultural affiliation.

Chronological Considerations:

The Late Classic – Epiclassic transition in Mesoamerica

In a 1978 article on the transition from the Classic to Postclassic period, Malcolm Webb debated the utility of using Preclassic, Classic and Postclassic period chronological designations to describe Pre-Hispanic cultural events (Webb 1978). He argued, much as Coe (1957) did years earlier, that such a system misleads one into assuming that the Early to Late stages within each period had more in common with each other than perhaps the Late stage of any one period and the Early stage of the succeeding period. He also illustrates the incongruity of using what are essentially Central Highlands derived terms to describe broad Pan-Mesoamerican cultural developments, noting in particular that recent radiocarbon data had pushed the florescence of the Peten Maya to more than two hundred years after the Late Classic period demise of Teotihuacan (Kidder et al. 1946).

As new archaeological excavations continued to refine local culture histories, the problematic nature of the established chronological scheme became even more evident (Sanders 1989). Price (1976:14) partly attributed this crisis to the tendency of archaeologists to use these categories inconsistently to designate both developmental stages and as strict chronological referents. Utilizing recent archaeological data, Webb (1978) proposed an update to the Preclassic-Postclassic period framework that focused on the rise and fall of state systems. In particular, he addressed the radical economic and politics transformations that followed the demise of Teotihuacan. In agreement with Jimenez Moreno (1966), and Paddock (1966), he argued that the realignment of populations, trade networks and political affiliations that occurred during the AD 650-900 time period established the basis for the rise of later Postclassic states, and he accepted Jimenez Moreno's (1966) previously proposed "Epiclassic" period designation.

Countering Webb's proposal, Sanders (1989) and others argued that even the use of the term Epiclassic should be avoided because, as Webb had himself pointed out, this time period encompassed the apex or potential "Classic" period of Lowland Maya culture. At a School of American Research Advanced Seminar, William Sanders and other researchers working in the Basin of Mexico worked out a completely different chronological scheme based not on implied cultural content but rather regional style complexes called "Horizons" (Millon 1976; Price 1976; Sanders 1989). Successive horizons were comprised of distinctly recognizable architectural, sculptural and ceramic styles. The earliest horizon was the Olmec, which originated along the Gulf Coast region circa 1250-950 BC. This was succeeded by the Teotihuacan Horizon style which peaked circa AD 450-650. A final Mixteca-Puebla Horizon was proposed for what was previously recognized as the Late Postclassic period. As Sander's explains:

> "We referred to the time periods encompassed by the three horizons as Early, Middle, and Late Horizons, and called the time between them intermediate periods. This is a vast improvement over the old system because it permits us to place regional developments securely in time while avoiding the problems inherent in the great cultural variability that often characterizes local sequences" (1989: 211-212).

The arguments for a neutral chronological scheme that could serve all regions of Mesoamerica are valid, yet for several reasons the original Preclassic, Classic, Epiclassic, Postclassic configuration is adhered to in this text. Within the Central Highlands region the chronological dates and events associated with these period designations do, in fact, reflect our current understanding of the rise and fall of the dominant powers of the Preclassic (Cuicuilco), Classic (Teotihuacan, Monte Alban), Epiclassic (Teotenango, Xochicalco), and Postclassic (Tula, Tenochtitlan) periods. Although most of these cities were located in the neighboring Valley of Mexico their social and political actions certainly impacted events in the Toluca Valley throughout its history. Any interpretation of human settlement within the valley must therefore be understood within the context of events transpiring in the Valley of Mexico and the use of the original scheme is thus justified. Previous publications by the Santa Cruz Atizapan Archaeological Project have also used the Classic and Epiclassic designations and proposed regional equivalents (Covarrubias 2004; Giles 2002; Sugiura 1998a).

The Epiclassic Period Coyotlatelco Complex

The problem that still lingers in the Sanders et al. (1979) model is that it continues to relegate important post-Teotihuacan and pre-Tula (AD 650-900) developments to secondary or transitional roles in Mesoamerican history by designating this period as an

Intermediate phase (Oxtotipac- see Table 1) bridging the Teotihuacan horizon and the later Mixteca-Puebla horizon. Others have similarly considered it a period of decline or a historical void (Rattray 1987, 1996). In actuality, current archaeological data on the initial Coyotlatelco phase of the early Epiclassic period illustrates the sudden and expansive spread of distinct Coyotlatelco pottery, architecture, and ideology throughout the Central Highlands as Valley of Mexico populations migrated outward from the valley. The diffusion was so quickly widespread that the presence of Coyotlatelco pottery is considered a definitive chronological marker for the start of the Epiclassic (Sugiura 1996). The Epiclassic period is now defined by changes in settlement patterns that demonstrate political realignments, the establishment of new regional centers, and reorganized networks for the exchange of materials such as obsidian.

The initial lack of archaeological understanding in two key areas led to the uncertainty regarding the Coyotlatelco period and the Epiclassic generally. The first concerns the enigmatic nature of the Coyotlatelco (Rattray 1966). For many years, the only definitive trait of the Coyotlatelco was the sudden widespread appearance of rather unimpressive red-on-buff pottery that paled in aesthetic appeal when compared to the Teotihuacan pottery that it completely replaced. With only this evidence at hand archaeologists were left to ponder the significance of the sudden widespread introduction of this completely different pottery style; particularly, when it appeared that Teotihuacan and the Valley of Mexico were experiencing a depressed period marked by a decline in monumental architecture and monumental art (Cohodas 1989). This confusion led to an array of uses for the term Coyotlatelco. The term has at various times been used to designate a ceramic type, a ceramic complex, a culture, a cultural phase and a horizon (Sugiura 1996).

There is also continued debate about the origins of the pottery style that best defines the complex. Related to this are discussions of cultural continuity and settlement. Scholars have proposed two competing theories on the development of the Coyotlatelco ceramic tradition. One perspective proposes a local Teotihuacan development (Diehl and Berlo 1989; Parsons 1971; Sanders 1989) by remnant populations within the city. The second position argues for a northern origin, possibly developed in the region of Tula prior to its import southward into Teotihuacan (Mastache and Cobean 1989; Rattray 1966). Sugiura (1996: 241) has hypothesized that Otomi people living in the northern part of the Valley of Mexico may be responsible for introducing Coyotlatelco pottery. Recent DNA evidence obtained from skeletal remains recovered from the Santa Cruz Atizapan site seem to confirm this assertion (Yoko Sugiura, personal communication 2006). As Rattray (1996: 213) states:

> “There is little doubt that a group of immigrants invaded Teotihuacan. The problem is; did they bring in the Coyotlatelco complex fully developed?”

Rattray’s position that immigrants from the north invaded Teotihuacan highlights the second area complicating our understanding of the Epiclassic period. While researchers have been able to document the demographic, economic and material culture changes resulting from the demise of Teotihuacan there is still no consensus regarding the events and causes that ultimately led to its decline.

CHAPTER 4: Obsidian in Mesoamerica

Despite a limited number of naturally occurring high quality obsidian outcrops in Mesoamerica, its presence in Pre-Hispanic archaeological assemblages suggests that nearly everyone acquired and utilized substantial quantities of this material; either though trade, direct procurement, or tribute (Cobean 2002). Obsidian artifacts, in fact, dominated the stone tool assemblages of Pre-Hispanic Mesoamerican societies for more than 3,000 years (Winter 2001). The glass properties of obsidian allow it to be modified with relative ease and its lack of crystalline structures produces extremely sharp edges. These were likely the primary reasons explaining its extensive and widespread distribution. The brittle nature of obsidian appears to have been offset by these two mechanical properties.

The use of obsidian artifacts in domestic contexts as cutting, piercing or scraping tools is well documented archaeologically. In many cultures, including the Aztec, Maya and Teotihuacan, they also took on ritual or symbolic meanings when flaked into elaborate forms or simply deposited in burial or other ritual contexts. At times, the mere presence of particular obsidian forms or colors might have held some meaning (Pastrana and Hirth 2003; Stark 1990). These functional and symbolic uses of obsidian made it a valuable commodity as both a raw material and finished product. Economic, political, and quite possibly social and ideological influence were awarded cities that could control this vital resource. The archaeological record has yet to provide us with direct evidence of competition over obsidian resources or the trade networks involved, but we do know that large political centers controlled the obsidian industry in nearly every region and during every time period leading up to the 16th century arrival of the Spanish.

CENTRAL MEXICAN OBSIDIAN SOURCES

> “Technologically and economically, everything concerned with the production, exchange, and consumption of Mesoamerican obsidian begins at the sources and outcrops (Clark 2003:17).

A by product of volcanic eruptions, obsidian glass forms when conditions allow for the rapid cooling of ejected lava so that crystallization does not occur. High silica containing rhyolitic obsidian is the most commonly occurring form. Low silica content trachytic obsidian also occurs but is quite rare in Mesoamerica (Cobean 2002). In addition to silicon, most obsidian contains large amounts of oxygen, aluminum, and potassium. It is however, the trace elements in obsidian that make it so useful for archaeological study. Obsidian sourcing studies using Instrumental Neutron Activation Analysis, X-ray Fluorescence and Proton Induced X-ray Emission (Trombold et al. 1993) techniques have focused on the minute concentrations of the following elements to distinguish source areas and link them to archaeological artifacts: Mn, Zr, Rb, Sr, Y, La, Ba, Sc, Sm, Fe, U, As, Ln, Nb, Na, Ti, Ca, Mg, Th, Ce, Cs, Gd, Hf, Nd, Zn, Dy, Eu, Hg, Sb, Ta, Tb, Yb, Lu, Li, Mo, Ga, V, Pb, Sn, Co.

Mesoamerican obsidian outcrops are not ubiquitous. They are generally only found within two large volcanic belts that run from west to east across Mexico, Honduras, Guatemala and El Salvador (Cobean 2002; Gill and Keating 2002; Santley 1989a). The largest belt originates in the Mexican pacific coast states of Jalisco and Nayarit, and connects northern Michoacan, the Central Highlands region, the state of Guanajuato and Bajio region of Queretaro, to the north-central part of the state of Veracruz. The second belt runs from the pacific coasts of Guatemala and El Salvador to the western edges of Honduras.

Six primary Central Highlands obsidian sources were exploited by Mesoamerican peoples: Otumba, in the State of Mexico; Sierra de Las Navajas, Zacualtipan, Tulancingo and Paredon in the state of Hidalgo; and the Ucareo and Zinapecuaro sources in the state of Michoacan (Cobean 2002 - Figure 3). To date, only three of these sources (Sierra de Las Navajas, Ucareo and Zinapecuaro) have been thoroughly investigated, along with the sources in the Ixtetal Valley and north slope of the Pico de Orizaba Volcano in Veracruz.

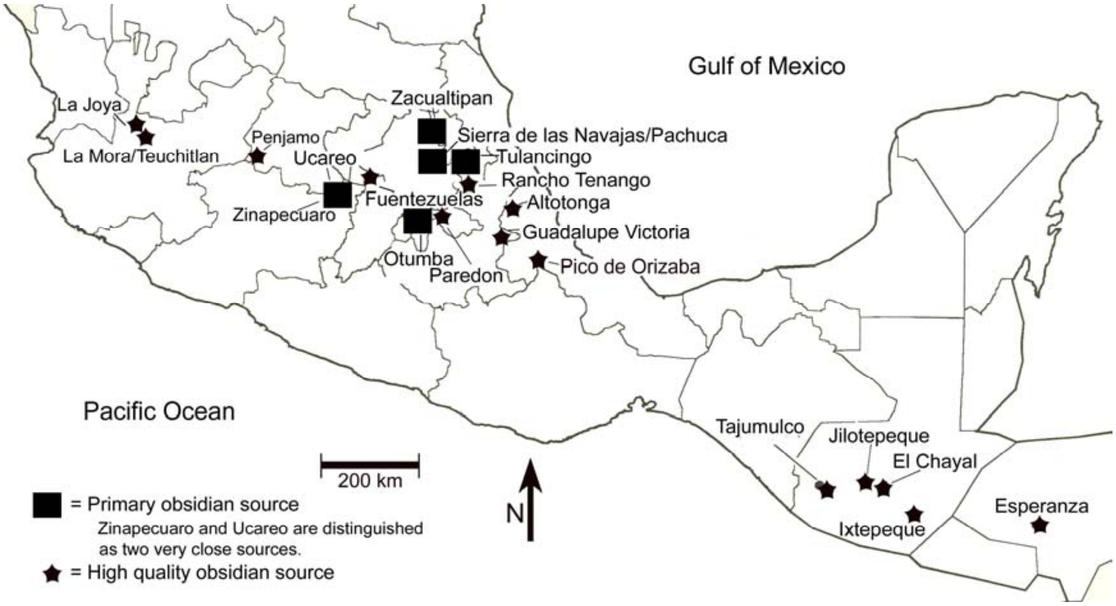


Figure 4. Primary Mesoamerican obsidian sources (Adapted from Hirth (2003: Figure 1.1)

Otumba

The obsidian from Otumba was exploited by many Pre-Hispanic cultures; most notably, Teotihuacan, Tula and the Aztec empire. Situated in the Teotihuacan valley, the source was easily accessible and its obsidian was used produce prismatic blades as well as bifacial tools. Because the nearby Sierra de Las Navajas sources were deemed a higher quality obsidian, the grainer Otumba obsidian was primarily used to manufacture projectile points and knives. Cobean (2002), notes that while the workshops identified at Otumba date to the Postclassic period, sourcing studies have shown that the source was heavily in use during the Formative and Classic periods as well. Indeed, the assemblage analyzed here contains several objects sourced to the Otumba quarries.

Otumba obsidian is of a variety of colors and translucencies. The most common descriptions refer to Otumba obsidian as dark gray and semi-translucent or opaque gray or black. In the Santa Cruz Atizapan collection we also noted a chatoyant (bright luster caused by reflections and tiny bubbles in the material) brown color that was easily distinguishable from other Otumba and non-Otumba obsidian. Unique to Otumba quarries is the occasional red-gray mottled opaque obsidian “mecca” that was rarely used to manufacture stone tools (Glascock et al. 1994).

Sierra de Las Navajas

The most exploited and widely traded obsidian in Mesoamerica was certainly the green obsidian procured from the Sierra de Las Navajas mines. Identified at sites as far away as the Yucatan, Honduras, and even the southeastern U.S. (Barker et al. 2002), it served as the primary obsidian circulating within the Teotihuacan and Aztec economic networks. Excavations by Pastrana (1998) have further demonstrated a substantial Toltec presence at the Navajas mines in addition to heavy mining by the Aztecs. Teotihuacan’s establishment as the region’s major power during the Classic period has been tied to it’s direct and indirect control of the Sierra de Las Navajas obsidian sources (Santley 1989a).

Obsidian from the Sierra de Las Navajas mines is commonly a distinctive green and often translucent color. Chatoyant yellow-green or gold obsidians are also quite common. This chatoyant obsidian comes from a slightly different sub-source in the region, but chemically it is still quite similar to the more common darker green obsidian. What makes this obsidian unique, beside its distinct contrast in color from most gray and black obsidians, is its high quality. Much of the green obsidian recovered from archaeological contexts contains few, if any, impurities. This permits the material to be worked efficiently and with minimal risk of failures. This obsidian is so easily worked that it is still exploited today to manufacture the souvenirs sold at tourist archaeological sites such as Teotihuacan. Gray and some black obsidian has been identified on the northern hillside of the Cerro Cruz de Milagro and Pena del Jacal regions of the Navajas region, but these were rarely exploited Pre-Hispanically (Lopez Aguilar et al. 1989).

Two extraction methods have been identified in the Navajas mines. The most common method was the use of "tiros" or pits that measured 0.5-2 meters in diameter and extended 2-12 meters in depth (Lopez Aguilar et al. 1989; Pastrana 1998). These extremely narrow pits were occasionally turned into horizontal tunnels several meters beneath the surface. A second extraction technique consisted of large crater-like pits excavated between 15-40 meters in diameter and 6-10 meters deep.

Zacualtipan

Zacualtipan obsidian occurs infrequently in the archaeological collections submitted for source identification. This may reflect its lesser importance in the past, but it may also be the result of a sampling bias produced by its jet black opaque color. Many obsidian sources contain black, often nearly opaque, obsidian somewhere within its boundaries. In cases where visually selected samples are submitted for characterization analyses, Zacualtipan obsidian might not be sufficiently differentiated (see Moholy-Nagy 2003). At a minimum, its true relative percentages might be higher than those established through sourcing studies.

That said, Zacualtipan obsidian has been identified in many regions, including the Toluca Valley (this study), western Morelos, Veracruz, Oaxaca, Puebla, Chiapas and the Peten Lakes region of Guatemala. One technologically distinguishable attribute of Zacualtipan prismatic blades is their tendency to be wider than blades produced from other sources (Cobean 2002).

Tulancingo

Tulancingo obsidian is commonly a black opaque color, or gray with a slight greenish hue. Its texture is much coarser than obsidian from Sierra de Las Navajas mines. The obsidian workshops associated with the Tulancingo sources suggest that bifacial tools and unifacial scrapers were the primary products. There is little evidence here for the core-blade technology. The most extensive quarrying activities at Tulancingo occurred during the Epiclassic period when Huapalcalco served as the nearest regional center (Cobean 2002). Teotihuacan control of the Tulancingo mines has also been suggested by Charlton (1978).

Paredon

Prismatic blades made of Paredon obsidian occur earlier in the archaeological record than the more common Sierra de Las Navajas and Ucareo sources. Early Formative Olmec sites such as San Lorenzo Tenochtitlan and Chalcatzingo have produced some of the earliest prismatic blades made of Paredon obsidian (Charlton et al 1978; Cobean et al. 1991).

Paredon obsidian is typically a gray translucent color with slightly darker gray bands running through it. Although cores, bifacial performs and finished tools have been identified at workshops associated with the mines, the Santa Cruz Atizapan collection contains numerous awls manufactured from Paredon prismatic blade fragments.

Ucareo-Zinapecuaro

The Ucareo and Zinapecuaro quarries were second only to the Sierra de Las Navajas mines in their importance to Pre-Hispanic peoples of Central Mexico. They were a major source for Early Formative people in the Basin of Mexico, Oaxaca Valley and at San Lorenzo, Veracruz (Healan 1997). It was equally important throughout the Central

Highlands region during the Epiclassic period when it replaced the Sierra de Las Navajas obsidian that ceased being traded with demise of Teotihuacan. The Late Postclassic Tarascan state also extensively utilized the Ucareo and Zinapecuaro quarries. Prior to the Late Classic period there were no substantial settlements in the Ucareo Valley, leading Healan to conclude that its initial exploitation involved short term, perhaps seasonal, forays from more populated areas (Healan 1997).

The Ucareo and Zinapecuaro obsidian sources are spatially close but geologically unique. For much of the past twenty years, they have been identified as a single source by archaeologists. Many objects once attributed to the Zinapecuaro source area are now known to have come from the Ucareo quarries. Ninety-nine percent of the more than one thousand extraction quarries identified are found in the Ucareo region. Healan (1997) notes that the extraction locations in both regions are best described as quarries rather than mines because, unlike the Sierra de Las Navajas mines, they are almost exclusively open, doughnut-shaped excavations.

TECHNOLOGY

In Mesoamerica, obsidian occurs predominately as prismatic blades; so called because their method of production creates long narrow blades that resemble prisms in cross-section. Along with the longitudinally faceted prismatic cores from which blades are removed via pressure flaking, this core-blade technology represents both the oldest standardized and most efficient lithic technology in Mesoamerica (Clark 1982). Aside from a having a high cutting edge to material weight ratio, prismatic blades and cores are both portable and highly versatile tools. One could export or import finished blades to be used immediately or alternately prepared cores that could be stored and worked later depending on the abilities of local craftsmen. One could also safely carry prismatic cores on long journeys rather than sharp blades, and simply produce blades on the spot when needed. The versatility is further demonstrated by the fact that prismatic blades were themselves, often pressure flaked into bifaces, scrapers, drills, and even eccentrics (see Chapter 6).

Bifacial technologies were also a major component of Pre-Hispanic technologies. Projectile points, spear points and knives are common in most excavated assemblages, though their numbers generally represent only a fraction of the quantity of prismatic blades present.

Clark (1989) has compiled a list of obsidian products available in Aztec markets during the contact period. Several blade, flake and scraping products are listed, but biface tools, that surely must also have been available, are not included. Blade tools included prismatic blade razors, awls and percussion-flaked, thick, backed blades. Flake tools available included single-edged knives and v-shaped pieces (possibly first-series pressure blades). Unifacial scrapers consisted of maguey and skin scrapers. Obsidian chips as well as debitage were also market products along with un-worked raw materials and cores.

EXCHANGE AND USE PATTERNS

In Pre-Hispanic Central Mexico a series of successive powerful cities appear to have maintained control over the procurement and exchange of obsidian resources (Healan et al. 1983). During the Middle Preclassic period it was the Olmec center of Chalcatzingo, in the present state of Morelos. It was succeeded by Cuicuilco in the Basin of Mexico during the Late-Middle Preclassic period and Early Classic period; Teotihuacan, during the Classic period; and the Aztec Empire during the Postclassic period. The earliest large-scale mining occurred during the Late Preclassic and Early Classic coinciding with the rise of the first major cities in Mesoamerica.

The principal obsidian circulated by Teotihuacan was green in color and was quarried from the Sierra de Las Navajas mines 50 km northeast of that city (Spence

1981). This green obsidian is unique to the Sierra de Las Navajas mines and its presence at Classic period sites throughout central Mexico is often cited as evidence for contact with the Teotihuacan state. Archaeological work at the distant Maya site of Tikal in the Yucatan Peninsula (Moholy-Nagy 1989; Moholy-Nagy and Nelson 1990; Moholy-Nagy et al. 1984) and excavations in the northern part of the present state of Campeche have also produced significant quantities of this green obsidian (Nelson et al. 1977). Sierra de Las Navajas obsidian is also abundant on the surface of Classic period sites surveyed in the Toluca Valley (Sugiura 1990).

The widespread occurrence of this green obsidian suggests that it was almost certainly important for maintaining and perpetuating political and economic ties throughout this central and south central portion of Mesoamerica. Widmer (1996) suggests that the foreign trade value of Sierra de Las Navajas obsidian was great enough to allow many Teotihuacanos to invest in the less profitable exotic craft industries which flourished at the height of the Teotihuacan state. During the Late Postclassic period (AD 1350-1521) this same green obsidian was also an indispensable resource for the Aztec Empire, whose dominion included the Toluca Valley as well as regions to the north, west and south of the Valley of Mexico. Gray obsidian mines near the Classic period site of Otumba, east of Teotihuacan, were also exploited, but the grainy texture of this material generally made it less suitable for producing the abundantly traded prismatic blades. Gray obsidian was instead used to manufacture many of the bifacial tools that were used locally at Teotihuacan and in the Valley of Mexico. Charlton and Spence (1982) believe that Teotihuacan may have also controlled obsidian sources as far away as Tulancingo and Paredon.

For regions immediately outside the Valley of Mexico, economic models are generally used to explain the presence of Teotihuacan obsidian. Hirth and Villaseñor

(1981) note that Teotihuacan materials are found in the greatest quantities along natural trade and communication corridors and in areas where scarce resources are located. With increasing distance from the city, other socio-political and symbolic models are often favored for explaining obsidian distribution patterns. In the Maya region, occurrences of green obsidian have been explained as incursions of Teotihuacan military forces (Agrinier 1970), merchant and political emissary activities (Sanders and Michels 1977), or inter-elite exchanges of status objects (Clark 1986; Drennan et al. 1990; Spence 1977; Stark 1990). In reality, there were probably many variables simultaneously affecting the trade of Teotihuacan obsidian. Mitchum (1989) states that we should be wary of simple trade models that assume goods increase in value relative to the increased cost or effort in transporting them. Mitchum's work at the site of Cerros, Belize demonstrated that although foreign obsidian was rare at that site it was not treated as a scarce resource. The recovery contexts of green obsidian at the site were quite variable and its distribution was found to be similar to other materials such as chert.

The market products described previously served a variety of esoteric and everyday functions in Mesoamerican life. Countless functional or utilitarian tasks could have been completed with blade or biface derived objects. As noted by Sahagun in the Florentine Codex, the Aztecs used obsidian to cut, saw and perforate soft materials; even shave heads. He further states that;

> “the knives…are to shave the head, and for other things; some are broken from the surface and others have backs, and others are of two cutting edges, and others for scraping the pith of maguey so it (the sap) will flow, and others of these knives are white, others speckled, others are yellow, and others are common, these are good for scraping off the hairs or bristles of pigs (skins), when they kill them, after they have been singed.” (cited in Clark 1989b:311)

Chapter 5: Research Framework

To investigate questions concerning the acquisition, use and discard of obsidian objects at the Santa Cruz Atizapan site, the following four research components were proposed:

1. Intensive attribute analysis of the obsidian assemblage.
2. Microscopic use-wear analysis of formal or special use tools such as bifaces, and eccentrics.
3. Sourcing studies using Instrumental Neutron Activation Analysis and X-ray Fluorescence techniques.
4. A small-scale field survey to recover obsidian samples from recently identified but uncharacterized obsidian outcrops in the northern Toluca Valley.

Because we could not export the obsidian collection from Mexico for follow up analyses, we also took more than four thousand two hundred digital photographs of the artifacts during various stages of analysis. These photographs were utilized as visual references when we were not in the field laboratory.

The obsidian assemblage was analyzed between 1999 and 2003 in the SCAT project field laboratory in the town of Capulhuac, Mexico, and in a project laboratory in Mexico City. The primary attribute analysis was performed by the author with the intermittent support of two assistants. More than 11,000 obsidian artifacts were analyzed, although, for various reasons outlined below, only approximately 8,500 were utilized in the final write-up. Microscopic use-wear analysis was attempted during the spring of 2003, using instruments borrowed from the Instituto de Investigaciones Antropologicas, UNAM. The problematic results of this approach are explained below. The Instrumental Neutron Activation Analysis of forty-seven obsidian samples was completed by Michael

Glascock at the Missouri University Research Reactor (MURR) under a grant provided by the National Science Foundation. This collection included forty-five artifacts recovered from various contexts during SCAT excavations, and two flake spalls chipped from high quality obsidian nodules pulled from road cuts in the northern part of the Toluca Valley. These represented the first naturally occurring obsidian samples sourced from the Toluca Valley. X-ray Fluorescence was also used to characterize the elemental composition of these two flake spalls. The analysis was performed by Fred Nelson at Brigham Young University.

During the spring of 2003, I and several students from the SCAT project joined archaeologist Ruben Nieto on a foray into the northern forests of the Toluca Valley to search for outcrops that contained the same high quality obsidian we observed in the two nodule samples submitted for NAA and XRF analyses. We focused our efforts on exploring two large known outcrops located close to where the initial samples were recovered.

The obsidian assemblage and data resulting from the four analytical components just described were also conditioned by the SCAT excavation methods implemented. For this reason, the areas excavated, methods used and features identified are detailed below for each field season (SCAT T1=Temporada/Field season 1, SCAT T2=Temporada/Field season 2, SCAT T3=Temporada/Field season 3). As is the case for most archaeological projects, only a small portion of the site was excavated. In an area where more than one hundred platform mounds have been identified, only significant portions of two platform mounds have been excavated. Equally important is the fact that the associated Epiclassic period pyramid of La Campana-Tepozoco has never been extensively investigated by archaeologists.

SANTA CRUZ ATIZAPAN EXCAVATIONS:

SCAT-T1 (1997)

The first season of fieldwork at the site of Santa Cruz Atizapan was initiated with an intensive field survey that identified the quantity and distribution of the artificially constructed platform mounds within the Chignahuapan Lake. The region was previously surveyed in 1979; however, many of the smaller nearly imperceptible platform mounds were only identified during the 1997 season. At total of ninety platform mounds measuring between 15 and 25 meters in diameter were recorded. Surface collections were made at each platform mound but the associated obsidian objects are not included in the current analysis.

Platform mound 20 (Figure 2) was selected for excavation for several reasons (Sugiura 1998): 1) It was the largest platform mound identified 2) It was located on an abandoned road, away from agricultural areas. 3) It contained an exposed yet well-preserved stratigraphic profile. 4) It was located near the lake, which would permit the preservation of perishable materials. 5) It was threatened by the expansion of the local municipal trash dump. 6) A great quantity of archaeological features and objects were visible on its surface. The stratigraphic profile also revealed a continuous occupation of the platform mound from the Classic to the Epiclassic period.

Geomagnetic and electrical resistivity remote sensing techniques were employed at Platform Mound 20 as well as other nearby platform mounds prior to the start of excavation. Realizing that the complete excavation of Platform Mound 20 would require more time than the three-month season of 1997, the decision was made to excavate only the central portion of the site.

Twenty centimeters of the site’s disturbed overburden was first removed with a backhoe. Hoes and pick axes were then used to loosen the soil, which was then shoveled to the sifting screens. Trowels were utilized when layers or levels came together and on cultural surfaces. This methodology was employed during each excavation season.

These excavations uncovered the southern portions of several large, superimposed, public use structures, several habitation units to their southwest, and numerous features that included burials with accompanying offerings, hearths, gravel surfaces and the foundation latticework used to construct the platform mounds themselves.

SCAT-T2 (2000)

The second season of fieldwork continued the remote sensing studies to delimit the dimensions of the platform mounds and identify their architecture and possible functions (Sugiura 2000b). Nine trenches were also excavated across the nearby Platform Mound 13 and across a modern day road (Figure 2). Excavation continued on the northern half of the public use structures of Platform Mound 20, but time constraints limited the depth of work to approximately 1 meter. Several new domestic structures were also identified to the northeast of this structure. The planned excavation of Platform Mound 13 was put on hold due to time constraints and the onset of the rainy season.

SCAT-T3 (2001)

Between the months of February and June 2001, the SCAT project completed its third season of excavation. At this time, the remaining northern portion of the Platform Mound 20 public structures were excavated along with Platform Mound 13 (Figure 2), a purely Epiclassic period platform mound. The site grid was also extended and units excavated that would define the boundaries of the site. The earliest occupation of the site was attributed to the deepest of the public structures, a Teotihuacan style platform.

Additional habitation units were uncovered in the eastern, northern and central areas of excavation along with several hearths and burials.

THE OBSIDIAN ASSEMBLAGE

The analyzed assemblage consisted of 11,317 obsidian artifacts recovered from excavated contexts. Two thousand five hundred and thirty-four artifacts were recorded during the first field season. This was followed by the excavation of 3,398 artifacts and 5,385 artifacts during subsequent seasons. After excavation, each object from general contexts and most special contexts were washed in water using small brushes and then individually labeled in white ink before being archived in plastic bags. Site (SCAT), excavation season (T1,T2,T3) and bag number were then handwritten on each obsidian artifact unless the piece was deemed to small to write on.

SCAT-T1 (1997)

The obsidian recovered during the 1997 field season was informative and perplexing, yet also problematic. The predominance of prismatic blade fragments and the presence of few specialized tools in the assemblage excavated in 1997, initially suggested to us that most obsidian objects at the site were imported for use in subsistence activities. In large part, the blades were simply used unmodified. However, blades were also shaped into fine awls, scrapers, c and w-shaped eccentrics and at least three projectile points. The green obsidian observed in the collection confirmed the region's link to the obsidian resources controlled by the city of Teotihuacan in the Valley of Mexico.

The extremely fragmentary condition of the prismatic blades was perplexing. In comparison with artifacts recovered in subsequent years those recovered during the 1997 excavations were much smaller, often exhibiting impact scars on their lateral margins. Many blades were smaller than 2cm x 2cm making the identification of use-wear and other analysis attributes very difficult. Two scenarios were proposed to explain this patterning.

Some of these objects had been discarded in a Pre-Hispanic trash midden that had been identified in this part of the site. This hypothesis was later superseded when it appeared that many fragmentary objects were also recovered from areas not located near the trash midden. I now believe that, despite the removal of several centimeters of overburden prior to excavation, many of this season's artifacts were still impacted by modern agricultural activities. As noted previously, the modern trash dump for the town of Santa Cruz Atizapan is located nearby and the old Camino Real road also crossed portions of the 1997 excavations. This would have further affected the integrity of the obsidian collection. The necessary labeling of the objects also affected the percentage of surface area that was visible during analysis. At times the labeling covered almost fifty percent of the objects entire surface.

SCAT-T2 (2000)

Obsidian from the second season was noticeably different than that recovered during the first season. Most dramatic was the more complete nature of the prismatic blade artifacts. Blade lengths were much longer and far more edges could be analyzed for use-wear. Greater numbers of bifaces and other forms were noted, but this was a direct result of more expansive project excavations than in the previous season. It was also in this assemblage that we first noticed several blades with repeated but distinct use patterns that produced "t-shaped" blades. These blades were heavily used except at their midsections where fin shaped lateral extensions faded out to points that were often the original widths of the blades.

SCAT-T3 (2001)

The third season of excavation produced the greatest quantity of obsidian artifacts. These were recovered from continued excavations at Platform Mound 20 and new excavations at Platform Mound 13 (Figure 2). As with the T2 assemblage, the artifacts recovered during this period were more complete and diverse than those of the T1 assemblage. Particularly noteworthy were the more than two hundred bifaces and 41 eccentrics recovered. Several exhausted prismatic cores were also identified, providing evidence that at least some blades were probably produced at the site itself. Labeling methods were refined, permitting us to analyze more edge wear on the artifacts.

ATTRIBUTE ANALYSIS

The entire excavated collection was subjected to detailed attribute analysis. The initial methodology was developed and refined during a preliminary survey of the collection in 1999 that simply divided the collection into blade and non-blade tools and noted the presence of green "Teotihuacan" obsidian, brown "Otumba" obsidian, or black "other" obsidian. The first intensive attribute analyses used a typological system that sorted the artifacts into the broad categories of cores, prismatic blades, scrapers, flake tools, bifaces, eccentrics and debitage. Evidence of use-wear was recorded, along with detailed color attributes that described color, texture, light transmittance, surface luster, surface texture, and inclusions. These color attributes were later synthesized into "types" when we became familiar with the region's obsidian. The attributes were further refined throughout the first field season, and at its conclusion.

During the second and third seasons of analysis we used Clark and Bryant's (1997) work at Ojo de Agua, Chiapas as a model for categorizing the prismatic blades at the site. Presenting a more complex understanding of obsidian reduction technologies than what had been previously published (see also Sheets 1975), Clark and Bryant were able to place their obsidian blades at precise points along the production continuum from raw material to pressure flaked prismatic blade. Using this classification system one could determine whether the majority of obsidian blades were pressure flaked prismatic blades, or preliminary percussion made blades that suggested an earlier stage of reduction. This information is particularly relevant for consumer sites that relied exclusively on imported obsidian for their daily utilitarian tasks. At Santa Cruz Atizapan we soon discovered that most prismatic blades were, as initially thought, final stage third series (3s) blades. Third series and higher blades are pressure flaked from very standardized prismatic blade cores; from which two cycles of blades have already been removed from around its circumference. The irregular nature of the first two series of blades, still retaining evidence of the transition from percussion to pressure flaking techniques, distinguish them from third series pressure flaked blades. Although Clark and Bryant's technological stages were recorded in the database they were not included in the morphological chart used during analysis (Appendix A)

The remaining attributes were the same as those used during the first field season, although a few extra were added to better describe the use-wear evident on the objects. A maximum of twenty-five attributes were ultimately recorded for blade artifacts. This number was reduced for other artifact categories.

Analysis Methods

The artifacts were analyzed by individual provenience as this seemed the easiest way to gain an understanding of any contextual patterning that might indicate use related events or depositional transformation processes. Bifaces, eccentrics, awls and other special tools were preliminarily analyzed and then separated from the main collection. They were later analyzed as separate artifact categories using specific attributes. The analysis was accomplished with the aid of a 5-20 power hand lens. Obsidian type designations were only made under natural lighting. Maximum length, width and thickness were originally measured using digital calipers, but we eventually resorted to using size charts on prismatic blades in order to reduce our analysis time. Mexican Customs officials did not allow us to import a digital scale during our first field season so we were unable to weigh any objects at that time. Weights were only recorded for SCAT-T3 materials, and all formal tools such as bifaces and eccentrics analyzed during our second and third field seasons.

Analysis Attributes

The stone tool assemblage consists of five primary artifact categories: bifaces, flake tools, core tools, prismatic blades and debitage. Due to their variation in morphology, each tool type was analyzed using a unique set of attributes. Debitage, while not a tool type, nonetheless provided us with pertinent information regarding production and discard patterns. Descriptive variables and use-wear patterns were recorded in depth for the remaining tools.

Prismatic Blades and Other Tools

Prismatic blades were the primary tools in use at the site and therefore warranted the greatest investment of energy during analysis. All artifacts were initially assigned to one of twenty-seven obsidian types, each distinguished by unique visual properties. The completion of the Instrumental Neutron Activation Analysis later demonstrated that these twenty seven categories actually represented the visual diversity of six major obsidian quarries (Appendix B). Each piece was then assigned a subtype based on further intentional modification of the blade (e.g. awls derived from blades) and its use-wear patterning (uni-marginal, bi-marginal wear). The remaining prismatic blade attributes were directed along two lines of inquiry: identifying the production stage of the blades and the location and intensity of macroscopically visible use-wear. We were especially interested in quantifying the amount of use-wear visible on the blades.

Other tools were investigated similarly, although different measurements were necessary due to the variation of artifact forms. Flake tools were analyzed with many of the same attributes used for prismatic blades (Appendix B). Bifaces and eccentrics were analyzed more in depth than flake tools. The attributes used to measure use location and intensity were generally the same for all categories of artifacts.

Debitage

Debitage varied in size but a substantial majority of pieces measured were larger than 1 cm x 1cm square. They were often large unidentifiable chunk fragments that did not exhibit evidence of intentional shaping or use. Few exhibited edges suitable for scraping or cutting. Due to their size and irregularity they were not considered production debris. This contention is supported by the absence of artifacts requiring the removal of material of this size. Large flake cores were not identified in the assemblage. Microflakes indicating blade retouching activities were not observed in the assemblage although re-sharpening activities must have taken place. These small retouching flakes must have sifted through the screens used during the field excavations. Due to these factors, only obsidian type, size dimensions, and weight were recorded for debitage.

SOURCING STUDIES

Source characterization studies are now integral components of archaeological research. Neutron Activation Analysis (NAA), X-ray Fluorescence (XRF) and Proton induced X-ray emission (PIXE) have revolutionized archaeological research into trade and political economy through their ability to link obsidian objects to their original quarries. NAA has especially benefited Mesoamerican obsidian research. Michael

Glascock at the Missouri University Research Reactor (MURR) has thoroughly characterized the primary Mesoamerican obsidian quarries and sourced thousands of archaeological artifacts using NAA. It is currently the most proven method for sourcing Mesoamerican obsidian, although XRF and PIXE offer non-destructive alternatives that are advancing in accuracy and accesibility.

The increasing use of characterization studies to infer cultural exchange and model behavioral patterns has not, however, advanced without some criticism. Hughes (1998) offers two cautionary points concerning sourcing studies. First, obsidian sources represent geochemical (geological) units based on chemical composition and not spatial areas as often interpreted by archaeologists. A single large archaeological "obsidian source" may, in fact, contain multiple chemical signatures. Secondly, trade cannot be assumed from the sourcing of objects to distant quarries. He notes that, "since trade, exchange, direct procurement, and mobility cannot be distinguished using obsidian sourcing information alone, it should be clear that geochemical data (the foundation for sourcing studies) are not direct evidence for prehistoric trade/exchange." (Hughes 1998: 111). Nevertheless, these are interpretive cautions that do not diminish the tremendous utility of obsidian sourcing studies.

Analysis Methods

Neutron Activation Analysis (NAA)

A National Science Foundation research grant to the MURR laboratory provided partial subsidized funding for the sourcing of two hundred samples from the Santa Cruz Atizapan site. The actual number of samples submitted was ultimately reduced to forty-seven as resources from the Proyecto Arqueologico Santa Cruz Atizapan provided funding for the analysis of twenty-two artifacts and the author could support the cost of analyzing an additional twenty-three samples. Two additional samples, flaked from nodules of obsidian recovered from the northern part of the Toluca Valley, represented potentially new sources and were therefore analyzed free of charge.

The full range of macroscopically identified obsidian types and the entire occupational history of the site were represented in the analysis. Artifacts from primary contexts such as floors were selected when possible and we included samples from public use and domestic use contexts. Larger artifacts exhibiting little or no evidence of use-wear were preferred for two reasons. First, by submitting these samples we did not lose important behavioral information. Second, we could snap these samples in two and retain one-half for our obsidian type collection.

The success of previous NAA sourcing studies in central Mexico now permit a ninety-five percent probability that an excavated artifact can be correctly sourced to its originating quarry. Advances have further led to an abbreviated procedure that measures fewer elements and requires much less time to analyze without sacrificing accuracy in the results (Glascock et al. 1994; 1998). The procedure involves five seconds of irradiation, twenty five minutes of decay and a twelve minute count (Michael Glascock, personal communication 2004). For the Santa Cruz Atizapan obsidian the following elements were used in an abbreviated NAA: Al (Aluminum), Ba (Barium), Cl (Chlorine), Dy (Dysprosium), K (Potassium), Mn (Magnesium), Na (Sodium). Plots of Mn vs. Na and Mn vs. Dy were found sufficient to assign sources to the SCAT samples. The analysis and source attributions were made by Michael Glascock at MURR.

X-ray Fluorescence Analysis (XRF)

The two Toluca Valley obsidian samples sourced using NAA were further analyzed by Fred Nelson at Brigham Young University using XRF analysis. This technique uses non-destructive X-rays to calculate the percentage of select compounds and the quantity of chemical elements in parts per million (ppm). The complete characterization of the two Toluca Valley samples included the following: Al_2O_3, CaO, Fe_2O_3, K_2O, MgO, MnO, Na_2O, P_2O_5, SiO_2, TiO_2, Ba, Ce, Nb, Rb, Sr, Y, Zn, Zr. As with the NAA, these two samples proved to be chemically unique from any other artifact or source sample previously submitted for XRF analysis at the BYU laboratory (Fred Nelson, personal communication 2004).

Visual Sourcing Analysis

The high cost of NAA, XRF or PIXE has encouraged archaeologists to find lower cost effective alternatives for attributing obsidian sources. Currently, visual sourcing methods offer the greatest potential. Several blind studies have demonstrated the accuracy of visual sourcing when an analyst becomes familiar with the local or regional obsidian and the conclusions are checked against chemical sourcing results (Braswell et al. 2000). Similar to the current study, Santley et al. (2001) used trends in color and material quality to extend the results of their NAA to a larger collection. Clark (2003) advocates a similar interactive approach, yet acknowledges that there is a learning curve before visual sourcing reaches an acceptable level of accuracy.

Using a 5 - 20 power hand lens we initially described over one thousand obsidian artifacts using the following attributes: Color, Surface Texture, Light Transmittance, Surface Luster, Inclusions, and Surface Cortex (Skinner 1997). After becoming familiar with the variation in these attributes, twenty-seven obsidian types were established with the belief that they could reflect unique obsidian sources. We combined some types when we observed single artifacts exhibiting an array of attributes from more than one type. The less common type then became a variant of the dominant one. The collection submitted for abbreviated NAA included pieces from all of our final types, including variants. As noted previously, when possible, we kept one half of each artifact submitted for NAA. This approach allowed us to create a very useful comparative collection that encompassed a wide range of variability for every real source identified through NAA.

The drawbacks of visual approaches have been debated elsewhere, with the loudest critiques rightly questioning the ability of analysts to distinguish between sources that may be visually quite similar. This is particularly problematic when less recognizable but visually distinct variants from one source overlap with the variants of other sources (Braswell et al. 2000; Moholy-Nagy 2003). This appears to be the case with gray obsidian sources in the Maya region. In a summary of visual sourcing studies, Moholy-Nagy (2003) noted that the diversity of obsidian sources is also generally underrepresented using visual methods. We attempted to avoid such pitfalls by using our twenty-seven descriptive types throughout the entire analysis. NAA results were then used to cluster these types into groups representing the true variation of actual sources. For example, our visually unique types 3, 14, and 7 were later identified as Ucareo obsidian. Each of our categories represented a visual variant of the Ucareo source.

MICROSCOPIC USE-WEAR ANALYSIS

Microscopic use-wear studies have increased in recent years (Clark 2003; Odell 2001). Low- and high-power magnification methods have provided a wide array of information regarding the materials that were processed with obsidian, the range of tasks performed, the manner in which a tool was held and the motion used to perform that task. A few well designed studies have used microscopic wear data to model social and political events at some sites (Aoyama 1995, 1999). The subjective nature of use-wear data has been lessened by experimental studies that attempt to recreate artifact wear through the processing of locally available natural resources with newly created obsidian tools. Such experiments require a substantial investment of time and energy in order to create sufficient wear patterns on a diversity of stone tools using the full range of materials that would have been processed during Pre-Hispanic times.

Despite the numerous published studies on use-wear, there is still no standard methodology established. Many of the proposed approaches were developed in response to the various authors' dissatisfaction with previous approaches. For this reason, I cautiously approached the study of microscopic use-wear on SCAT obsidian. Without the time or resources to invest in experimental studies it was clear, at the outset, that this might create an interpretive disadvantage.

Analysis Methods: Problems and Potential

One hundred obsidian objects were initially selected for the use-wear analysis. They were pulled from primary contexts and represented Classic and Epiclassic period domestic and public use areas. At this stage we did not pre-select artifacts exhibiting heavy macroscopic use-wear. We utilized the methodology and descriptions of use-wear patterning, published by Aoyama for the Copan obsidian assemblage (Aoyama 1994, 1995, 1999). Using this methodology we proceeded to hand wash each artifact with soapy water and then wipe it with alcohol for quick drying. Each sample was then immersed in a warm solution of 10 percent HCL for ten minutes to thoroughly clean all surfaces and dissolve any calcium deposits that might have accumulated on its surface.

An Olympus PME-3-ADL Inverted Metallurgical Microscope was made available for research by the Instituto de Investigaciones Antropologicas, UNAM and the analysis began under 100, 200, and 500 power magnification. Several significant problems became apparent after the analysis of just the first ten objects. At such high magnification we found the microscope hard to focus on the edge of the artifacts when we could not lay the object flat on the viewing surface. Second, the visible use-wear patterns were difficult corroborate with any of Aoyama's eleven categories. Rather than not identifying any wear at all, we were overwhelmed by the amount and variation of striations evident on the surfaces of all objects. They were neither concentrated in any one area of the artifact nor running in any single dominant direction. Surface gloss was evident but appeared minimal and covered over by later striations. After two days of furious note taking and repeated analysis of the same objects, a decision was made to bring in a different collection for analysis comprised of artifacts exhibiting heavy macroscopic use-wear.

It was after studying this collection that I began to question our ability to successfully utilize the published use-wear methodologies and analysis techniques. I considered that my own inexperience and the absence of a comparative use-wear collection might have been the primary cause. I also considered the possibility that depositional or post-depositional activities had somehow impacted the use-wear evidence. After some deliberation and consultation with Kazuo Aoyama, who had published the Copan methodology in question, there appeared to be two possibilities for the discrepancy in use-wear patterning evident on the SCAT assemblage and that identified in the Copan assemblage (Kazuo Aoyama, personal communication 2003). First, my lack of familiarity with the precise use-wear patterning created on obsidian objects when used against a variety of materials was certainly a disadvantage. Had I not been able to successfully identify any of the use-wear categories described by Aoyama I would have considered this to be the primary source of confusion. Second, there was the possibility that the washing of the artifacts in the field laboratory had introduced a significant amount of extraneous wear on the objects.

As mentioned previously, each artifact was thoroughly scrubbed with a brush and water prior to labeling and archiving. The brushes in use varied from toothbrushes to stiffer bristled industrial use varieties. The nature of the site's soil matrix and its extreme adhesion to the obsidian artifacts also required a fair amount of pressure to clean each object. Unfortunately, obsidian is a very susceptible to being scratched. Previous studies have noted that non-use related microscopic striations easily form on obsidian surfaces (Aoyama 1995; Hurcombe 1992). The microscopic presence of extensive yet randomly directed striations on the SCAT objects led me to conclude that the washing and brushing of the artifacts in the laboratory had covered, if not obliterated, the actual traces of use-wear. This aspect of the obsidian analysis was discontinued at this point. Future methods of washing and labeling obsidian objects should be modified to assist with the preservation of microscopic use-wear.

EXPLORATORY FIELD SURVEY: PREDICAMENTS AND PROSPECTS

During the spring of 2003, a one day exploratory survey was conducted in the northern part of the Toluca Valley. The survey was organized following the procurement of two visually distinct and high quality obsidian nodules from a road cut near the modern town of Jocotitlan by the archaeologist Ruben Nieto (personal communication 2003). These samples confirmed earlier claims made by the geologist Ezequiel Ordoñez, more than one hundred years ago (Ordoñez 1892, 1895, 1900). Several other minor outcrops had also recently been identified by Nieto in other parts of the valley, but these had yet to be thoroughly surveyed by archaeologists. Given a restricted amount of time and resources, the goals of the current project were limited to documenting the characteristics of the previously identified outcrop regions and the collection of high quality samples that could later be submitted for Neutron Activation Analysis and X-ray Fluorescence analysis.

Chapter 6: Artifact Analysis

This chapter explores the nature of obsidian exchange networks and obsidian consumption at Santa Cruz Atizapan during the height of Teotihuacan's influence in the Toluca Valley and the period following its demise, when commodity distribution networks controlled by the city were reconfigured. Decades of archaeological fieldwork in this region has shown that obsidian tools were essential commodities and that most residents could obtain the basic prismatic blade and bifacial tools necessary to carry out daily tasks such as hunting, food preparation, or ritual ceremonies. Every sizeable settlement known in the Central Highlands of Mexico acquired significant quantities of obsidian either directly or via third party trade networks or markets.

OBSIDIAN PROCUREMENT

To understand the significance and complexity of Central Highland procurement and distribution networks we need to recall that only six high quality obsidian sources supported the entire Central Highlands region (Figure 4) for more than 2,000 years (Cobean 2002: 39). The control of scarce obsidian source areas, tool production, and distribution networks must have therefore played a significant role in the political and social economies of the past. Teotihuacan's rise to regional dominance during the early Classic period has been attributed to its ability to control the Sierra de Las Navajas obsidian quarries north of the city. The acquisition of green obsidian from this source by foreign peoples (e.g. from Tikal) has often been presumed to signify important ties to Teotihuacan. In fact, Sierra de Las Navajas obsidian in the Maya region was once exclusively attributed to high-level political, social, or religious exchanges by elite members of both societies. While these types of elite exchanges likely occurred, the predominance of core-blade and bifacial technologies in most obsidian assemblages from the Preclassic period to the Spanish Contact period suggests that much more obsidian circulated for utilitarian purposes.

The intricacies of such exchange systems have proven difficult to map archaeologically. For example, despite the tremendous increase in obsidian research in recent decades not one definitive obsidian workshop has been positively identified at Teotihuacan (Clark 1986, 2003), and only recently has Hirth (1998) proposed archaeological correlates for the identification of Mesoamerican market systems. Economic factors such as energy expenditure, cost, and distance have thus often been used to model regional obsidian distribution networks (Santley 1980, 1984, 1986, 1989a, b). These purely economic models have been critiqued for not considering the full range of behavioral variables, yet they provide a valuable baseline from which to begin exploring these other factors.

Classic and Epiclassic period sites in the Toluca Valley provide a particularly interesting contribution toward understanding the social, political, and economic variables impacting Central Highlands obsidian distribution networks. While there is evidence that high quality obsidian outcrops might have been available in the northern part of the Valley, current data suggest that most if not all obsidian artifacts were imported into the region from the same distant quarries that supplied much of Mesoamerica during the Classic and Epiclassic periods. The Toluca Valley also experienced exponential population growth during the Late Classic and especially the Epiclassic periods (Sugiura 1990, 1993), which additionally, indicates that reliable obsidian import networks must have been in place both during the height of Teotihuacan's regional influence and following its demise.

In this chapter I use the results of chemical studies and visual analyses to describe the obsidian sources that were exploited to provide the tools and raw materials that make up the collections from the Santa Cruz Atizapan site. I also present the Neutron Activation Analysis and X-ray Fluorescence analysis results of flakes struck from two high quality obsidian nodules recovered from outcrops in the northern part of the Toluca Valley. Here I also describe the findings of a preliminary targeted surface survey undertaken in the northern part of the Toluca Valley. The primary purpose of this survey and the chemical sourcing of the two outcrop samples from this part of the valley, mentioned above, was to establish the existence of extensive and high quality obsidian raw materials within the Toluca Valley. The morphological variability of the excavated collections is also described in order to illustrate the production technologies that circulated within the Toluca Valley. The Classic and Epiclassic period are then described individually to highlight changes that may have resulted from the disruption of Teotihuacan controlled exchange networks. I end the chapter with a discussion of the consumption patterns evident between domestic and public spaces at the site.

Results of the Sourcing Studies: Neutron Activation Analysis, X-ray Fluorescence, and Visual Sourcing

The results of the Neutron Activation Analysis (NAA) sourcing studies were significant, yet the limited number of analyzed samples (N=47) prevents a full discussion of any temporal changes or contextual associations at the Santa Cruz Atizapan site using these data alone. Previous studies have suggested that a sample size of at least 200 artifacts is required in order to fully characterize a site assemblage using the NAA technique (Glascock 1998). Despite this interpretive limitation, the present NAA sourcing data succeeds on multiple levels. Most importantly, it established the presence of obsidian from six Central Highlands obsidian sources at the Santa Cruz Atizapan site. Using these data, we were also able to assign real obsidian source regions to the 27 obsidian categories that were established during the visual attribute analysis based on surface color, surface texture, translucency, and material imperfections or inclusions. At least one artifact from each of the original 27 analysis categories was submitted to the MURR lab for Neutron Activation Analysis. Grouping these original analysis categories into the six true present sources had the added benefit of providing us with a full range of visual variability for each obsidian source. This included slight variations in color, translucency, material granularity and the presence or absence of impurities.

Utilizing our sourced objects as a comparative type collection, we were then able to assign a single obsidian source to each artifact in the assemblage. When compared against the results of the NAA data we found that our visual analysis categories were consistently unique to only one source region in 41 of the 45 samples analyzed (91%). In only two instances involving two artifact categories did the NAA data return two potential and different source regions. One of the obsidian categories in question was seldom used during the visual analysis and thus its potential for introducing error into the analysis is considered minimal. The second discrepancy is attributable to human error and the grouping of two distinct categories early on in the analysis. The artifacts placed into these problematic categories were re-checked during the third season of analysis. If we accept that 25 of our original 27 categories were consistently recorded during the entirety of the visual analysis, we can claim a high degree of accuracy in the visual sourcing data. In this regard, the author was directly responsible for recording much of the analysis data including the designation of obsidian type categories. When research assistants analyzed objects the obsidian category data were routinely double-checked for accuracy. A sample of artifacts from the first field season was also later re-analyzed to check the consistency of the entire database.

Chemical Sourcing Studies

Forty-five prismatic blade fragments and large flake artifacts from the site of Santa Cruz Atizapan were submitted to the Missouri University Research Reactor for abbreviated Neutron Activation Analysis. The elements Aluminum, Barium, Chlorine, Dysprosium, Potassium, Manganese and Sodium were measured and compared against standard samples from each obsidian source in order to correlate samples and obsidian sources. The elemental results of the 45 site artifacts and the two new Toluca Valley samples are presented in full in Table 2. The six obsidian sources present in the collection are clearly distinguished in the scatter plots comparing Magnesium (Mg), in parts per million, against the quantity of Dysprosium (Dy) and against the percentage of Sodium (Na) for each object (Figure 5, 6). The artifact samples are illustrated in Figures 7, 8, 9 and the counts per obsidian source are summarized in Table 3.

It was not surprising to discover that obsidian from the Ucareo source in the state of Michoacan, the Sierra de Las Navajas mines in the state of Hidalgo, and the Otumba quarries in the state of Mexico (Figure 4) comprised a significant part of the sourced collection. These three obsidian sources circulated in abundance throughout the Central Highlands region during the Classic and Epiclassic periods. The presence of obsidians from quarries at Paredon in the state of Hidalgo, Zacualtipan in the state of Puebla, and Fuentezuelas in the state of Queretaro was also established by the NAA results. Obsidian from the Paredon and Zacualtipan mines are not uncommon at Central Highlands sites but they generally represent minor sources during the periods of interest here.

In contrast, the sourcing of one artifact from Fuentezuelas, Queretaro quarries was surprising. In more than twenty years of analysis, the MURR laboratory had only sourced three other artifacts to the Fuentezuelas mines (Michael Glascock, personal communication 2004). This obsidian is a translucent greenish-grayish color (Figure 10).

	Element							
Sample ID	**Al (%)**	**Ba (ppm)**	**Cl (ppm)**	**Dy (ppm)**	**K (%)**	**Mn (ppm)**	**Na (%)**	**Source Name**
ABO001	6.95	254	245	3.80	4.24	173	2.79	Ucareo, Michoacan
ABO002	6.93	118	174	4.01	4.45	174	2.85	Ucareo, Michoacan
ABO003	6.50	192	222	4.01	4.19	172	2.74	Ucareo, Michoacan
ABO004	6.88	84	225	4.22	4.21	173	2.78	Ucareo, Michoacan
ABO005	6.71	133	210	4.06	4.29	173	2.79	Ucareo, Michoacan
ABO006	6.30	169	214	3.51	3.89	169	2.74	Ucareo, Michoacan
ABO007	6.51	137	200	3.95	4.12	174	2.82	Ucareo, Michoacan
ABO008	6.72	116	208	3.64	4.07	172	2.79	Ucareo, Michoacan
ABO009	6.55	50	217	3.70	4.22	169	2.74	Ucareo, Michoacan
ABO010	6.69	0	203	4.30	4.06	172	2.80	Ucareo, Michoacan
ABO011	7.06	114	234	3.74	4.20	173	2.75	Ucareo, Michoacan
ABO012	6.78	231	233	3.92	4.13	172	2.79	Ucareo, Michoacan
ABO013	5.82	0	858	15.18	3.69	1125	3.76	Sierra de Las Navajas, Hidalgo
ABO014	6.62	193	219	3.55	4.29	169	2.77	Ucareo, Michoacan
ABO015	6.55	130	234	3.87	4.11	172	2.79	Ucareo, Michoacan
ABO016	7.24	821	274	3.49	3.38	393	3.04	Otumba, State of Mexico
ABO017	7.50	728	214	2.44	3.48	393	3.05	Otumba, State of Mexico
ABO018	7.27	791	274	3.23	3.87	398	2.94	Otumba, State of Mexico
ABO019	6.49	134	240	3.80	4.20	166	2.74	Ucareo, Michoacan
ABO020	6.41	162	222	4.26	4.14	169	2.73	Ucareo, Michoacan
ABO021	6.73	85	228	3.74	4.12	174	2.80	Ucareo, Michoacan
ABO022	7.49	812	261	3.41	3.68	407	3.13	Otumba, State of Mexico
ABO023	7.81	810	235	2.70	3.36	397	3.15	Otumba, State of Mexico
ABO024	6.64	115	274	3.68	4.02	173	2.83	Ucareo, Michoacan
ABO025	6.74	105	218	4.34	4.21	170	2.76	Ucareo, Michoacan
ABO026	6.05	0	555	15.48	3.96	226	3.23	Fuentezuelas, Queretaro
ABO027	7.17	817	229	3.42	3.45	394	3.00	Otumba, State of Mexico
ABO028	7.41	706	211	3.88	3.76	398	3.06	Otumba, State of Mexico
ABO029	7.73	804	234	3.39	3.60	394	3.06	Otumba, State of Mexico
ABO030	6.46	176	162	3.91	4.02	168	2.71	Ucareo, Michoacan
ABO031	7.55	823	266	3.09	3.55	391	2.86	Otumba, State of Mexico
ABO032	6.73	161	259	4.08	4.06	170	2.79	Ucareo, Michoacan
ABO033	6.17	108	249	3.87	4.17	168	2.74	Ucareo, Michoacan
ABO034	6.88	299	249	7.89	4.65	169	2.49	Zacualtipan, Hidalgo
ABO035	7.42	791	277	3.34	3.50	385	2.98	Otumba, State of Mexico
ABO036	7.70	847	254	3.10	3.52	389	3.04	Otumba, State of Mexico
ABO037	6.78	0	619	7.73	4.23	366	2.97	Paredon, Puebla
ABO038	6.74	309	273	7.32	4.48	179	2.53	Zacualtipan, Hidalgo
ABO039	7.18	761	249	3.20	3.44	399	3.14	Otumba, State of Mexico
ABO040	6.47	103	216	4.15	4.01	173	2.79	Ucareo, Michoacan
ABO041	6.35	126	217	4.06	4.04	171	2.77	Ucareo, Michoacan
ABO042	7.11	821	223	3.03	3.36	385	2.99	Otumba, State of Mexico
ABO043	6.38	64	779	14.80	6.34	1101	2.14	Sierra de Las Navajas, Hidalgo
ABO044	5.85	0	855	15.32	3.68	1117	3.72	Sierra de Las Navajas, Hidalgo
ABO045	7.22	841	255	3.25	3.52	396	3.06	Otumba, State of Mexico

Table 2. Neutron Activation Analysis results using the abbreviated irradiation method.

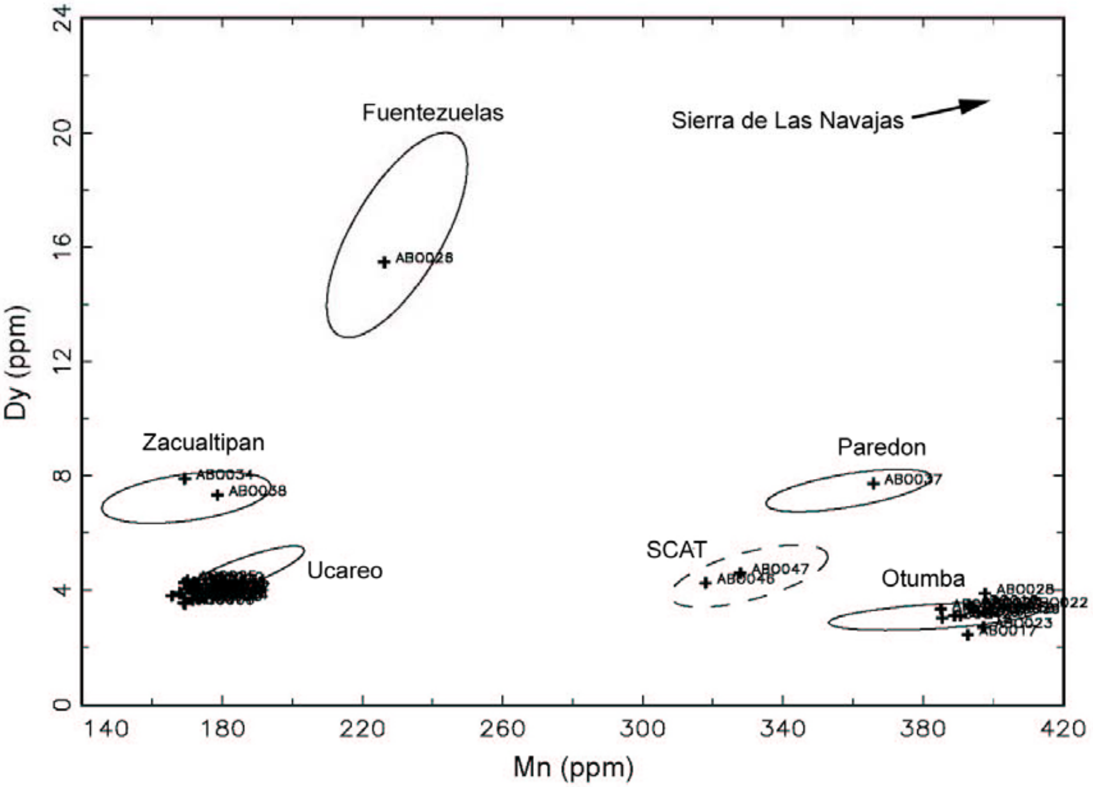


Figure 5. Scattergram of manganese (parts per million) versus dysprosium (parts per million) showing 95% confidence-interval ellipses. The Toluca Valley source is identified as SCAT.

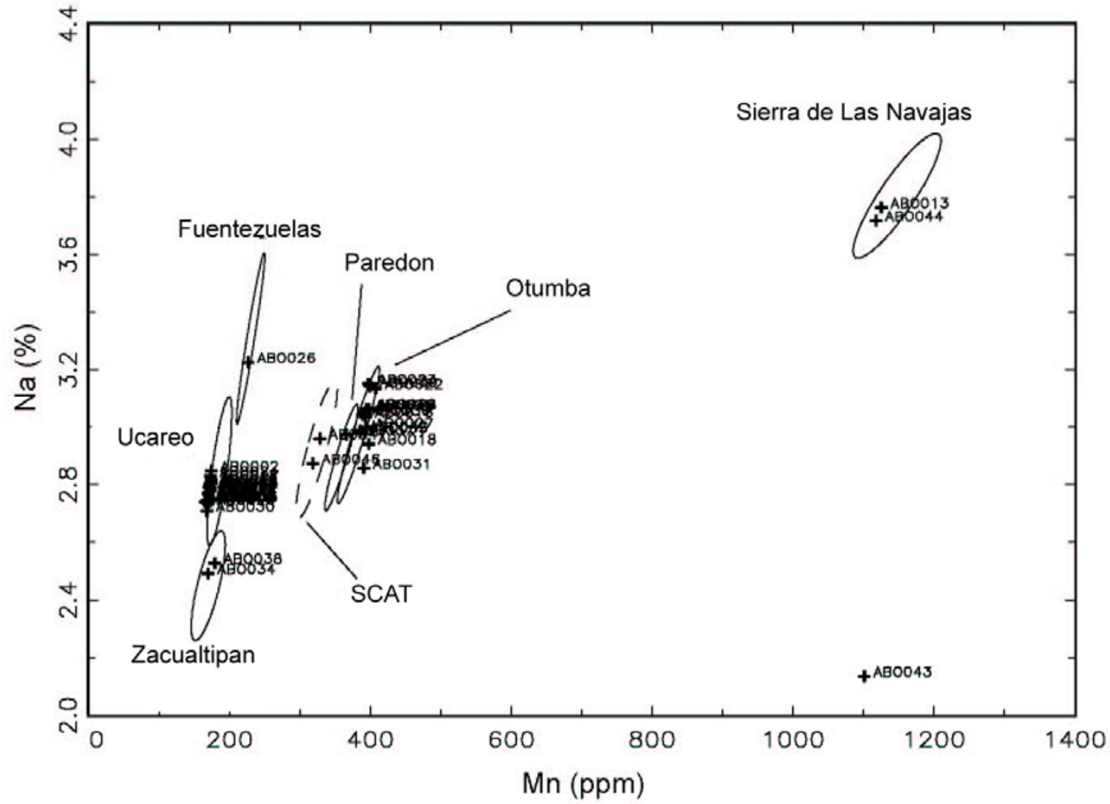


Figure 6. Scattergram of manganese (parts per million) versus sodium (percentage) showing 95% confidence-interval ellipses. The Toluca Valley source is identified as SCAT.

Source	No. of Samples
Ucareo, Michoacan	24
Sierra de Las Navajas-1, Hidalgo	3
Otumba, State of Mexico	14
Fuentezuelas, Queretaro	1
Paredon, Puebla	1
Zacualtipan, Hidalgo	2
Toluca Valley, State of Mexico	2
Grand Total	**47**

Table 3. Santa Cruz Atizapan artifacts sourced using Neutron Activation Analysis. Note: Toluca Valley samples are not from site excavations.

Figure 7. NAA artifacts sourced to Ucareo, Michoacan

Figure 8. NAA artifacts sourced to Otumba, State of Mexico

Figure 9. NAA artifacts sourced to the following mines: 1, Paredon, Puebla; 2,3, Zacualtipan, Hidalgo; 4,5,6 Sierra de Las Navajas-1, Hidalgo; 7, Fuentezuelas, Queretaro; 8,9 non-artifact samples from nodules recovered from the northern Toluca Valley.

Figure 10. Close-up of projectile point made of Fuentezuelas obsidian

Despite the limited sample size, we also wanted to definitively identify the presence of each obsidian source during each respective occupation period. The selection of our NAA samples thus included an equal number of artifacts from Classic and Epiclassic period contexts (Table 4). The provenience of two samples (ABO033, ABO034) was called into question following the analysis, and their correct temporal associations could not be determined. These samples, which are from the Ucareo and Zacualtipan sources, respectively, are not included in Table 4.

The analysis results demonstrate that many of the samples submitted from Classic period contexts were made of Ucareo obsidian. This was contrary to what we expected to find. In fact, upon further exploration, it was determined that 12 of these 15 samples were recovered from floor and fill contexts associated with the construction and use of the earliest public structure (Structure 7) identified at Platform Mound 20 (Figure 2).

Source	Classic	Epiclassic	Possible Transitional Period	Total
Fuentezuelas	-	1	-	1
Otumba	5	8	1	14
Sierra de Las Navajas	-	3	-	3
Paredon	1	-	-	1
Ucareo	15	7	1	23
Zacualtipan	-	1	-	1
Grand Total	**21**	**20**	**2**	**43**

Table 4. Distribution of NAA samples by occupation period. The provenience of samples ABO033 and ABO034 are in question and are therefore not included in this table. Note: Modern samples from the northern Toluca Valley are not included in this table.

Structure 7 is considered a Classic period Teotihuacan structure due to its architectural construction and its associated material culture (Covarrubias 2004).

The abundant recovery of Teotihuacan style pottery provides further evidence that the site's early population maintained important connections with the Valley of Mexico. The unusual yet definitive presence of numerous Ucareo obsidian artifacts during the Classic period occupation of the site provided the first hint that obsidian distribution networks in the Toluca Valley were, perhaps, more complex than previously understood. Initial impressions were developed during the attribute analysis, but we had not yet linked our obsidian type categories to real source regions. The NAA results and our visual analysis allowed us to explore this possibility in the remaining collection.

The distribution of obsidian sources during the Epiclassic period were varied as we hypothesized. The presence of Zacualtipan and Fuentezuelas obsidian in the NAA samples of this period is not considered significant until it is compared against the remaining assemblage of visually sourced artifacts. A Transitional period is included in this table and in future tables when it was identified in the field excavations. Despite its potential to describe the shift from the Classic to the Epiclassic period, not enough obsidian artifacts have been identified from securely dated Transitional contexts to allow for significant inferences to be drawn.

Northern Toluca Valley Obsidian

Flakes struck from two obsidian nodules procured from outcrops in the mountainous Ixtlahuaca region of the Toluca Valley were subjected to NAA and XRF analysis (see Table 5, 2). The two samples are visually distinct gray and black colored nodules. Their textures vary from a smooth glass-like appearance in the black obsidian sample to a slightly sugary texture in the gray mottled sample (Figures 11-14). The gray obsidian displays a chatoyant sheen reflection, created by slight impurities in the material, while the black obsidian exhibits a veined patterning along its edges when held up against light. Both obsidians are moderately translucent and the cortex of each was relatively smooth. The NAA data presented previously and the XRF data shown in Table 5 demonstrate how chemically similar the two Toluca Valley samples are to each other despite their visual dissimilarities. This highlights the potential for error in using only a visual analysis to attribute source regions to obsidian artifacts.

Sample Number	Obsidian Sample	Al2O3 %	Ba ppm	CaO %	Ce ppm	Fe2O3 %	K2O %	MgO %	MnO %	Na2O %	Nb ppm	P2O5 %	Rb ppm	SiO2 %	Sr ppm	TiO2 %	Y ppm	Zn ppm	Zr ppm
3385	AB046 (SCAT-1)	13.31	631	0.83	72	1.41	4.38	0.15	0.04	3.67	14	0.02	163	76.45	95	0.09	28	44	125
3386	AB047 (SCAT-2)	12.95	621	0.82	67	1.4	4.31	0.14	0.04	3.48	13	0.02	159	74.31	94	0.09	27	44	123
BYU Source #88. Toluca Valley, Mexico, Mexico																			

Table 5. Results of X-ray Fluorescence analysis on obsidian samples procured from the Northern Toluca Valley.

The two Toluca Valley samples were subjected to chemical characterization analysis for multiple reasons. First, no naturally occurring obsidian sources in the valley are known to have been exploited during the Pre-Hispanic period. Our samples, despite lacking precise provenience, represented the first characterized obsidian from the Toluca Valley. Second, the samples were from high quality sources with few inclusions. This would have made them ideal materials for blade production. We surmised that if these high quality obsidians were common in the northern region of the valley, their use could be established by comparing their chemical signatures against the thousands of samples previously analyzed at the NAA and XRF laboratories. At present, the two chemically characterized Toluca Valley samples do not match any of the thousands of artifacts previously analyzed at the Missouri University Research Reactor (Michael Glascock, personal communication 2004) or artifacts in the XRF database of the New World Archaeological Foundation (Fred W. Nelson, personal communication 2004). They therefore represent a single new obsidian source. Third, the two obsidians appeared visually similar to several artifacts encountered in the Santa Cruz Atizapan assemblage. Confirming the use of regionally available obsidians would have completely altered the current model of obsidian acquisition in the Toluca Valley. Unfortunately, none of the artifacts from the Santa Cruz Atizapan site matched the northern Toluca Valley nodules submitted for analysis. The mere existence of the two nodule samples does, however, establish the possibility that local high quality obsidian raw materials might still have been procured from within the valley itself during the Pre-Hispanic period. Future survey work in the northern mountain regions should provide more details on the existence of obsidian outcrops and determine if they were actually mined at any point in history. As far as the author knows, the artifacts from the Santa Cruz Atizapan assemblage are the only Toluca Valley artifacts that have been chemically characterized using NAA or XRF for the Classic and Epiclassic periods; perhaps even the entire prehistory of the valley.

Figure 11. Toluca Valley-1 obsidian nodule recovered from the northern Toluca Valley

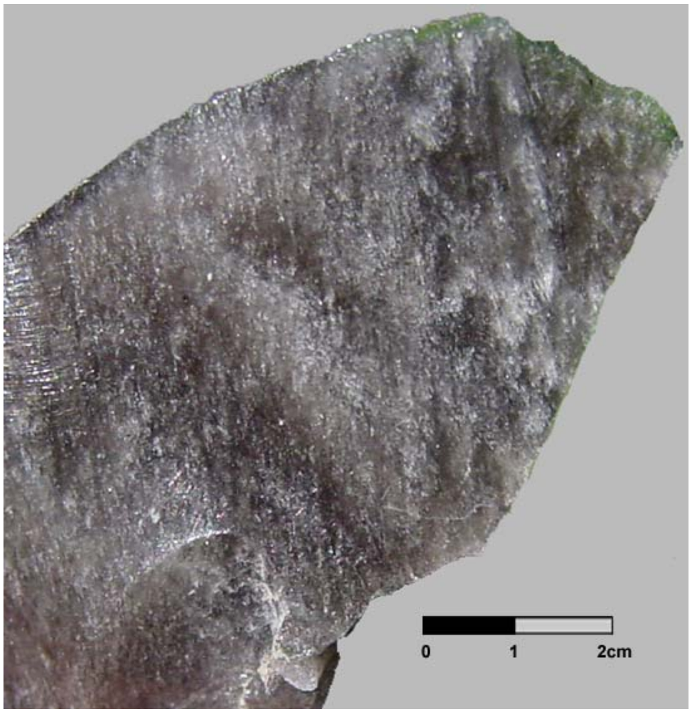


Figure 12. Flake from Toluca Valley-1 sample analyzed by NAA and XRF

Figure 13. Toluca Valley-2 obsidian nodule recovered from the northern Toluca Valley

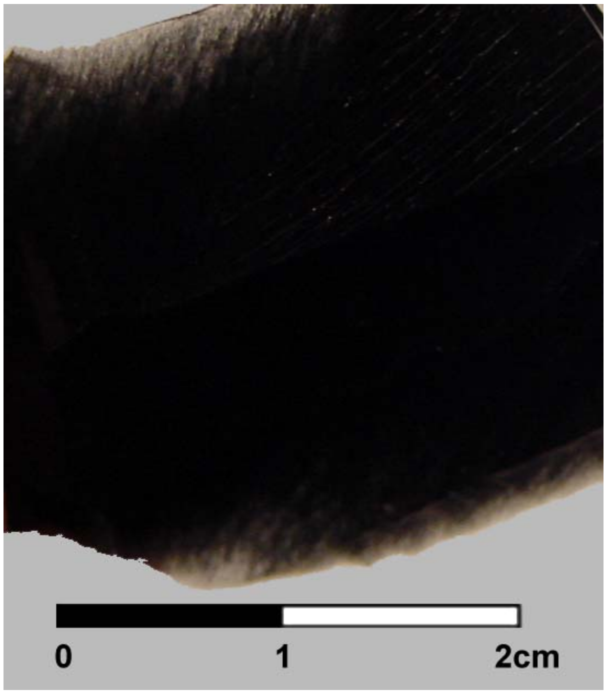


Figure 14. Flake from Toluca Valley-2 sample analyzed by NAA and XRF

Results of the Exploratory Field Survey

With a crew of four archaeologists and three assistants, a survey party was organized to explore the previously identified obsidian outcrops at the Cerro de Las Navajas and Las Palomas regions of the northern Toluca Valley. Upon our arrival at Cerro de Las Navajas we fanned out and surveyed the flat terrain (Figure 15). We immediately identified small nodules of obsidian, very few of which were larger than the size of a golf ball (Figure 16). We did not identify a major obsidian vein or outcrop, but we were unable to scale a large nearby hill that was fenced off to see if it was the source of the nodules. It appeared to most of us that the nodules were eroding out of the ground we were walking over. The obsidian we did pick up was of poor quality and likely of little use during the Pre-Hispanic era (see Figure 16).

We next proceeded to the town of Las Palomas, where we very quickly identified a large obsidian dome that formed a small hill near the town's elementary school (Figures 17, 18). Completely black, and with little vegetation cover, this outcrop was visible for quite a distance. The mound was surveyed for high quality material and evidence that it might have been quarried. We identified large veins of obsidian and large blocks of obsidian strewn everywhere. Unfortunately, much like the obsidian at the Cerro de Las Navajas outcrop, the material here contained substantial crystallization and was of poor quality (Figure 19). We surveyed the surrounding foothills but were unable to locate any more outcrops or obsidian nodules. It appears that this was an isolated dome of low quality obsidian.

The travel to and survey of these two outcrops used up much of the day and left us with little time to make the long 3-hour trek to the Jocotitlan region where the two chemically characterized obsidian nodules had been recovered. Ruben Nieto, the Toluca

Figure 15. Survey members walking a wash at the Cerro de Las Navajas outcrops.

Figure 16. Low quality obsidian nodule from the Cerro de Las Navajas outcrops

Figure 17. Obsidian dome at the Las Palomas outcrop. Note residential area to the left and fenced in school yard in the foreground.

Figure 18. Close-up of the obsidian dome at Las Palomas.

Figure 19. Obsidian nodules from the Las Palomas outcrops

Valley archaeologists who recovered the original samples, also informed us that there is a large pyramid site near this source area which had not yet been explored.

A much larger scale survey and excavation project focused on the pyramid site and these nearby outcrops would certainly help increase our understanding of obsidian procurement in the region. On our return from the survey areas, we spoke with several locals who claimed that there were other obsidian outcrops in the mountainous areas surrounding the Cerro de La Navajas and Las Palomas outcrops. This was substantiated by the presence of a tremendous number of small obsidian nodules along roads and streams. We also noted that numerous obsidian pebbles are incorporated into the architecture of a local restaurant suggesting that the existence of obsidian is well known.

A shortage of funding and scheduling conflicts prevented a return to the obsidian regions to conduct more substantial surveys, but the evidence suggests that such a project would involve much more time than was anticipated or planned for the current research. In many ways, this goal of our project has been met through our limited survey work and the previous surveys by Ruben Nieto. We have identified usable obsidian sources in the Toluca Valley, and have established the potential for many more to be discovered. We characterized our two outcrop samples using NAA and XRF and verified their status as unique, previously uncharacterized sources. Much more work is needed, however, before we can conclusively establish or discount any link between these northern Toluca Valley obsidians and the tools used at the Santa Cruz Atizapan site.

Classic Period (Visual Analysis)

A total of 7,072 artifacts in the collection was recovered from secure chronological contexts. Employing the visual comparative collection established through N.A.A sourcing, more than ninety-eight percent of these artifacts were assigned to one of the six obsidian sources identified in the collection (Table 6). The remaining two percent of artifacts (N=149) were visually indistinct and could have originated in either of two sources. Counts of these artifacts are listed separately in the data tables that follow.

The majority of obsidian artifacts from the Santa Cruz Atizapan site were recovered from Epiclassic period contexts. Platform Mound 13 was occupied from the Tejalpa phase of the Epiclassic period, so it is not surprising that the totals were skewed toward this occupation period. Contexts considered Transitional between the Classic and Epiclassic periods were occasionally identified during excavations; however, the limited number of obsidian objects identified from those contexts prevents a full description and discussion of this intermediate period. Counts for Transitional period artifacts are still included here as they may serve future discussions of obsidian use.

Classic period proveniences provided the most promising line of evidence for understanding the distribution of obsidian during the height of Teotihuacan's regional influence. As hinted in the NAA results, a vast majority of obsidian artifacts imported to the region during the Classic period had their origins in the mines of Ucareo, Michoacan.

Obsidian Source	Classic	Transitional	Epiclassic	Grand Total
Ucareo	2079 (82.93%)	164 (76.64%)	3545 (81.48%)	5788
Sierra de Las Navajas	217 (8.66%)	30 (14.02%)	363 (8.34%)	610
Otumba	130 (5.19%)	18 (8.41%)	298 (6.85%)	446
Ucareo, Otumba **	16 (0.64%)	1 (0.47%)	14 (0.32%)	31
Ucareo, Zacualtipan **	39 (1.56%)	-	79 (1.82%)	118
Zacualtipan	20 (0.80%	1 (0.47%)	44 (1.01%)	65
Paredon	4 (0.16%)	-	6 (0.14%)	10
Fuentezuelas	2 (0.08%)	-	2 (0.05%)	4
Grand Total	**2507 (100%)**	**214 (100%)**	**4351 (100%)**	**7072 ***

Table 6. Counts and percentages of sources present in the collection during early and late occupations of the site. Note: These counts exclude surface artifacts and any contexts where occupation period could not be established. Teotihuacan controlled sources are italicized. ** Artifacts attributable to more than one source are listed under a combined category.

This surprising conclusion is drawn from the fact that 2079 of the 2507 artifacts (82.9%) from solidly dated Classic period deposits are from that source. Equally surprising is the small percentage (8.66%) of obsidian originating from the Sierra de Las Navajas mines. It has previously been assumed that the proximity of the Toluca Valley to the Valley of Mexico and Teotihuacan meant that the region was connected to its obsidian distribution network. Indeed, the significance of the Teotihuacan obsidian industry has been highlighted by previous archaeological studies (see Drennan 1984; Santley 1989b; Spence 1996). What this present data suggests is that perhaps the people of the Toluca Valley valued Teotihuacan green obsidian differently than did populations located in more distant regions who might have used the distinctive green Sierra de Las Navajas obsidian to establish political or social ties to Teotihuacan. Perhaps, as I outline in chapter eight, the populous of the southeastern Toluca Valley found it more economical to participate in a obsidian distribution network originating from the Ucareo source. It also suggests a fair degree of autonomy in their ability to continue cultural and presumably political ties with Teotihuacan while simultaneously opting out of an economic system that may have served as one basis for Teotihuacan's regional dominance.

The relatively small percentages of obsidian entering the Santa Cruz Atizapan locus from other source areas is difficult to interpret with the limited data available here (Table 6). It is certainly possible that these artifacts were obtained through first party exchanges with populations near these sources, or were brought in through networks established by those parties. However, almost every archaeological site in Central Mexico appears to have acquired a variety of obsidians through second or third party transactions that moved different source obsidians through the same exchange network (Charlton and Spence 1982; Cobean 2002). It is quite probable that Zacualtipan, Paredon, and perhaps even Fuentezuelas obsidian was traded alongside Sierra de Las Navajas and Otumba obsidians controlled by Teotihuacan. Charlton and Spence (1982) speculate that the Paredon source may have even been under the control of Teotihuacan itself.

The spatial distribution of obsidian sources across the site was also considered when addressing the issue of procurement. We reasoned that if the various obsidians maintained differential levels of significance in various contexts this would be most evident when comparing domestic contexts versus public use contexts (Table 7). We hypothesized that the most accessible and abundant varieties of obsidian would occur in domestic contexts while public spaces, due to their higher order and restricted functions, would have been spaces where the rarest and thus most valuable materials were used or displayed.

	CLASSIC PERIOD			
Obsidian Source	**Domestic**	**Public**	**Public-Domestic Use**	**Total**
Ucareo	1411 (81.89%)	309 (89.31%)	140 (81.87%)	1860 (83.04%)
Sierra de Las Navajas	154 (8.94%)	16 (4.62%)	18 (10.53%)	188 (8.39%)
Otumba	89 (5.17%)	10 (2.89%)	13 (7.60%)	112 (5%)
Ucareo, Otumba*	13 (0.75%)	3 (0.87%)	-	16 (0.71%)
Ucareo, Zacualtipan*	34 (1.97%)	4 (1.16%)	-	38 (1.70%)
Zacualtipan	16 (0.93%)	4 (1.16%)	-	20 (0.89%)
Paredon	4 (0.23%)	-	-	4 (0.18%)
Fuentezuelas	2 (0.12%)	-	-	2 (0.09%)
Grand Total	**1723 (100%)**	**346 (100%)**	**171 (100%)**	**2240 (100%)**

Table 7: Classic Period Obsidian sources recovered from Domestic, Public and Public-Domestic Use spaces at Santa Cruz Atizapan. * Artifacts for which source could not be distinguished

In this study, excavation contexts at Santa Cruz Atizapan were put into three general types: Domestic, Public and Public-Domestic use areas. Domestic contexts include habitation and other associated areas, where daily subsistence activities likely occurred. At Santa Cruz Atizapan, distinct habitation areas included two areas containing a series of super-imposed habitation structures within Mound 20, northeast and west of the major public structures of the mound. Mound 13 is also a domestic use area, as it contains only habitation structures and not any public use structures or areas. Public contexts were limited in this study to areas of Mound 20 that appeared dedicated to community activities and contained well-made masonry structures. During the life history of Mound 20, a series of public structures was constructed in the center of the mound beginning with Structure 7 (Figure 20). These structures contained masonry walls and transitioned from being square shaped during the early occupation period, to circular shaped by the end of the Mound 20 occupation period. Adjoining and related to these public structures are work areas designated “annex areas” (Figure 20). These annex areas appear to have been at least partially walled-in structures, and through excavation it was determined that food and other substances were processed here for use in the public structures. These annex areas were therefore designated Public-domestic spaces to distinguish them from purely Public and purely Domestic contexts. Other identified prepared surfaces to the west of the Public structures were also considered Public-domestic if they adjoined the Public structures. The excavation crew identified these areas as potentially related to the structure itself, and it seemed logical that other activities related to the use of the Public structure would have occurred on these prepared surfaces as well.

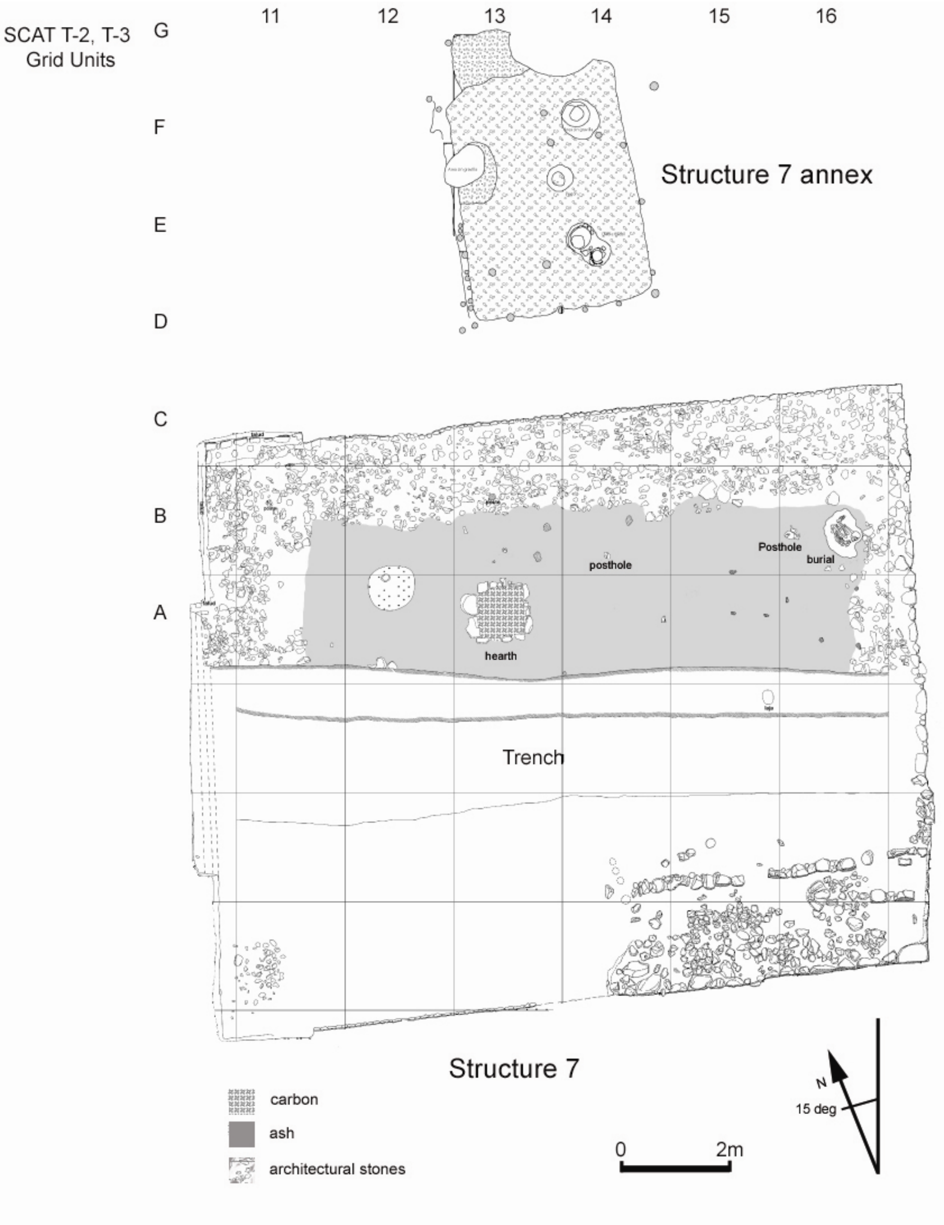


Figure 20. A Public (Structure 7) and an associated Public-domestic (Structure 7 annex) area at Platform Mound 20. Note: Structure 7 is a Teotihuacan influenced construction. . (Map adapted from Proyecto Arqueologico Santa Cruz Atizapan maps)

The result of this contextual analysis revealed a consistency in the major types and quantities of obsidian sources found in domestic spaces, public spaces, and areas identified as public-domestic use areas. Ucareo obsidian was the dominant obsidian source utilized in all contexts at the site. Public-domestic use areas consisted of spaces adjacent to public structures where food preparation or other domestic functions were performed in support of the activities occurring inside the large public structures. The quantities of obsidian recovered from Public contexts at Santa Cruz Atizapan is limited but this appears to be a function of the activities occurring in these spaces that limited the amount of obsidian used there. Such spaces may have also been routinely cleaned and kept free of accumulating obsidian debris. Slight differences in the percentages of Sierra de Las Navajas and Otumba obsidian are considered inconclusive here due to the small samples size of artifacts recovered from Public contexts. The excavation of future Public use spaces will provide a more accurate picture than what is evident in Table 7. Zacualtipan obsidian, and possible Zacualtipan (Ucareo, Zacualtipan) obsidian were only recovered from Domestic contexts suggesting their exclusive use in these areas. It also hints at a supply network that may have been in place to supply individual households with obsidian from this source.

The clear conclusion to be drawn from the Classic period source distributions is that Ucareo obsidian was the overwhelming dominant source utilized at the Santa Cruz Atizapan locus. This stands in stark contrast to the long held belief that Sierra de Las Navajas and Otumba sources represented the primary Classic period obsidians entering the Toluca Valley through the Teotihuacan network that is viewed as controlling most of the obsidian procurement and trade in the Central Highlands region. At the current site, Teotihuacan directed sources represent less than 15 percent of the total obsidian recovered from well established domestic and public contexts during SCAT excavations.

Classic period correlations between obsidian source and artifact categories also illustrate the stone tool technologies in play at the source regions or in workshops away from the source area prior to their import into the Toluca Valley (Table 8). Clearly evident again, is the abundance of Ucareo blades. In securely dated Classic period contexts they represent 77.29% of the entire count of Ucareo obsidian. Nearly every one of these blades is also what Clark and Bryant (1997) refer to as 3rd series blades. These are pressure flaked blades taken from well-shaped prismatic blade-cores and represent the final stage of blade-core production. They are also the most consistently shaped and desirable blades to use for cutting. Combined with the presence of 14 fragmentary and exhausted prismatic core blades (at the end of their use-life) we concluded that most of the Ucareo blades must have arrived as finished blades. Although we have some evidence for local flintknapping (antler tines), the raw materials needed to support a local industry have not yet appeared in the archaeological record. Artifacts made of modified Ucareo blade fragments were also identified. Eccentrics represent the most interesting, yet least understood artifact categories. Throughout most of Central Mexico archaeologists have recovered small crescent shaped and trilobe shaped blade fragments from archaeological sites. They vary from well shaped to crudely shaped objects and their function is generally unknown. Drills, perforator/punch and projectile point artifacts made of Ucareo prismatic blades are also common, with the drill/awls well shaped to sharp points. The projectile points exhibit rough notching flakes that suggest they were made locally at the site on an as-needed basis. “Amantla” (Healan 1993: Figure 2; Tolstoy 1971) blades are regular blade fragments that exhibit extensive macroscopic use wear in distinct alternating patterns. They exhibit no apparent intentional shaping but rather are transformed into cross-shapes through their use.

Classic	**FUENT**	**OT**	**SDLN**	**PAR**	**UC**	**UC-OT**	**UC-ZAC**	**ZAC**	**Total**
Prismatic Blade (P.B.)	-	16 (12.31%)	136 (62.67%)	2 (50%)	1606 (77.29%)	7 (43.75%)	25 (64.10%)	6 (30%)	1798 (71.75%)
P.B. Tool									
Eccentrics	-	-	2 (0.92%)	-	10 (0.48%)	-	-	-	12 (0.48%)
Drills	-	1 (0.77%)	-	-	3 (0.14%)	-	-	-	4 (0.16%)
Projectile Pt.	-	-	-	-	2 (0.10%_	-	-	-	2 (0.08%)
Perforator/ Punch	-	-	-	-	1 (0.05%)	-	-	1 (5%)	2 (0.08%)
"Amantla" Blade	-	1 (0.77%)	-	-	53 (2.55%)	-	-	1 (5)%	55 (2.19%)
Macroblade	-	2 (1.54%)	13 (5.99%)	-	89 (4.28%)	1 (6.25%)	6 (15.38%)	6 (30%)	117 (4.67%)
Prismatic Blade-Core	-	-	1 (0.46%)	-	14 (0.67%)	-	-	-	15 (0.60%)
Biface									
Hafted Biface	1 (50%)	25 (19.23%)	6 (2.76%)	1 (25%)	51 (2.45%)	-	1 (2.56%)	-	85 (3.39%)
Unknown Biface	-	5 (3.85%)	7 (3.23%)	-	16 (0.77%)	-	-	1 (5%)	29 (1.16%)
Unhafted Biface	-	2 (1.54%)	2 (0.92%)	-	6 (0.29%)	-	-	-	10 (0.40%)
Flake Tool	-	9 (7%)	7 (3.23%)	-	64 (3.08%)	2 (12.50%)	3 (7.69%)	3 (15%)	88 (3.51%)
Debitage	1 (50%)	69 (53.08%)	43 (19.82%)	1 (25%)	163 (7.84%)	6 (37.50%)	4 (10.26%)	2 (10%)	289 (11.53%)
Grand Total	2 (100%)	130 (100%)	217 (100%)	4 (100%)	2078 (100%)	16 (100%)	39 (100%)	20 (100%)	2506 (100%)

Table 8: Classic period distribution of artifact categories by obsidian source. FUENT=Fuentezuelas, OT=Otumba, SDLN=Sierra de Las Navajas, PAR=Paredon, UC=Ucareo, UC-OT=Ucareo/Otumba, UC-ZAC=Ucareo/Zacualtipan, ZAC=Zacualtipan.

Fifty three of these objects made of Ucareo obsidian were recovered from Classic period contexts. Their use is explored in a subsequent part of this chapter. Eighty-nine macroblades, representing the initial stages of polyhedral core reduction are also evident in the Ucareo assemblage. The presence of these percussion derived large blade fragments may indicate that they were also imported as blanks along with smaller 3rd series blades or that local workshops producing blades from large polyhedral cores exist on some other nearby platform mound. A total of 117 macroblades made of all obsidians were recovered and these may indicate local flintknapping activity that has yet to be well defined through archaeological investigations. Many appear to have been used with no prior formal modification.

Bifaces and Flake Tools represent the final Ucareo stone tool categories in evidence at Santa Cruz Atizapan. Seventy-three bifaces, hafted and unhafted, were made of Ucareo obsidian. Due again to the lack of evidence for extensive local obsidian reduction, and the absence of biface blanks or raw materials of sufficient size to have produced them, it is argued that most, if not all, of these biface artifacts were imported into the site as complete and finished artifacts. The variability of their hafting notches, base forms and degree of shaping made it difficult to identify particular projectile point types. This is not unusually for this region of Mesoamerica and for bifaces originating at the Ucareo source.

Our most substantial evidence for local obsidian working comes from the presence of 64 flake tools and 163 pieces of debitage made of Ucareo obsidian. The flakes tools exhibit moderate to extensive evidence for having been used. Derived from regular flakes knocked from Ucareo nodules or block obsidians, these tools are variously shaped through use. Flake tools in Mesoamerica are rarely considered import or trade items unless substantial amounts of energy are invested in producing them. We are inclined to believe at this site that the occasional large flake and obsidian nodule was imported into the site along with core-blade artifacts. Certainly there was a need to perform subsistence tasks with tools that were sturdier than prismatic blades. Scraper tools and other multipurpose tools were occasionally well and formally shaped and these do appear to have arrived as finished tools. As with the prismatic blade technology, it may have been much more practical to import Flake “blanks” that could then be used on an as needed basis in a variety of ways. Given the absence of shaping on many flake tools (e.g. scrapers) we can conclude that this was also the most economical route to take.

During our analysis, debitage was defined as non-blade, non-flake tool obsidian debris that exhibited no evidence for having been used. On rare occasions it may represent minute pressure flakes used to shape or resharpen blade or biface tools but we could not determine with certainty when that was the case. It was more often the case that debitage consisted of blocky debris resulting from the shatter of larger objects. Not seeing the need nor function of such artifacts we could only conclude that they represent the occasional reduction of obsidian nodules somewhere in the vicinity of Santa Cruz Atizapan. Several nodules exhibited moderate amounts of cortex on their dorsal surfaces. These may have been procured for use in tasks that we have yet to define through the archaeological record or they may represent souvenirs of some sort that had no function whatsoever. The long distance trade of such materials would seem counterproductive to our current understanding of the role of obsidian trade in the Central Highlands. Unlike obsidians made of rarer Paredon or Fuentezuelas obsidian, Ucareo obsidian is gray-black and not visually unique or rare.

The distribution of Otumba and Sierra de Las Navajas obsidian artifacts largely parallels that of Ucareo made artifacts but in substantially reduced numbers. Sierra de Las Navajas obsidian appears to have been primarily focused on prismatic blade production with the occasional import of large macroblades. Although 19.82 percent of the artifacts are listed as debitage, this includes blocky debris and unidentifiable fragments of green obsidian; it does not imply manufacturing debitage. Again, manufacturing debris was not identified in the assemblage, as either large percussion or small pressure flakes. The complete absence of small pressure flakes may reflect, in part, the use of screens that did not allow for their collection, but more likely the complete absence suggests that little local obsidian production occurred. Classic period Otumba obsidian does stand out in two areas. Most important is the high percentage of hafted bifaces made of Otumba obsidian. At 19.23% of the entire Otumba materials imported, they greatly outnumber the Sierra de Las Navajas obsidian bifaces in sheer numbers as well as in the total percentage each source. In conjunction with the small percentage of Otumba prismatic blades imported to the site (12.31%), we can clearly see an Otumba obsidian industry geared toward the production and export of hafted and unhafted bifaces. The superior quality of Sierra de Las Navajas green obsidian for producing fine prismatic blades, and the conversely sturdier quality of Otumba obsidian for producing more resilient bifaces, is demonstrated by these numbers.

These properties and distributions have been noted in other obsidian assemblages. In the Epiclassic La Hacienda de Metepec obsidian workshops of Teotihuacan, for example, Otumba bifaces continued to be produced and exported during the Epiclassic despite the breakdown of Teotihuacan networks procuring and distributing Sierra de Las Navajas obsidian (Rattray 1987). The Otumba sources were still locally available to produce bifaces yet the more economical availability and acquisition of Ucareo obsidian prismatic blades made the Sierra de Las Navajas outcrops a disposable source. We can reason that Otumba bifaces were still preferable, but that the investment required to procure Navajas obsidians was not energy efficient for a population whose capital city and supremacy in the Mesoamerican world had just evaporated.

The debitage category for Otumba is unique in that a large proportion of these objects are nodule flakes with cortex present on their exteriors. Several are small split cobbles with not apparent use. The significance of these artifacts alongside well made hafted bifaces is unknown and perplexing. The size of the nodules and the presence of cortex precludes the possibility that they were utilized in the production of the bifaces.

Zacualtipan, Paredon, and Fuentezuelas obsidians entered the region as prismatic blades, bifaces and flake tools, with no emphasis on any particular tool type.

Epiclassic Period (Visual Analysis)

Four thousand, three hundred and fifty-one artifacts from strong Epiclassic contexts were sourced using the visual analysis approach (see Table 6). The distribution of obsidian sources for this period is astonishingly similar to that of the Classic period. In fact, the distributions do not vary more than two percentage points for any single source, including Ucareo. Every source present during the early occupation is also present during the later occupation of Santa Cruz Atizapan. Their similarity speaks volumes concerning the distribution networks that moved this material into the southeastern Toluca Valley and regions to the west, that would have been even less tied to trade networks controlled from the Valley of Mexico.

The high degree of similarity between the two time periods might lead one to hypothesize that while the Teotihuacan sources were minimized, the Valley of Mexico trade networks that brought in obsidian during the Classic period still persisted into the Epiclassic period. However, as detailed in a subsequent chapter I propose the possibility that during the Classic period, the Teotihuacan controlled sources may have entered the Toluca Valley via the same *third-party* distribution network that circulated Ucareo obsidian; a system that may not have been linked at all with the Teotihuacan obsidian network. The Epiclassic period regional center of Xochicalco provides an interesting comparison. Although its people also relied on Ucareo obsidian, it imported a percentage of Sierra de Las Navajas obsidian similar to that of Santa Cruz Atizapan. It may be that Xochicalco was somehow provisioned under the same distribution network supplying the southeastern Toluca Valley. The presence of a third party supplier of Sierra de Las Navajas and Otumba obsidian could partially explain the low percentages of Teotihuacan obsidian at Santa Cruz Atizapan during the Classic period and the continued percentage of this obsidian source during the Epiclassic period. More research focused on Toluca Valley sites and others on the western periphery of Teotihuacan's core area is necessary before a complete reanalysis of Teotihuacan distribution networks can be supported. The material evidence supporting cultural links between the early occupants of the Santa Cruz Atizapan site and Teotihuacan are undeniably strong.

Contextual analysis of the Epiclassic period materials produced results similar to Classic period materials (Compare Table 7 and 9). The only visible shift that occurs is that Ucareo artifacts in domestic contexts decrease by more than 5% (81.89% to 77.19%) during the Epiclassic period while the number of Otumba artifacts increases from 5.17% to 8.98%. The specific contexts included under the Domestic, Public, and Public-Domestic Use labels were investigated individually to identify patterns that may have been masked by the use of the general categories above.

It is important to point out that while the number of Ucareo artifacts recovered from Public-Domestic Use areas increases by 437 (N=140-577) artifacts, the relative percentage of Ucareo obsidian in those deposits remains consistent. The increased numbers of objects from Public-Domestic Use areas and the decrease of artifacts from Public contexts reflect changes in excavation areas from one season to the next. In addition, the third season of excavation produced many more objects from Epiclassic deposits.

	EPICLASSIC PERIOD			
Obsidian Source	**Domestic**	**Public**	**Public-Domestic Use**	**Total**
Ucareo	1323 (77.19%)	151 (82.97%)	577 (82.78%)	2051 (79.10%)
Sierra de Las Navajas	149 (8.69%)	17 (9.34%)	60 (8.61%)	226 (8.72%)
Otumba	154 (8.98%)	14 (7.69%)	49 (7.03%)	217 (8.37%)
Ucareo, Otumba*	13 (0.76%)	-	1 (0.14%)	14 (0.54%)
Ucareo, Zacualtipan*	44 (2.57%)	-	5 (0.72%)	49 (1.89%)
Zacualtipan	28 (1.63%)	-	3 (0.43%)	31 (1.20%)
Paredon	2 (0.12%)	-	1 (0.14%)	3 (0.12%)
Fuentezuelas	1 (0.06%)	-	1 (0.14%)	2 (0.08%)
Grand Total	**1714 (100%)**	**182 (100%)**	**697 (100%)**	**2593 (100%)**

Table 9: Classic Period Obsidian sources recovered from Domestic, Public, and Public-Domestic Use spaces at Santa Cruz Atizapan.

The tools imported into the Santa Cruz Atizapan region during the Epiclassic period exhibit some change with regard to obsidian sources (Table 10). First and foremost, while the quantity of prismatic blades increases during the Epiclassic there is a clear decrease in the variety of other tools imported into the site. Lower percentages of “Amantla” blades, macroblades, prismatic blade-cores, hafted bifaces and flake tools all occur during the transition to the Epiclassic. Prismatic blade percentages increase along with a nearly 5 % increase in the number of debitage or debris flakes. While all of the artifacts types of the early occupation are still imported to the site, it seems that the imported technologies were somewhat streamlined after the fall of Teotihuacan. An increase in debitage flakes may indicate increased local tool rejuvenation, but this seems less likely if we consider the wide range of artifacts that were included under this category. The only Ucareo artifacts more common during the later occupation are prismatic blade based eccentrics; both crescent and trilobe shaped. Archaeologists have yet to outline the exact functions of these artifacts but if they reflect an ideological or religious symbolism as some have argued (Stocker and Spence 1973), then it may be significant that Otumba and Sierra de Las Navajas varieties occur during this time period. Perhaps these played instrumental parts in the new religious ideology of the day. Having analyzed the more than fifty eccentrics in this collection, I am more inclined to believe that they probably fulfilled some real functional purpose. The investment in the shaping of these tools varies tremendously and many exhibit definitive wear on their notches (see below).

The fact that the local tool-kit was streamlined during the Epiclassic is supported by an increase in the percentages of both Sierra de Las Navajas (62.67%-70.99%) and Otumba prismatic blades (12.31%-20.13%) at the site. Navajas macroblades, hafted bifaces and flake tools decrease during the Epiclassic but our artifacts counts regarding these tools are too low to define any real change.

Obsidian Technology

The artifact types recovered from Santa Cruz Atizapan excavated deposits are listed in Tables 8 and 10. They represent the common range of types recovered from many archaeological sites in Mesoamerica. In this chapter, I will outline the obsidian technology evident in the excavated objects, combined with those objects recovered from surface contexts. Surface artifacts are included in the following analyses because here we are interested in exploring the tool technologies that were imported into the site. The chronological designation of surface materials is considered acceptable for this aspect of the analysis.

Epiclassic	**FUENT**	**OT**	**SDLN**	**PAR**	**UC**	**UC-OT**	**UC-ZAC**	**ZAC**	**Total**
Prismatic Blade	**1 (50%)**	**60 (20.13%)**	**257 (70.99%)**	**1 (16.67%)**	**2925 (82.70%)**	**8 (57.14%)**	**69 (87.34%)**	**28 (63.64%)**	**3349 (77.13%)**
Prismatic Blade derived									
Eccentrics	-	5 (1.68%)	5 (1.38%)	-	22 (0.62%)	-	1 (1.27%)	-	33 (0.76%)
Drills	-	13 (4.36%)	3 (0.83%)	-	2 (0.06%)	-	-	-	18 (0.41%)
Projectile Pt.	-	-	-	-	6 (0.17%)	-	-	-	6 (0.14%)
Perforator/Punch	-	-	-	-	2 (0.06%)	-	-	-	2 (0.05%)
"Amantla" Blade	-	-	3 (0.83%)	-	34 (0.96%)	-	-	-	37 (0.85%)
Macroblade	-	**1 (0.34%)**	**6 (1.66%)**	-	**56 (1.58%)**	-	-	**3 (6.82%)**	**66 (1.52%)**
Prismatic Blade-Core	-	-	**1 (0.28%)**	**1 (16.67%)**	**6 (0.17%)**	-	-	**1 (2.27%)**	**9 (0.21%)**
Biface									
Hafted Biface	-	18 (6.04%)	3 (0.83%)	-	25 (0.71%)	-	-	3 (6.82%)	49 (1.13%)
Unknown Biface	-	23 (7.72%)	4 (1.10%)	-	21 (0.59%)	-	-	-	48 (1.11%)
Unhafted Biface	-	3 (1.01%)	-	-	4 (0.11%)	-	1 (1.27%)	-	8 (0.18%)
Flake Tool	-	**9 (3.02%)**	**6 (1.66%)**	-	**33 (0.93%)**	**3 (21.43%)**	**2 (2.53%)**	**2 (4.55%)**	**55 (1.27%)**
Debitage	**1 (50%)**	**166 (55.70%)**	**74 (20.44%)**	**4 (66.67%)**	**401 (11.34%)**	**3 (21.43%)**	**6 (7.59%)**	**7 (15.91%)**	**662 (15.25%)**
Grand Total	**2 (100%)**	**298 (100%)**	**362 (100%)**	**6 (100%)**	**3537 (100%)**	**14 (100%)**	**79 (100%)**	**44 (100%)**	**4342 (100%)**

Table 10: Epiclassic period distribution of artifact categories by obsidian source. FUENT=Fuentezuelas, OT=Otumba, SDLN=Sierra de Las Navajas, PAR=Paredon, UC=Ucareo, UC-OT=Ucareo/Otumba, UC-ZAC=Ucareo/Zacualtipan, ZAC=Zacualtipan.

It was felt that chronological changes in technology were best determined by analyzing the variability of formal tool types produced from the same obsidian source. If the physical attributes of a particular tool type remained unchanged in the later occupation period we concluded that its production and distribution systems likely remained unchanged. If, however, changes were noted in the physical attributes of similar types, then we could explore the possibility that the production and distribution networks were impacted by economic or political reasons. While some observable differences in tool assemblages may result from local behavioral changes unrelated to shifts in supply or demand, it is more likely that the producer and not the consumer end was the underlying force. We may see shifts in local obsidian utilization if particular artifact types (e.g. bifaces) are traded less often but at this point it does not appear that the people of Santa Cruz Atizapan had much say in the type of tools circulating in this exchange system. The lack of local obsidian production zones and the absence of exotic or rare obsidian forms further supports their participation in a purely subsistence tool based, and therefore economic, distribution network.

In the following descriptions, only bifaces, prismatic blades, and prismatic blade derived tools are given separate sections. The remaining tools are described in a single section that describes the sources in a combined format. This was done to highlight the significance of the biface and blade-core technologies, and also to acknowledge the limited numbers of some of these tool categories where, for instance, you may have only one macroblade made of Otumba obsidian during the Epiclassic period. Discussion is warranted in these cases.

A total of 2538 objects from Classic period deposits were analyzed and assigned one of the morphological/technological categories found in Appendix A. These included 124 bifaces, 1822 prismatic blades, and the following blade derived tools: two projectile points, four awls, two perforators, 12 eccentrics, and 57 “Amantla blades”. Fifteen exhausted prismatic blade core fragments were also identified. The remainder of Classic period materials include: 119 macroblades, 89 flake tools, 1 flake core, and 291 pieces of debitage. The general properties of these artifacts categories are described below for the Classic period.

Classic Period

Bifaces

Bifaces represent the most energy intensive artifact type in the Santa Cruz Atizapan collection. Their forms, sizes, degree of shaping, and obsidian sources varied between and within each obsidian source (Figure 21). One general observation of the Santa Cruz Atizapan obsidian is that they are not consistently shaped or made in standardized forms. In fact, we had great difficulty in establishing typological categories for the hafted bifaces due the excessive variability of hafting notches, stem base shapes and sizes, overall artifact size and cutting edge curvature. After several analytical passes we had established more than 15 possible variants in an assemblage containing 85 bifaces, plus two prismatic blade points (Figure 22). We, also noted that detailed biface typologies were difficult to find in the archaeological literature. Few other projects had created them for Mesoamerica; and when they did it only included only the generalized types discussed in Chapter 7 of this thesis.

Bifaces: Ucareo

Seventy four bifaces made of Ucareo obsidian are from Classic period deposits. Fifty two of these are hafted bifaces of varying forms and displayed both extensive and minimal shaping (Figure 22).

Figure 21: Hafted and Unhafted bifaces from Santa Cruz Atizapan. Clockwise from top left are a Ucareo biface, a Zacualtipan biface, a unhafted Sierra de Las Navajas biface and a unhafted Otumba biface.

Six unhafted bifaces also occur, with their shapes also varying. Sixteen biface fragments were considered too incomplete to determine if they had been hafted, or they were point tip fragments that could not provide this information. These were recorded as “Biface, Indeterminate.” Sixteen of the hafted type were complete and twenty others were more than seventy-five percent complete. An additional four hafted bifaces were between fifty and seventy-five percent complete. The remaining bifaces were less than fifty percent complete. Of the unhafted bifaces, only one was complete and two others more than seventy-five percent complete. As expected the majority of indeterminate bifaces were less than twenty-five percent complete.

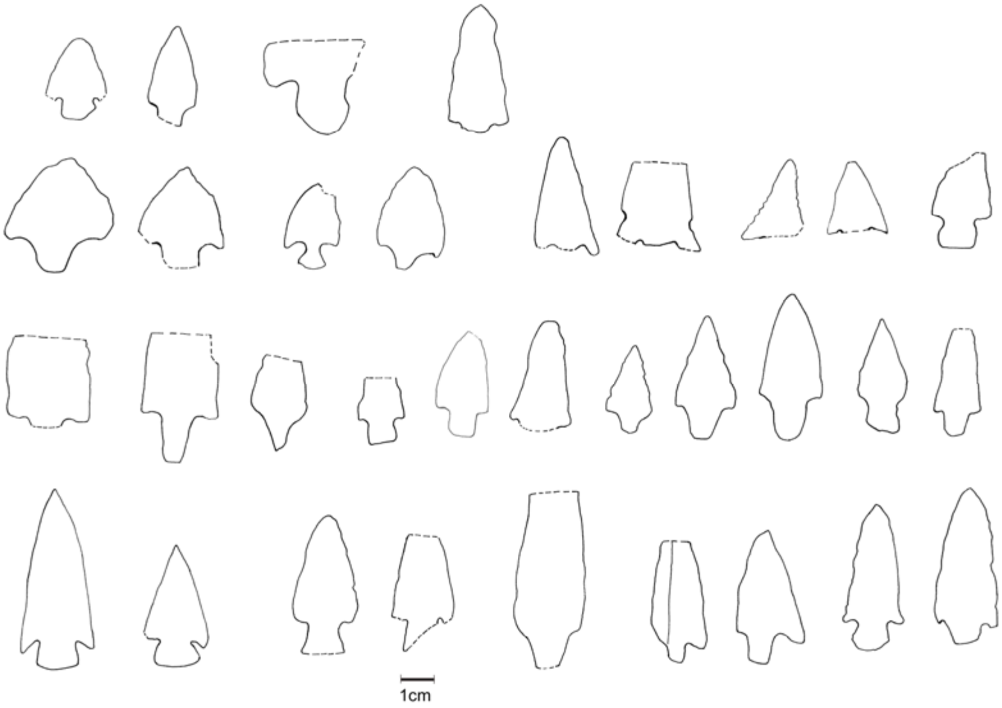


Figure 22: Classic period hafted bifaces made of Ucareo obsidian. Note: these are only representative samples as not every artifact was illustrated.

If we take the summary count of bifaces bases to suggest a minimum number of bifaces for this time period we can conclusively add twenty whole hafted bifaces and sixteen bases or stems to make 36 total hafted bifaces. Similarly, we can conclude the presence of one whole unhafted biface and two separate distal fragments. We measured the maximum width of all bifaces by placing our calipers perpendicular to the objects surface. We then held this position until we reached the widest point on the blade. We recorded the object's widest point, whether it was mid-way down the blade or at the tangs. Only objects with both edges present were used to calculate our average maximum biface widths. We used complete artifacts, and those with great than 75% of their original material present, to establish that the average maximum width of hafted

Ucareo bifaces was 34.9mm. Unhafted bifaces were slightly more narrow at 22.58 mm. The small number of unhafted bifaces present makes this average of somewhat dubious statistical significance. Complete hafted bifaces measured an average of 50.7 mm in length, while those greater than 75% complete measured an average of 46.68 mm. The single complete unhafted biface measured 50.4 mm in length. Average thickness could be calculated for most every biface artifacts regardless of how complete it was. As most midsections appeared to have been the thickest parts of the bifaces and were often the fragment preserved, we could establish a fairly accurate average thickness for these Ucareo artifacts. The average thickness of hafted varieties was 7.48 mm and unhafted bifaces were generally about 7.65 mm thick. If we include indeterminate biface fragments in these calculations, the average thickness of Ucareo bifaces used at Santa Cruz Atizapan during the Classic period was 7.35mm.

In an attempt to establish a typological classification for hafted bifaces, I recorded several attributes that might indicate variability in biface manufacture. They include base-stem shape, hafting notch location, pressure flaking location and intensity, and cross-sectional profile. Although I also recorded blade edge symmetry and point shape, these two variables were eliminated from the final analysis. Rejuvenation or re-use of any broken biface tip or edge could introduce significant error into the analysis. The remaining variables were less likely to have been modified without leaving clear evidence of retouching or rejuvenation. For example, during the analysis we noted several hafted bifaces made of Ucareo obsidian that had one tang missing. After closer scrutiny we realized that it was not an initial production design but rather each tang had been broken and subsequently pressure flaked on that edge to make the biface usable again. Stem bases were placed into one of the eight shape categories found in Figure 23. These eight categories described most base stems except in cases where stems were too fragmentary. We recorded hafting notches using the categories found in Table 11. Several other descriptors were condensed into these final six categories.

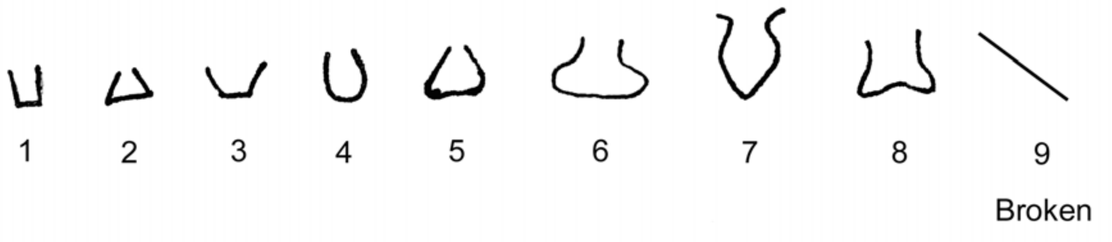


Figure 23: Hafted biface stem shapes recorded during attribute analysis

Biface Notching Descriptions used for Analysis:

1	Side notched
2	Corner notched
3	Corner notched at 90 degree angle
4	Corner notched greater than 45 degree angle but not flat
5	Basal notched
6	Notch open greater than 90 degree angle

Table 11: Hafted Biface notching locations used during the SCAT obsidian Analysis.

Classic period Ucareo hafted bifaces exhibited the following shaping characteristics. Fifteen bifaces had squared base stems. This was followed by nine artifacts with tapered base stems, five artifacts each with rounded and rounded triangular stems, and four with triangular shapes. Two pointed base stems were also recorded. The variability of stem shape alone suggests a great diversity or individuality in the production of Ucareo hafted bifaces. Forty-two bifaces were corner-notched, with their notches exhibiting varying degrees of openness. Eighteen of these were described as simply corner notched but six were described as corner notched-ninety degrees. Eight notches were greater than 45 degree but less than ninety. Ten notches were completely open and greater than ninety degrees. Only one basal notched biface was identified. Three notches were described as indeterminate. The variability in hafting and base stem shapes was not found to correlate with chronological changes nor specific contexts but this may only be a consequence of their re-use and re-shaping over time.

The extent to which these bifaces were pressure flaked also indicated the amount of work invested in each artifact. Twenty-nine of the fifty-two hafted bifaces were well shaped on both surfaces indicating a fair amount of work investment. Fifteen hafted bifaces were shaped completely on one surface and only partially on the second surface. Seven of the Ucareo hafted bifaces were shaped only on their edges. These were likely some of the large macroblades that were imported to the site which were subsequently pressure flaked into hafted bifaces when the need arose. The unhafted bifaces were also varied in their intensity of pressure flaking, but only one displayed extensive shaping on both surfaces. These unhafted bifaces may have been local products.

As expected, the bifaces exhibiting the greatest amount of flaking had the most uniform and ideal longitudinal cross sections. Twenty-one of the twenty-nine hafted bifaces, and eight of the nine unhafted bifaces that had been completely shaped on both surfaces, displayed ovoid cross-sections. Those that were not ovoid were diamond shaped, domed, and trapezoidal. Bifaces with one surface well-shaped and a second minimally-shaped tended to have domed or triangular-shaped cross sections. Nearly every biface shaped only on its edges exhibited triangular cross-sections.

Overall, the Classic period Ucareo obsidian bifaces exhibited a fair degree of variability in formal shape and investment of work. Although we believe that many of the these bifaces were imported as finished products, there is some evidence to suggest that some bifaces were manufacture at the site, albeit in very crude forms. We did not identify any biface blanks in the assemblage, although some may argue that some of the unhafted bifaces may represent blanks. My experience with unhafted bifaces leads me to believe that these Ucareo objects were not blanks. Several are well shaped yet do not appear to have been reshaped. They would likely not have warranted a conversion to hafting. Second, several of the unhafted bifaces exhibit use-wear scars on their edges as if they were used as is. Perhaps at a later date they could have been reworked into other objects.

Bifaces: Otumba

Bifaces made from Otumba obsidians exhibit a broad range of colors and shapes (Figure 24). When compared to Ucareo materials of either early or late occupations of the Santa Cruz Atizapan region, they exhibit a more refined pressure flaking technique, often

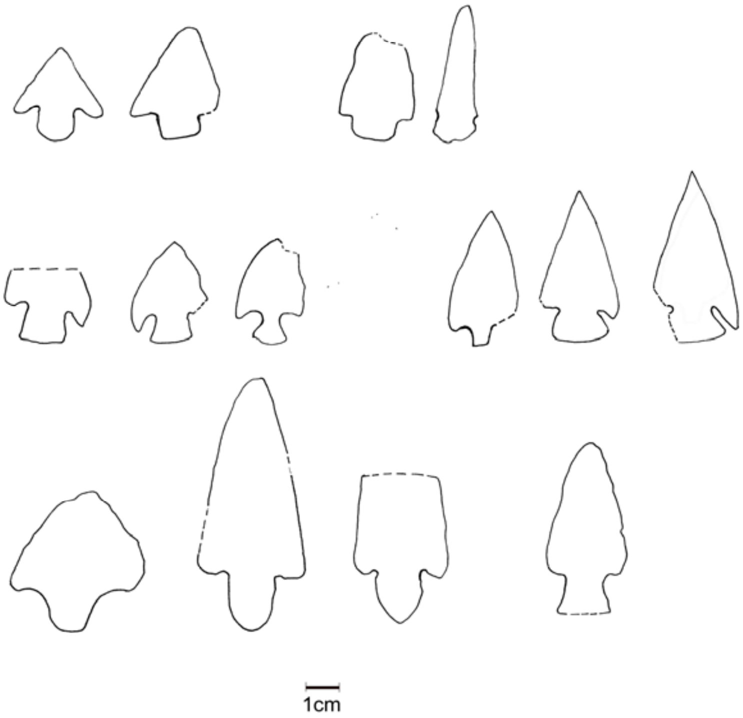


Figure 24: Classic period hafted bifaces made of Otumba obsidian. Note: these are only representative samples and not every artifact was illustrated.

seeming sharper at their points and cutting edges. Their association with the Teotihuacan obsidian industry must have surely demanded such high quality production. Although Ucareo bifaces can be equally well made, they often appear bulkier and with blunter point tips.

Twenty-nine complete and fragmentary Otumba bifaces were recovered from Classic period deposits. Twenty-two bifaces were notched, and thus were hafted at some point in their use-lives. Two bifaces were unhafted and five were too fragmentary to categorize. Only four complete hafted bifaces were found in the collection. This is complemented by ten additional specimens that are more than seventy-five percent complete. Three other hafted types are between fifty and seventy five percent complete. The remaining tools are less than fifty percent complete. One unhafted biface is complete and a second is only a base fragment representing less than twenty five percent of the complete biface.

Eight distal hafted fragments and the nine nearly complete artifacts described above add up to a minimum of seventeen bifaces from the Classic period deposits. The average maximum width of these complete bifaces was 28.26 mm. The single complete unhafted biface had a width of 34 mm. Utilizing only the complete hafted bifaces, the average length of complete bifaces was 43.9 mm. Hafted bifaces averaged a maximum thickness of 7.34 mm. The single unhafted biface was more than 12 mm thick. As is clearly evident in Figure 24, however, there does appear to be two or more distinct size classes of Otumba bifaces. This is the case with most collections. The averages presented here serve to allow comparisons of the same materials during different time periods. They should not be indiscriminately utilized for comparison with other Otumba materials that may have been produced or traded through a different network than that which supplied the current site.

Twenty-one hafted Otumba artifacts were corner notched, accounting for all bifaces except one that was side notched. Base stem shapes for hafted bifaces were predominately square and triangular (N=13). The remaining had rounded stems, except for a single flared flat bottomed specimen. As mentioned above, the visible regularity in form and consistency in flake scar patterning demonstrates a high degree of technical expertise in the manufacture of Otumba bifaces (see Figure 21). This is further supported by the data recorded during the present analysis. Sixteen of the twenty two hafted bifaces were extensively shaped on their entire surfaces. The result was a very consistent ovoid cross section (at times thin). The same patterning is evident in three of the five indeterminate bifaces and the one unhafted biface as well.

Bifaces: Sierra de Las Navajas

Six hafted bifaces (Figure 25), two unhafted bifaces and seven unidentified fragments make up the Classic period collection of the site. One hafted artifact is complete and three additional are nearly complete. A single unhafted biface also occurs. Widths for Sierra de Las Navajas bifaces measure an average of 25.25 mm for the hafted types ,and 40.9 mm for the sole unhafted artifact where this could be measured. The average length of the hafted bifaces (including the bifaces more than 75% complete) is 57.02 mm. The unhafted biface found in these deposits was exceptionally long at 91.4 mm. The average thickness of hafted bifaces was 7.23 mm and, again, the unusually large unhafted biface measured a not so average 14.1 mm thick.

Navajas bifaces were exclusively corner notched. Base stems on Sierra de Las Navajas bifaces did not fall into any particular pattern. The base stem shapes, square, triangular, and flared flat represent one artifact each. Two additional had rounded triangular stems.

As with the Otumba bifaces, the Sierra de Las Navajas bifaces were well shaped and generally a consistent ovoid shape in cross section.

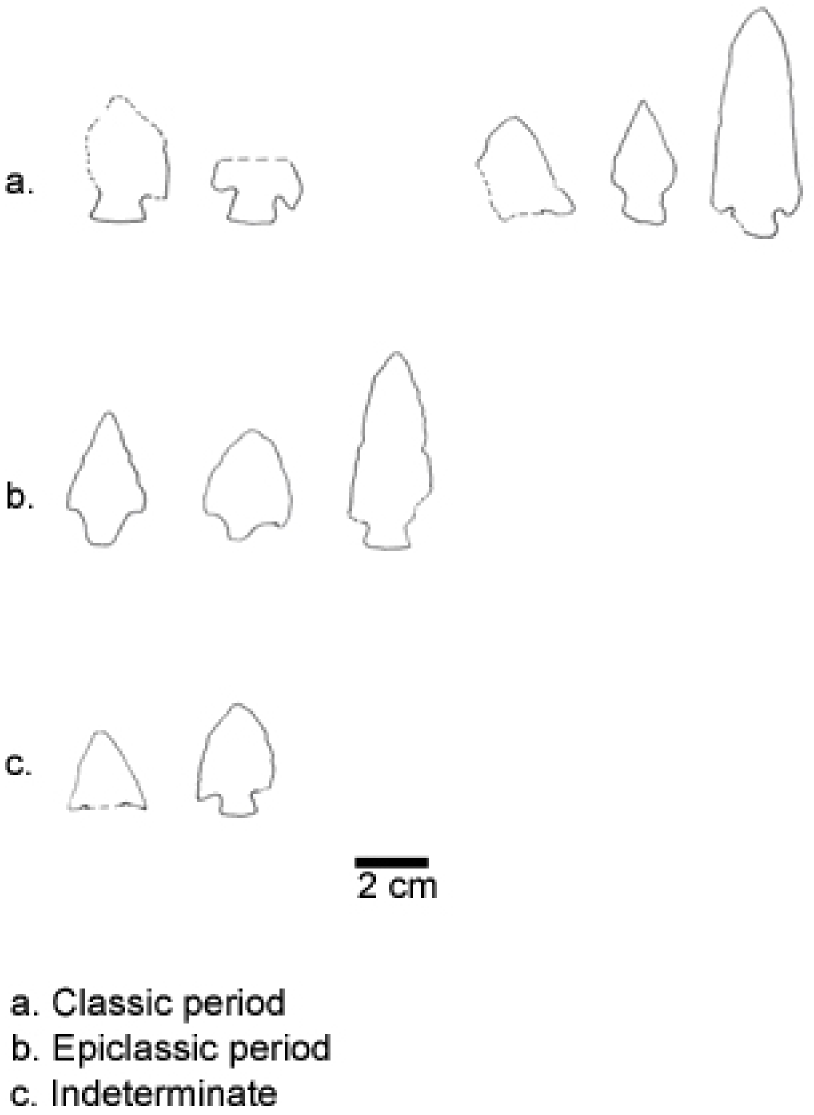


Figure 25: Classic and Epiclassic period hafted bifaces made of Sierra de Las Navajas obsidian. These are only representative samples and not every artifact was illustrated.

Prismatic Blades: Ucareo

One thousand, six hundred and six prismatic blades were recovered. These included blades with no evidence of having been used and blades with extensive wear on multiple edges. Twenty-four complete blades were recorded but the vast majority (N=1197) of blades were small fragments, estimated to represent less than twenty-five percent of the original blade size. An additional 200 blades were between twenty-five and fifty percent, while another 102 were greater than fifty percent but not complete. Eighty-one blades were in such condition that we could not estimate their degree of completeness. Only 127 blades exhibited evidence of platform preparation. Seventy-nine appear to have been abraded and another twenty-two were flaked or crushed on their platforms. It has been argued that such preparation facilitates the production of prismatic blades by securing the pressure flaker on the core. Indeed, prismatic cores at Xochicalco were always ground.

The vast majority (N=1342) of blades were also medial fragments. Only 215 proximal blades and forty two distal ends were counted. The most accurate dimension to record on these objects is thus complete width. For Ucareo obsidian blades this equaled 13.24 mm. The few complete blades in the collection measured an average length of 27.8 mm. The average thickness of Ucareo blades was 3.54 mm. The number of ridges on blades can at times indicate the stage of blade manufacture. Standard final series blades often have two parallel ridges running down their dorsal surfaces. However, Ucareo obsidian blade during this period appear with two, one and 3 ridges, in respective frequency. Of the 737 blades for which this variable was measured, 604 exhibited two dorsal ridges. Sixty-four blades had single ridges, and 55 others had three ridges visible.

Eight blades had four ridges. This suggests a degree of consistency in the production of blades at the Ucareo workshops, wherever they were located.

Prismatic Blades: Sierra de Las Navajas

Only 136 blades from this source were identified during analysis. This is somewhat surprising considering it was previously presumed to have been the dominant source for this period. Ninety-one of these blades were small fragments representing less than twenty-five percent of the original blade size. Platform abrasion was noted on four proximal blades and two others appeared to have been flaked or crushed prior to their removal. Unlike the Ucareo material from this time, the Navajas blades consistently contained only two parallel dorsal ridges (N=50 of 54 total). The average width of Navajas blades was 12.63 mm, and their average thickness was 3.44 mm.

Prismatic Blades: Otumba

Only sixteen blades from the Otumba source were documented during our analysis. Eleven blades were small fragments and only one complete blade was recorded. Bifaces and not blades were clearly the tools manufactured from Otumba materials. Otumba blades were also consistently made with two ridges, although we have only a small sample size. Otumba blades averaged a width of 12.15 mm, and a thickness of 3.47 mm.

Prismatic Blades: Minor Sources

Zacualtipan, Paredon

Six Zacualtipan obsidian blades were analyzed and measured an average of 19 mm in width and 4.15 mm in thickness. Zacualtipan blades are generally larger than blades from other obsidian sources. There is a possibility that these blades may reflect percussion, and were not third series prismatic blades. However, other than size, they did not exhibit the characteristics of percussion produced blades.

Only two Paredon obsidian blades were analyzed and these were unused, broken fragments.

Prismatic Blade: Formal Tools

The value of prismatic blade technology is not only reflected in the high edge to weigh ratio of the blade artifacts themselves, nor the easily transportable nature of prismatic cores. Equally as valuable is the facility by which these blades could be

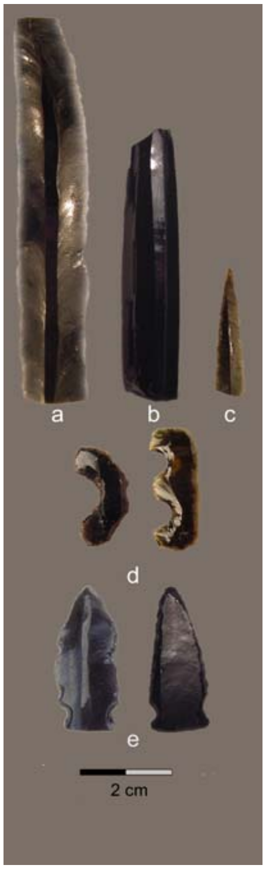


Figure 26: A variety of core-blade tools from Santa Cruz Atizapan: a, prismatic blade; b, exhausted prismatic blade core; c, prismatic blade awl; d, prismatic blade derived crescent and trilobe shaped eccentrics; e, prismatic blade derived notched projectile points.

transformed into other formal tool categories (Figure 26). At Santa Cruz Atizapan, prismatic blades were modified through pressure flaking into several tool categories that, perhaps, served specific functions. Awls were sharp pointed and narrow blades that were likely used to perforate materials and may have served as bloodletting tools in some cases. In almost all cases, these objects were pressure flaked on the blades ventral surface to create the sharp edge. Larger and thicker blades were often worked on multiple surfaces to produce a more rounded tool (in longitudinal cross-section) that could be used as a perforator or punch for more intensive piercing or scraping tasks. Amantla blades (Figure 27) are also modified blades with a distinct shaping pattern, described below. Larger blades, possibly 1st or 2nd series blades and not the typical 3rd series blades, were often well shaped and used on their edges. We kept these objects separate despite not being able to distinguish their use from regular 3rd serried prismatic blades.

Eccentrics

Three varieties of eccentrics occur at Santa Cruz Atizapan (Figures, 27, 28, 29): Crescent forms, Trilobed forms, and Zoomorphic forms. Out of 58 eccentrics recovered during the entire three excavation seasons, 12 were obtained from Classic period deposits. Six crescents, three trilobed eccentrics and three zoomorphic forms have been identified in the collection. In the following paragraphs, I only discuss the crescent and trilobed eccentrics. As stated previously, these are all made from prismatic blade fragments. We identified them as prismatic blades fragments through the presence of the dorsal ridges that are characteristic of prismatic blade production (Figure 27). Five of the six crescents, and three of the trilobed objects are complete artifacts, while one zoomorphic form is nearly complete, representing more than seventy-five percent of the

Figure 27: Crescent shaped eccentric demonstrating use wear and shaping on interior and exterior surfaces.

complete object. Ten of these eccentrics are made of Ucareo obsidian, while the remaining two are from the Sierra de Las Navajas source. The two Sierra de Las Navajas objects include one zoomorphic eccentric and one crescent shaped eccentric.

As with most artifacts at the site, eccentrics appear to be distributed in all contexts at the site but they are more heavily concentrated in domestic areas (N=9). All three eccentric forms occur more often in domestic areas than public contexts. The anthropomorphic eccentrics occurred in a variety of shaped, although all were only roughly shaped. Figure 29 demonstrates one of the few complete zoomorphic eccentrics that may be identifiable as a dog or some other animal. A second fragment (Figure 29), very similar in shape to the complete artifact, suggests that this form may have been recreated numerous times at the sites. It's significance is still undetermined.

A primary goal in analyzing the Santa Cruz Atizapan crescent and trilobe eccentrics was to establish whether the artifacts were heavily used and/or shaped prior to

Figure 28: Trilobe shaped eccentric demonstrating use wear and shaping on interior and exterior surfaces.

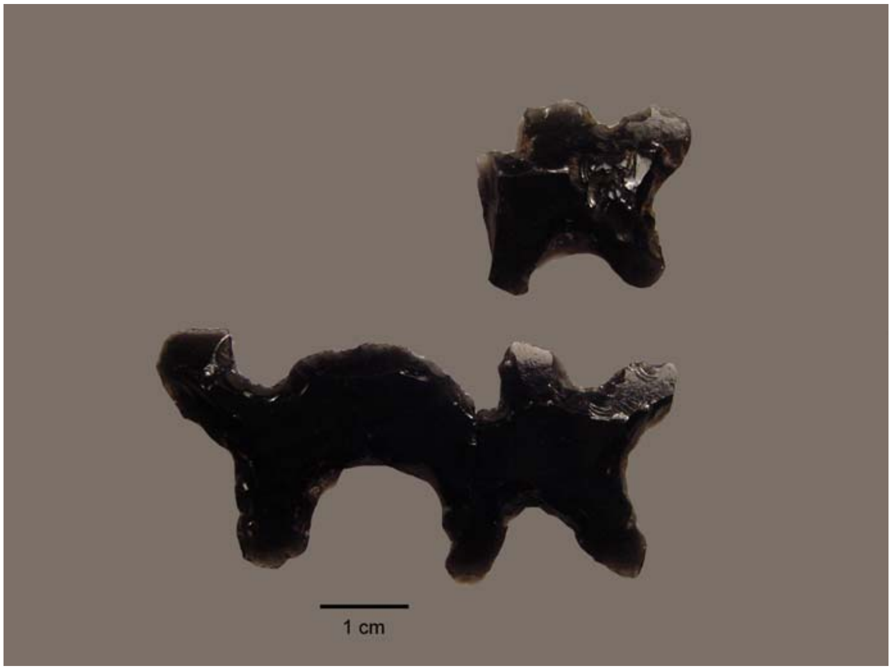


Figure 29: Zoomorphic eccentrics excavated from the Santa Cruz Atizapan site.

their use. To determine this we analyzed the exterior surfaces as well as the interior surfaces of the objects for use wear. We also recorded the overall plan-view shape of the object to determine if there was a morphological consistency that might indicate a particular type of use. Finally, we recorded the shape of each artifact's longitudinal cross-section to determine whether the objects were consistently manufactured using the same part of prismatic blade fragments.

The in-depth analysis of the Classic period eccentrics demonstrated that, although most objects were shaped to some degree on their interior (within the curved portion of the artifact) and exterior surfaces (the outer edge of the crescents and long edge of the trilobe), the objects varied as to whether they were unifacially or bifacially worked on their exterior surfaces. The exterior surfaces of crescent-shaped eccentrics were equally divided between those exhibiting bifacial and unifacial pressure flaking. In contrast, all three trilobe shaped eccentrics were unifacially shaped on their exterior surfaces.

More consistently, the interior edges of both the crescents and the trilobe shaped eccentrics exhibited wear or shaping that was indicative of bifacial pressure. This flaking, and almost crushed appearance, on the interior edges of the crescents, suggests that it was created through use rather than through intentional shaping. Pressure appears to have been concentrated on specific points within the curved portion of each artifact (Figure 27) which suggests that it might have been used for scraping some fine edged surface or perhaps that they were tied in this area by some type of rope. Analysis of the longitudinal cross-section of these objects concluded that the crescent shaped eccentrics tended to be ovoid shaped or in the shape of a right triangle. This is consistent with the longitudinal shapes of prismatic blades, depending on whether the edge or the ridge of the blade was used to create the object. Trilobed eccentrics, however, were uniquely triangular in cross-section.

Awl

Four awls made of modified blade fragments were found in Classic period deposits (Figure 26). Three are made of Ucareo obsidian and one is made of Otumba obsidian. Each awl was pointed on one end. The average width of these blades measured 16.6 mm. Despite being modified segments of larger blades there is some consistency in their desired lengths as well. For Classic period awls this averaged 30.6 mm.

Perforator/punch

Two large blades were modified into bifacially worked tools that we described as punches or perforators. Both were fragments measuring less than twenty-five percent of their original blade length. This of course could be a dubious estimate for these objects as we are not sure what their desired length was to begin with. The average width for this category of objects was 19.0 mm.

Amantla Blade

Fifty-seven Amantla blades were recovered from Classic period contexts. Amantla blades display a characteristic wear patterning that alternates as one turns the blade over from dorsal to ventral surfaces (Figure 30). Although these forms are created through use as much as intentional shaping, we still defined them as unique artifact types because they are commonly found at other sites. Hirth (1993: Figure 2) believes that rather than having a specific use, these artifacts were shaped this way to permit a particular type of hand held cutting or scraping motion.

Fifty-three of these blades were made of Ucareo obsidian, two of Zacualtipan obsidian and one of Otumba obsidian. As these represent intentionally broken blades of varying size I will not list dimensional data for them. Although all parts of prismatic blades were used to produce Amantla blades, forty-nine of the fifty-seven were medial fragments. Six were made from proximal blade sections and two from distal fragments.

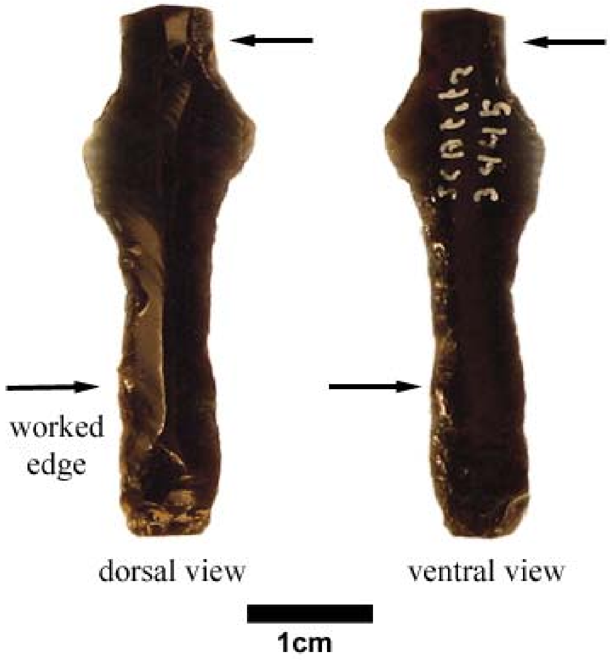


Figure 30: Amantla blade exhibiting typical wear patterns.

Macroblades

Macroblades represented a wide range of artifacts that were simply utilized percussion blade fragments. They are wider (>2.5 cm) (Clark and Bryant 1997) than prismatic blades and often much thicker and more irregular. One hundred and thirteen macroblade artifacts were in the collections from Classic period deposits. Most were minimally shaped blades utilized in a variety of different ways. Fifty-three were unifacially utilized on one edge, seventeen were bifacially utilized on one or more edges, and eight were used both bifacially and unifacially on at least two edges. Fourteen blades were not utilized at all. Ten macroblades were shaped intentionally or through use, enough to have been considered macroblade scrapers. Macroblades from this site measure an average of 23.5 mm in width.

Prismatic Blade Cores

Fifteen blade cores were found in the Classic period deposits (Figure 25b). Fourteen are made of Ucareo obsidian and all are exhausted cores at the end of their use life. One blade core was made of Sierra de Las Navajas obsidian. These exhausted cores averaged a diameter of 12.28 mm.

Epiclassic Period

Bifaces: Ucareo

Thirty hafted, four unhafted and twenty-three indeterminate bifaces comprise the Epiclassic period Ucareo artifacts (Figure 31). Eleven hafted artifacts are complete and six additional are present in greater than seventy-five percent of their original condition. Eleven hafted bifaces are less than fifty percent complete. Two are between fifty and seventy-five percent complete. Unhafted bifaces consist of two fragments less than twenty-five percent complete and two artifacts greater than seventy-five percent complete. Counting base fragments and complete bifaces, there are minimally twenty-two bifaces represented for the Epiclassic period. Conversely, only two base fragments of unhafted bifaces were recognized.

A comparison of average maximum widths between Epiclassic and Classic period bifaces indicates a slight decline in the size of hafted bifaces from 25.77mm to 24.42mm. This may seem a minor difference, yet it is based on a comparison of fifty-two Classic period and thirty Epiclassic period artifacts. The sole measurable unhafted biface measured a width of 34.13mm. The maximum lengths of complete Ucareo hafted bifaces average 47 mm, which also indicates a slight decrease in size from the 50.7mm average of Classic period specimens. The most telling dimensional data comes from a comparison of hafted biface thickness measurements between the Classic and the Epiclassic period.

While the average thickness during the Classic period was 7.48mm, this number drops to 6.78mm in the Epiclassic period. Changes in artifact thickness may present perhaps the most direct clue for adjustments in production technology.

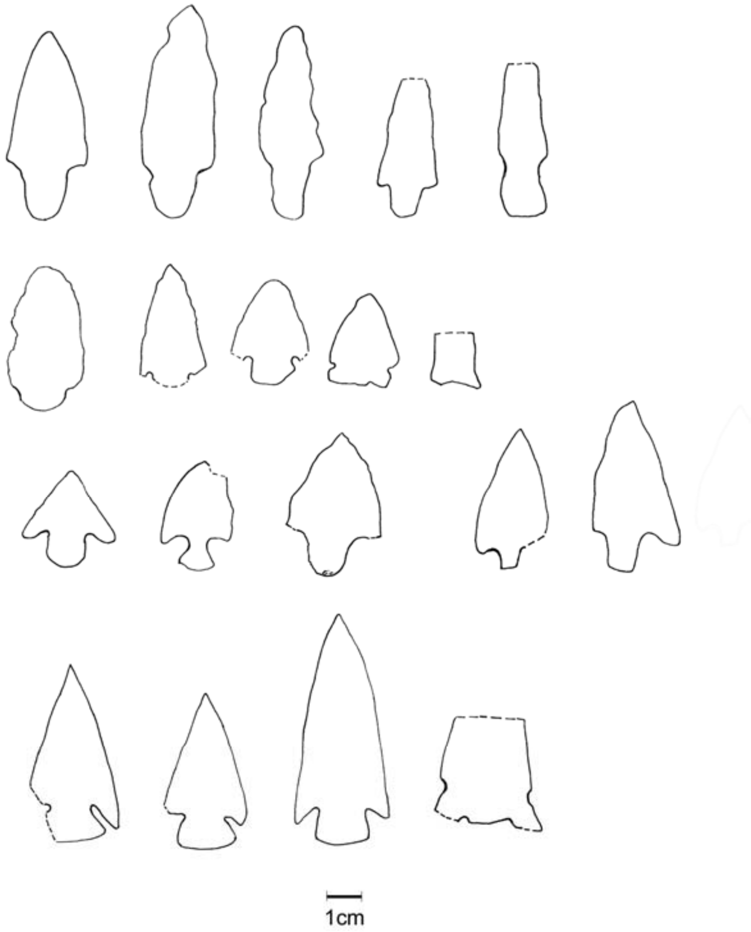


Figure 31: Epiclassic period hafted bifaces made of Ucareo obsidian. Note: These are only representative samples and not every artifact was illustrated.

It is the least modifiable property of a biface blank. It, of course, may be thinned through pressure flaking, but it is not as amenable to change as is an artifact's width and length.

Corner notched points are most common in the Epiclassic period Ucareo bifaces, representing sixteen of the thirty hafted bifaces. Three other bifaces were considered side notched and the remaining were indeterminate. Base stem shapes were recorded for twenty-two hafted bifaces. Similar to Classic period Ucareo hafted bifaces, a majority (N=10) exhibited square or slightly tapered stem shapes. Eight of the remaining bifaces had triangular or rounded triangular shaped stems. Of the remaining bifaces two had rounded stems, one was flared/flat, and a third had a concave base.

As noted in the Classic period biface collection, the manufacturing scars on the Epiclassic Ucareo bifaces indicates that the majority were carefully pressure flaked across both of their surfaces. The resulting shape desired for most of these artifacts produced a ovoid shaped longitudinal cross-section. This would seem to indicate a standardized manufacturing process despite a visible variability in the general forms of the hafted bifaces.

Bifaces: Otumba

There is a rather dramatic increase in the number of Otumba bifaces recovered from Epiclassic contexts (N=62), as compared to Classic period contexts (N=29). This trajectory is probably attributable to a large increase in the number of indeterminate biface fragments recovered. Twenty-four hafted bifaces and three unhafted bifaces, added to the indeterminate bifaces (N=35), comprise the total biface count.

Only four complete bifaces (Figure 32) were recovered from Epiclassic period deposits, yet sixteen additional base fragments are also represented; making the minimum hafted biface count a total of twenty artifacts. Otumba hafted bifaces averaged a width of 30.9 mm and the unhafted types averaged 30.6 mm. The overall length of complete hafted bifaces measured 51.95 mm. Thickness of hafted and unhafted types measured 7.0 mm and 6.6 mm, respectively. Seven of nineteen bifaces measured had squared base stems. Nine other base stems were split evenly between triangular, rounded, and flat flared shapes. A single concave stem was also identified. In line with the Classic period Otumba bifaces, those recovered from later contexts exhibited a similar investment of expertise in flintknapping.

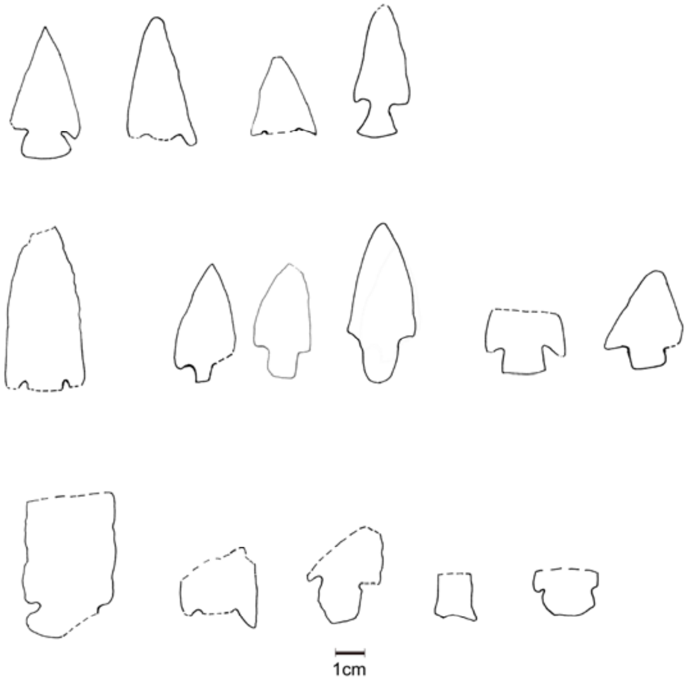


Figure 32: Epiclassic period hafted bifaces made of Otumba obsidian. * these are only representative samples as not every artifact was illustrated

Only seven percent of all bifaces were not pressure flaked across their entire surfaces. Only one of these exhibited minimal bifacial flaking on its edges.

Bifaces: Sierra de Las Navajas

Only four hafted and five indeterminate biface fragments were recovered from Epiclassic deposits. One hafted biface was complete and two others were nearly complete. The majority of indeterminate bifaces were small fragments. The interpretive potential of describing every facet of these artifacts is minimal when compared against the larger samples available for Ucareo and Otumba artifacts. Therefore, summary presentations for these and other low count sources with bifaces will only highlight important aspects of those collections.

In general, the characteristics of Epiclassic period Navajas bifaces are similar to what was evident during the Classic period. The bifaces are well shaped with varied base stem shapes and average thickness of 7.9 mm, based on two artifacts. That specialists were involved in the production of these bifaces is without doubt the most telling aspect of these bifacially flaked artifacts.

Biface: Minor Sources during the Classic and Epiclassic Periods

Zacualtipan

Only one Classic period and four Epiclassic period bifaces of Zacualtipan obsidian were identified during the analysis. The Classic period artifact consisted of a small fragmentary piece that provided us with minimal analytical data. The Epiclassic period artifacts included three hafted bifaces and one indeterminate artifact. One hafted biface was complete and a second nearly complete. The remaining biface artifacts were fragments. The complete biface measured a width of 29 mm, a length of 43.3 mm, and a thickness of 7.8 mm. Base stems on the two hafted artifacts were squared and triangular and they were both corner notched. Zacualtipan bifaces traded into the region also appear well shaped and exhibit ovoid cross-sections.

Paredon

A single hafted biface made of Paredon obsidian was recovered from Classic period contexts at the site. This biface was complete and measured 33.1 mm wide x 40.6 mm long x 5.8 mm thick. It was corner notched with a wide angle, greater than forty-five degrees and less than ninety degrees, and its base stem was rounded. It was well shaped on both surfaces and a consistent ovoid shape in cross-section.

Fuentezuelas

A single complete Classic period corner notched biface of Fuentezuelas obsidian was analyzed (see Figure 10). It measured a width of 20.5 mm, a length of 52.9 mm, and a thickness of 6.2 mm. Its base stem was rounded and its surfaces were well shaped.

Prismatic Blade: Formal Tools

Eccentrics

Forty-six eccentrics were recovered from Epiclassic period deposits. This includes twenty-seven crescent shaped eccentrics, eight trilobed shaped eccentrics, and eleven eccentrics that were categorized as zoomorphic. Twenty-one crescents, four trilobed eccentrics and one zoomorphic eccentric were complete. Eight zoomorphic eccentrics were considered indeterminate with regard to artifact completeness. As with the Classic period eccentrics, during the Epiclassic period most eccentrics were manufactured from Ucareo obsidian (N=31).

In contrast to Classic period eccentrics, shaping techniques and cross-sectional profiles appear specific to Epiclassic period crescent and trilobed shaped artifacts. Fifteen of the twenty-seven crescents display triangular cross-sections. This means that the blade edge of the prismatic blades were fully incorporated into each eccentric. Despite this there was no evidence for use-wear on these cutting edges. Within this collection, the exterior surfaces of the crescents were also primarily unifacially pressure flake. The interior surfaces of seventeen crescents also displayed the use-wear identified in the Classic period eccentrics. Another ten crescents exhibited only unifacial flaking scars. This may indicate their different function or perhaps they were simply unused artifacts.

Awls

Twenty-three awls were found in Epiclassic period deposits. Fifteen were made of Otumba, four of Sierra de Las Navajas obsidian and four of Ucareo obsidian. Three awls were made of proximal blade fragments, and 17 were flaked from medial blade fragments. The average width of these thin modified blades was 14.1 mm, and their average length measured 18.82 mm.

Perforator/punch

Four Ucareo blades were modified into perforator/punch forms. All were derived from medial blade sections. Their average width measured 13.5mm and their average length measured 37.8. None of these artifacts was complete.

Amantla Blade

Forty "Amantla" blades were of Ucareo obsidian and three others were made from Sierra de Las Navajas obsidian. Only eight of these blades were complete. Twenty-four Amantla blades were made of medial blade sections and four were distal fragments. Three were proximal fragments. Their average length was 23.7 mm and average width was 15.03 mm.

Macroblades

Seventy-one artifacts were made of large percussion based macroblades. Sixty were Ucareo obsidian and seven were Sierra de Las Navajas obsidian. Three Zacualtipan macroblades also appear in Epiclassic deposits. One other macroblade was from Otumba obsidian.

Prismatic Blade Cores

Four blade cores were present in the collection: two, from Ucareo and one each from Zacualtipan and Paredon sources. Only two of these blade cores retained their proximal sections. These exhausted cores averaged a thickness of 14.8 mm. Two core segments were spall fragments, perhaps a result of a failed attempt at bipolar lithic reduction.

OBSIDIAN CONSUMPTION

Classic Period: Domestic and Public Contexts

Domestic contexts at the Santa Cruz Atizapan site included numerous domestic household units and outside work areas. Many were defined by the presence of hearths or other features. Although many features were directly superimposed every attempt was made to isolate them during the analysis. As is the story with much of the obsidian, the materials were consistently used and distributed across the site. Nevertheless, we explored the various domestic and public deposits to search for patterns of use on the landscape.

Public contexts were much easier to define as these were often demarcated by substantial architecture (Figure 33) and their associated work spaces. A series of superimposed public structures were situated in the central portion of Platform Mound 20 for the entire history of the site's occupation. The lowest and oldest structure was a characteristically Teotihuacan construction (Figure 34). Above this structure were constructed six subsequent newer structures that, during the Epiclassic period, transitioned to circular forms (e.g. Figure 35). The size and work investment required to build such structures suggests that they served a communal or public purpose.

Figure 33: Northern half of excavated Classic period Teotihuacan influenced Public structure (Structure 7) at Mound 20, Santa Cruz Atizapan. (photo used by permission of Proyecto Arqueologico Santa Cruz Atizapan)

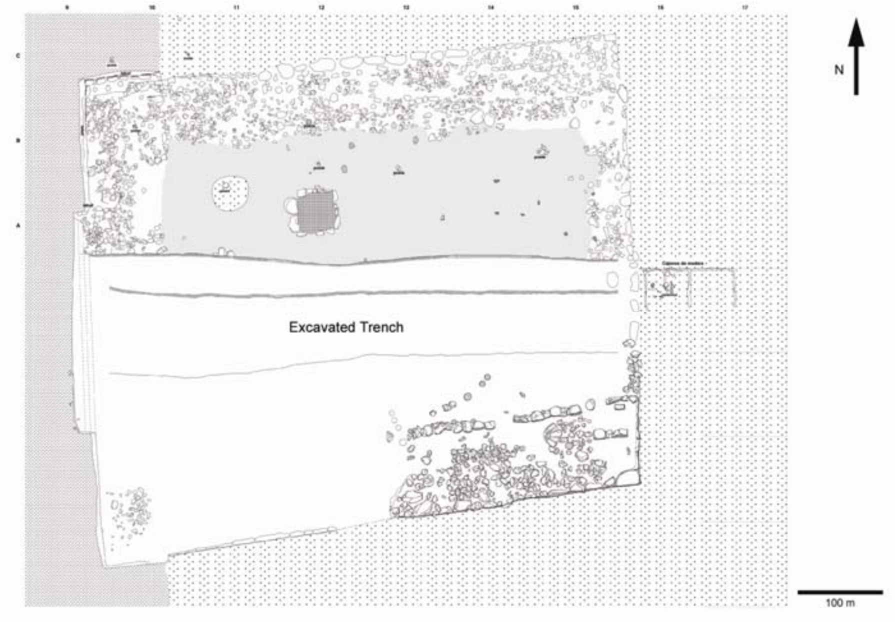


Figure 34: Plan map of completely excavated Teotihuacan influenced Public structure (Structure 7) illustrated in Figure 33. (Map used by permission of Proyecto Arqueologico Santa Cruz Atizapan)

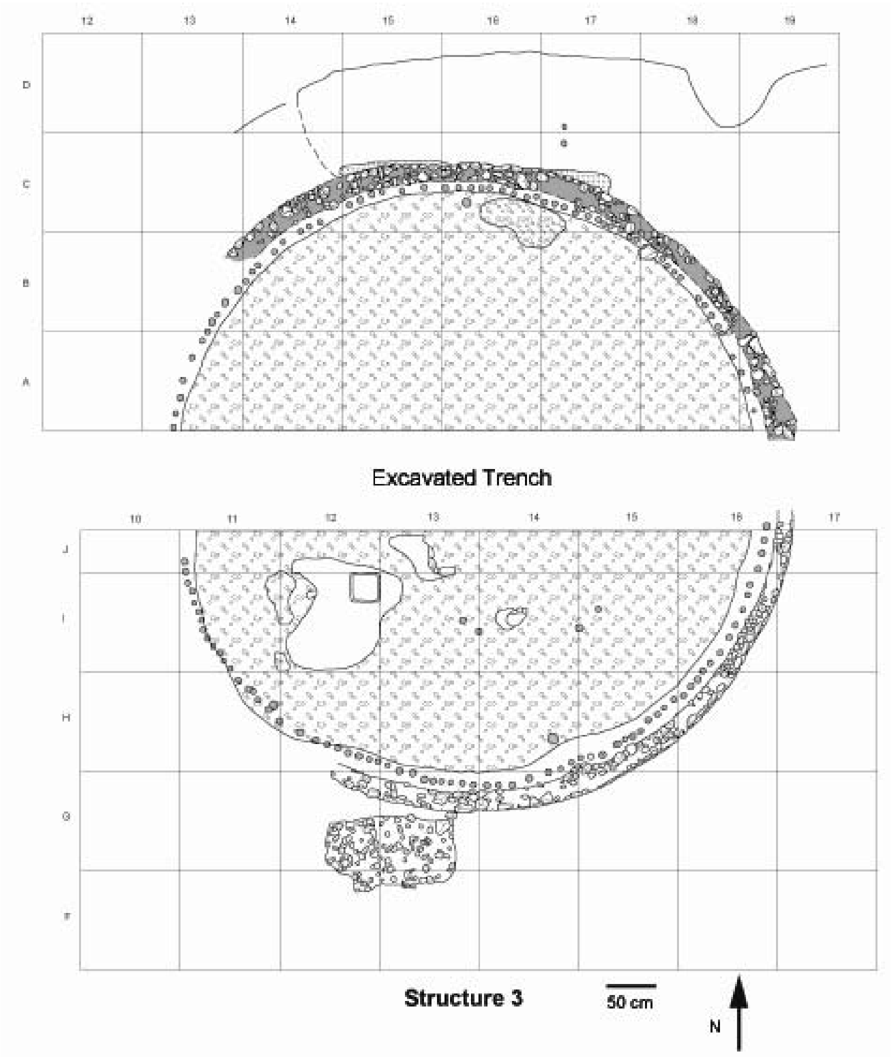


Figure 35: Epiclassic period Public structure excavated at Mound 20, Santa Cruz Atizapan. This structure was constructed atop the Classic period Structure 7. (Map used by permission of Proyecto Arqueologico Santa Cruz Atizapan)

Technology

To assess the distribution of technology over the site, we mapped the distribution of artifact type categories with the assumption that they represented potential activities that may have occurred in those areas. We understand the potential for misinterpreting this data, but because it was an exploratory approach we were only interested in searching for unique patterns or clusters of artifacts.

Domestic Areas:

The full range of artifact categories are found in domestic contexts. These objects were often broken and discarded, and not found in situ. One thousand seven hundred and fifty-four artifacts were recovered from sound domestic contexts. Seventy percent (N=1226) are blade fragments. Macroblades, hafted bifaces, and debitage are the next most common artifact categories. Interestingly, nine other artifacts are eccentrics of various crescent and trilobe shapes. This is significant when compared against their near absence in public contexts. This does not provide definitive evidence for their use but certainly establishes their presence in non-ritual contexts.

Public Areas:

Although a similar variety of tools is found in public contexts they occur here with much less frequency. The most interesting pattern to develop is the surprising number of debitage artifacts from these contexts. The remaining distributions are similar to domestics areas.

Tool Use

Domestic Area

To measure the degree of tool-use within domestic contexts we calculated the percentage of an artifacts visible use surface that was modified through use. Again the contexts were so extensive and the patterning so regular that I resorted to summarizing their use by these larger depositional categories. Of the 532 objects recovered from Classic period domestic contexts, 248 were used on more than 66 percent of the visible surface. Forty-seven objects were shaped on 33 to 65 percent of their surfaces. The remaining used artifacts were shaped on less than a third of their visible surface. I concede here that accidental wear patterns may have skewed the results to suggest that more use was occurring than it was in reality. We took great care to assign the presence of wear only when it could be adequately substantiated.

Public Areas:

More than eighty percent (N=41) of the artifacts from Public spaces exhibited heavy wear on their surfaces. Many of these were recovered from the Teotihuacan structure or its related features.

Epiclassic Period: Domestic and Public Contexts

Technology

Domestic Area

The tools in use during the Epiclassic period do not vary in form. Percentages of artifacts remains consistent over time but the number of objects has increased due to the larger Epiclassic areas that were excavated during the final season.

Public Area

Only 193 artifacts were recovered from public use spaces. These again do not vary over time. It is notable that only two eccentrics were recovered from public contexts.

Tool Use

Domestic Area

Three hundred and fifteen of the 615 total artifacts exhibited use traces on more than 67 percent of their surface. The majority of these were recovered from activity areas north and west of the central part of the platform mound.

Public Areas:

Most objects (42 of 52) recovered from public contexts were well used. This supports our belief that available obsidian might have still been considered a rare enough resource to cause them to use every artifacts to its fullest.

Chapter 7: Comparative Sites: Teotihuacan, Tula, Xochicalco

TEOTIHUACAN

Obsidian Technology, Obsidian Use and Exchange Models

Obsidian tool artifacts at Teotihuacan include core-blade and bifacial-unifacial technologies (Spence 1981). Recent analysis of obsidian workshop debris has shown that both Ucareo and Sierra de Las Navajas (SN) obsidians were occasionally worked at the same workshops. SN obsidian was imported to the city as prepared macro-cores that were initially given their rough shapes at the procurement quarries

SN bifaces and unifacial implements represent thirty percent of the total bifaces, while grey Otumba obsidian was used for the remaining seventy percent of bifaces. Otumba obsidian prismatic blades are scarce in these workshops. Macro-cores are rare and blades represent less than ten percent of pressure-based artifacts. It appears that Otumba obsidian was processed at the quarry and imported as large flake blanks.

Eccentric forms occur regularly in special deposits at Teotihuacan (Figure 36). Charleton et al. (1978) also note that even exhausted cores were routinely used in lapidary workshops and burnished and perforated to produce beads. Ritual blood letters in the form of awls and drills, also found at Santa Cruz Atizapan, also occur. As the center of Central Mexico during the Classic period, most anything could be had in the city.

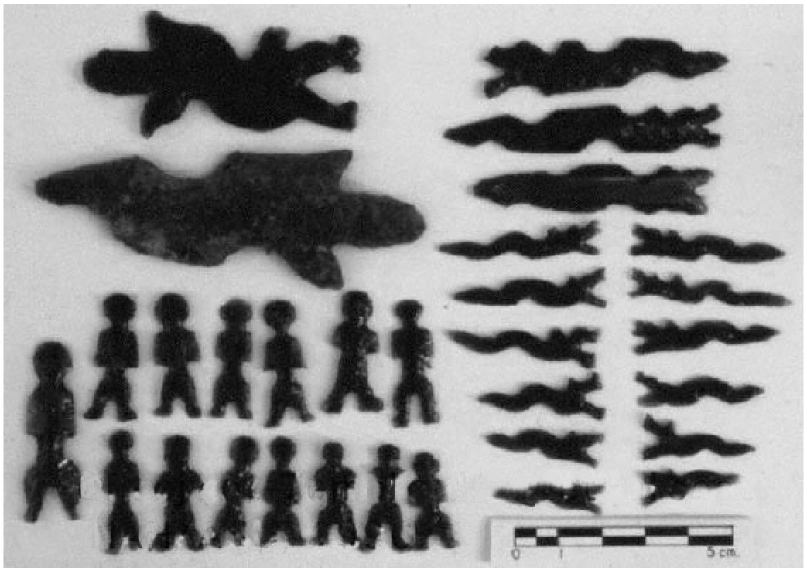


Figure 36: Obsidian eccentrics from the Temple of Quetzacoatl, Teotihuacan.
Http://archaeology.asu.edu/teo/fsp/Offer/ofobfigr.htm

Rattray (1987) excavated the Epiclassic period workshops of La Hacienda Metepec and found that they specialized in the production of a standard type of point called San Marcos. Similar forms are evident in the Santa Cruz Atizapan collection, made from Otumba obsidian as well as Zacualtipan and Ucareo obsidian (Figure 21, upper right; Figure 32, second row, far right)

Clark (2003) states that while obsidian was heavily traded from Teotihuacan, there is no hard evidence that it was state controlled. Santley (1989b), Spence (1996) and others argue the contrary and the author is inclined to side with them. If we take another comparative look at Otumba bifaces and compare them to those of Ucareo we see a clear distinction in manufacturing standardization and expertise. I believe Otumba bifaces and Sierra de Las Navajas prismatic blades were so standardized because the industry was controlled by the state. If it wasn't I would expect to see the same variations that are evident in the Ucareo artifacts.

That Sierra de Las Navajas obsidian circulated far and wide is undisputed. But the mechanisms by which it did so are being debated. Santley (1989b) and Drennan (1984) have presented economic models, while Spence (1996) views a different relationship when one reaches areas further away from Teotihuacan. These are both likely correct to a large extent. Although I do not see Teotihuacan as an economic monopoly regarding regions to its west, I do believe that it marketed its product to support itself economically and politically. How it did so is debatable, but Santley (1989a) sees Teotihuacan in charge of an interregional network of relatively autonomous regional subsystems.

TULA

Obsidian Technology, Obsidian Use and Exchange Models

During the Epiclassic period Tula rose to power and replaced the void left by Teotihuacan centuries earlier. Although it was occupied during the Classic period Tula did not control vast resources and have great wealth until the fall of Teotihuacan (Healan 2002). As the city grew it came to rely on the Ucareo obsidian zone for most of its obsidian. This would change during a late stage of the Postclassic period, but for several hundred years it imported the same gray black obsidian that was common at the site of Santa Cruz Atizapan.

Healan (2002; Healan et al. 1983) has excavated workshops at Tula and describes a local production industry that imported macrocores in highly refined states. This means that much of the preliminary shaping occurred at the source zone. Forty-six percent of Tula workshop blades proved to be 1s (first series) and 2s (second series) blades. Similar to the blade cores found at Xochicalco, those at Tula were ground on their platforms in order to improve the pressure flaking surfaces. Early occupation blades were not ground, and are more similar to the Santa Cruz Atizapan cores and prismatic blades.

XOCHICALCO

Obsidian Technology, Obsidian Use and Exchange Models

Xochicalco plays an interesting role in the movement of obsidian from the Ucareo source during the Epiclassic period. Not only because it imported great quantities of Ucareo obsidian, but because it did not participate in the Classic period Teotihuacan sphere or the Coyotlatelco ceramic sphere that succeeded it, as did the people of the Toluca Valley. Xochicalco acquired tremendous quantities of Ucareo obsidian and may have somewhat controlled its trade, even at its great distance. Percentages of Ucareo and Sierra de Las Navajas obsidians are somewhat similar to those found at Santa Cruz Atizapan. Hirth (1998) mentions that Navajas green obsidian represents anywhere from 1-10% of the obsidian at the site while Ucareo represents 64.7%.

An interesting modification in the use of obsidian allows us to explore the relationship between Xochicalco and Santa Cruz Atizapan. The blade cores and prismatic blades at Santa Cruz Atizapan generally exhibit flat platforms. However, at Xochicalco cores arrived with flat platforms but were then immediately ground (Hirth 2002), as they were at Tula. Because of the reductive nature of lithic technology we can safely surmise that these objects were not traded into the Toluca Valley by Xochicalco. The relationship must have been different and likely directed the other way.

Chapter 8: The Toluca Valley in Central Highland Mexico: Late Classic and Epiclassic Subsistence Economies, Exchange Networks and Regional Political Economies

Classic period life in the Central Highlands region of the Toluca Valley was likely a stark contrast to the urban setting of Teotihuacan in the neighboring Valley of Mexico. In many ways, the events of the Toluca Valley probably were peripheral to those occurring within Teotihuacan's core region. However, the link between the two regions is not always clear. Despite earlier claims that the Toluca Valley was central to Teotihuacan's symbiotic region, the present obsidian data appears to argue that, at a minimum, this relationship did not include the import of obsidian to the Toluca Valley. This would seem to defy the logic of being included in such a symbiotic region. One would expect that if vital subsistence resources were traded from the outlier area to the core then surely, the core's most visible export would be returned in exchange. On a purely economic level, Teotihuacan leaders must have preferred that their own obsidian circulate within the Toluca Valley. Yet, it did not, so we must then begin to wonder what exactly framed this relationship between superpower center and outlying region. Was this in fact, a traditional core-periphery relationship or did Toluca Valley residents attain some semblance of autonomy, guarded and isolated by the Sierra de Las Cruces mountain range that separates the two regions?

One way to evaluate this relationship is to look beyond it and explore the "what ifs" of not having the presumed center-periphery relationship. At the Santa Cruz Atizapan locus we have the ideal setting to do just that. In this thesis I assessed both, local subsistence consumption patterns and investigated the relationship between the two zones by studying changes in the presence and use of obsidian artifacts during and following the height of Teotihuacan's regional influence. The following scenario of daily life in the Toluca Valley synthesizes these results and suggests what life in the Toluca Valley may have been like during the Classic period and Epiclassic period.

At AD 600, the Valley of Mexico is politically on edge. The city of Teotihuacan has become something of a paradox. As the city reaches unsurpassed size, power, and wide-ranging influence, it has also begun to show the weakness of its explosive population growth, and its over-extended trade networks. It has begun to spread itself too thin, relying on third parties to secure Teotihuacan's role as Mesoamerica's leading city. Within the city things have taken a turn for the worse. The large population of Teotihuacan is unsettled and unhappy about recent events. Perhaps there is not enough food to support the estimated 100,000 citizens of the city? Perhaps there is a sense of overcrowding as there is not enough room to support the increasing immigration to the city? There are probably multiple reasons.

One certain cause of stress is the city's constant search for, and importation of, basic subsistence resources from regions that are further and further away. This does not come without a high economic burden. With such a large urbanized center, the few farmers who have not given into the lure of city life still tend the limited agricultural lands in the Teotihuacan Valley, but they can only support the urbanized citizenry for so long. The need to import substantial quantities of subsistence items needed for daily activities has thus left the city vulnerable. Without the food to support its people, it would be powerless. Without the import of ritual items such as greenstone from regions south of the valley, religious and ritual practices might also be threatened and the religious authority of the city's spiritual leaders placed in question.

Rising powers to the south, west, and east in Oaxaca, Morelos, and Puebla have sensed this weakness in Teotihuacan's network of control and are prepared to take advantage of it. By effectively cutting off the trade routes that run through their controlled territories vital resources could be prevented from being imported to the Basin of Mexico or exported out of the city. These disruptions could curtail the supply of exotic feathers or conch shells, but it could also mean a disruption in food supplies. Teotihuacan is not well protected from these potential threats. But could we blame them? For several hundred years the city faced no real threat.

In part to assert its authority, and partly as a last resort, Teotihuacan leaders turned to public displays of power, commissioning murals and monuments that depict warfare and the might of the once great city. In hindsight we see the irony of the city's collapse in its futile displays of power. But perhaps these signs were also clear to the Teotihuacan populace that started emigrating from the city. Perhaps in waves, or as families or individuals, beginning around AD 600, people moved from the great city. It might have been due to a general decline in the quality of life over several decades, but certainly the exodus must have gained strength or reached its culmination when new groups of people entered the Valley of Mexico from the north (Yoko Sugiura, personal communication 2006). These new people introducing new pottery styles and ideologies, and then ceremoniously burned and destroyed the monuments of power, temples and elite residences, that once lined the two mile long central Avenue of the Dead in the heart of the city. Who exactly came, who left, and what they took with them are all questions that still perplex archaeologists today. The transformations that would forever change Mesoamerican history are poorly understood. We see the evidence, e.g. the introduction of Coyotlatelco red on buff pottery (Rattray 1966), yet we can't find a suitable cause. Better yet, there are far too many causes being proposed for this one great effect: the collapse of the Teotihuacan state.

But we return to the more tranquil setting of the Toluca Valley where, circa AD 550, newly arrived immigrants have begun settling near the large shallow lakes in the valley's eastern region. No one is sure why they elected to settle there, because they first had to construct large platforms on which to erect their household and community structures. Much time and energy is invested in these platform mounds and the structures they build on top of them. They haul in large logs, basalt rocks and colored sands from the mountain regions to prepare these mounds in specifics way. Great care is taken to support the earth brought up from the lake beds to form the platform mounds. Large posts support an extensive lattice work of brush that serves as the foundation of the lake mud islands they create. Their floors are prepared using very specific layers of sand, mud, and vesicular basalt gravel that provide support and allow for drainage. They have brought with them the pottery of the Teotihuacan city, and also construct their dwellings in similar styles.

The sparse populace living in the valley prior to the arrival of the lake people was using the same aquatic resources. But they did not choose to live on the water and now, out of choice or necessity, they may have had to obtain these resources through negotiation with the recently arrived lake dwellers. The increasing immigration of the lake dwellers allowed them to; eventually, far outnumber the earlier inhabitants of the valley. They subsisted on the local aquatic flora and fauna found on the lakes they now fully controlled, as well as woodland fauna and a diverse range of migratory waterfowl. Dogs were also a common presence at these sites as were the full range of animals, insects and fish that lived in the lakes.

These activities, occurring a mountain range away from the happenings of the Valley of Mexico, require only one thing: stone tools to perform the tasks associated with living on the lake. Local stone materials were scarce in the natural environment and the available schist and basalt tools did not cut, pierce or scrape as well as the obsidian tools they had always used. The local Toluca Valley population was confronted with two options for acquiring much needed stone tools. They could import the obsidian through Teotihuacan, as much of the Central Highlands region was doing, they could trade for obsidian from the northern part of the valley, or they could participate in a smaller scale distribution network that had developed or was in the process of being developed partly within the Toluca Valley itself. This obsidian did not come from the Sierra de Las Navajas mines nor the Otumba mines controlled by Teotihuacan. It was a very different colored black and gray obsidian from mines in the state of Michoacan. Was there a cost differential? A degree of autonomy that was expressed by opting out of the Teotihuacan network? These are difficult questions to answer. Yet, the new valley immigrants decide to at least try out this new obsidian. After all, they really only needed basic tools to cut, scrape and pierce. Maybe this new material was more accessible and reliable, as well as cheaper? Teotihuacan blades were traded in bulk but even those costs may have been higher than purchasing or trading for this new obsidian. Still, more importantly, acquiring obsidian through this regional network allowed them to establish new links to these closer groups living in the Toluca Valley. If the lake dwellers controlled the aquatic resources and these older residents of the valley were already participating in the gray-black obsidian trade, then it would seem natural that one might exchange the two essential materials on an as-needed basis.

If the lake dwellers sensed that Teotihuacan was already beginnings its decline, as evidenced by the increasing numbers of people migrating to the Toluca Valley, they could also elect to use the new obsidian without threat of repercussion from Teotihuacan. And who would want Teotihuacan obsidian when it was associated with a city on the way down? This was likely of no concern to the new Toluca Valley immigrants because, having been citizens of the city in the past, their association with the famed "green" obsidian of Teotihuacan had never been what it was in the distant Maya regions where it was ascribed some symbolic significance. Green obsidian was always green obsidian and they did not suddenly infuse that material with great importance simply because they decided to move over the mountains, as did the Maya to the south (Moholy-Nagy 1989). The links they kept with the old city of Teotihuacan and their past history was held in the religious iconography, the pottery, the figurines and the more substantive architecture they brought from the city. They produced many Teotihuacan ceramic style vessels, which further suggests that there was a symbolic meaning attached to them. They would use chert to cut, pierce and scrape, if they could find it readily available and if it was effective for the tasks at hand. We know that this populace did not import fancy jewelry or mirrors made of obsidian that might have held some significance, yet they likely did trade and import a full range of commodities such as food, clothing, baskets and other perishables.

The Toluca obsidian circulating in the valley was new only to the lake dwellers. At various times in history it had been heavily exploited by other groups and traded far distances. It is thus not surprising to find that it was circulating within the Toluca Valley prior to Teotihuacan's resurgence in the region. The gray-black obsidian tools (now known to be from the Ucareo source) were most readily available as prismatic blades and blade fragments that were modified locally into awls, perforators, and eccentrics. Out of necessity only the awls were consistently well-shaped. Some eccentrics were crescent shaped while other were trilobed or anthropomorphic. Some were extremely well shaped and others minimally shaped blades. Bifaces are also traded but they represent a secondary technology in the valley. These bifaces vary widely in their overall forms, hafting and base stem shapes. This would seem to indicate a certain level of individuality in their manufacture; something we would not expect to see in a state controlled obsidian production system such as the one at Teotihuacan. In fact, the Teotihuacan blades and bifaces recovered from the Santa Cruz Atizapan platform mound appear much more standardized than the Ucareo tools. On a local level, during the Classic period these Ucareo tools were found to be perfectly suitable for the lake dwelling population.

Perhaps this Ucareo obsidian network is the result of local cottage industries that produced and bartered obsidian tools via numerous small interlinked networks. What site or population, if any, controlled this source is now unknown. Ucareo prismatic blades traded into the valley are also much less consistently shaped than the prismatic blades made of Sierra de Las Navajas obsidian and Otumba obsidian. This, combined with the trade of large flakes, flake tools and macroblades, outlines a distribution network that supplied the Toluca Valley residents with just about any tool they might need. So the question should not be phrased to ask why Teotihuacan obsidian networks stalled at the entrance to the Toluca Valley; rather, we should understand all of the reasons why Ucareo obsidian was the only real practical Toluca residents, however closely tied to Teotihuacan. On a subsistence level and economic level, which are the only two factors influencing obsidian procurement and consumption at the Santa Cruz Atizapan site, the use of Ucareo obsidian made sense.

I can now rephrase an earlier question and ask why and how Teotihuacan obsidian regularly showed up in the Santa Cruz Atizapan collection at all? Did a modified Teotihuacan supply network simply import less obsidian quantities to the valley, alongside the pottery and figurines that were acquired from the city? Or was it a result of different interlinked regional obsidian networks that circulated numerous types of obsidian to various regions at the same time. I believe it was a bit of both during the Classic period.

By AD 650, the final decline of Teotihuacan was now fully underway. The ideological and political systems within the city core, had shifted dramatically, although their final forms are not well understood. A population once possibly reaching 100,000 people was now reduced to less than 30,000. Still a large city during the Epiclassic period, it paled in comparison to its former self. In some parts of the city, the new Coyotlatelco using populations lived on the rubble of the previous occupants and appear to have invested little in restructuring the city. The obsidian industry continues but without the intensive exploitation of the Sierra de Las Navajas green obsidian. It fades in importance throughout Central Mexico. Any question regarding the role of Teotihuacan obsidian networks was irrelevant during the Epiclassic period. A new dominant source has taken its place: Ucareo gray-black obsidian.

The fall of Teotihuacan had repercussions in the Toluca Valley. The most apparent regional shift is toward the use of Coyotlatelco pottery, symbolism and architecture. Not surprisingly, historical, filial, and other links are still maintained with residents of the Valley of Mexico, who introduced Coyotlatelco attributes into the region. So as the Valley of Mexico transitioned to a new ideology and material culture introduced from the north, the eastern part of the Toluca Valley followed suit. Our lake dwellers were now fully immersed in what some have identified as Coyotlatelco culture.

If we return to the descendants of the lake dwelling residents whose ancestors migrated from Teotihuacan more than a century earlier, we see that they have continued their previous lacustrine based lifestyle, for the most part. They continue to import Ucareo obsidian in nearly the same quantities and forms, and use them to perform the same tasks as in previous years. Seemingly, not much has changed in the last hundred years. Yet things have changed significantly, in several ways.

The last years of Teotihuacan saw a mass exodus to the southern parts of the Valley of Mexico and to outlying regions like the Toluca Valley. Dozens of new sites sprung up in the Toluca Valley in a wide range of locales. At one point, the valley was so congested that new immigrants were relegated to life in the harsh northern regions that lacked abundant natural resources. More importantly, several regional polities arose to take control of access routes into the valley. One such site, Teotenango, grew to monumental proportions during the Epiclassic period. We have a tremendous amount to still learn about this city. While it was excavated over several field seasons more than thirty years ago, the excavation data has never been fully published and sits in the archives of the Teotenango project.

More locally, the pyramid site of La Campana-Tepozoco is established alongside the increasing number of platform mounds that have been constructed adjacent to the Santa Cruz Atizapan locus. These platform mounds, now numbering over one hundred, border the pyramid site and form a large regional complex that likely controlled access to the southern entry point into the valley. We would expect such a drastic political shift to impact every facet of life in the Toluca Valley, but surprisingly it caused no change in the local obsidian industry at Santa Cruz Atizapan.

While politics, ideologies, and architecture changed in the valley, the daily tasks that still needed to be performed did not. The obsidian tool-kit for this region appears to have been exclusively determined by the subsistence needs of its population. Neither new artifacts forms nor fancy eccentrics or polished obsidian artifacts were introduced into the site despite its link to the large regional La Campana-Tepozoco center. In fact, the shapes and use patterns evident on the artifacts are very similar to the Classic period artifacts. While the unexcavated La Campana-Tepozoco site may reveal the presence of other obsidian tool forms or even local obsidian production zones, it appears unlikely that these would exist without some hint at their existence in the platform mounds loci which presumably now served the La Campana capital.

The sudden increase in Ucareo obsidian at most sites in Central Mexico during the Epiclassic period underscores the growth of the distribution network that was already in place during the Classic period. If we take a look south to Xochicalco, another major regional center that arose during the Epiclassic, we see that they too are heavily importing Ucareo obsidian. This is significant for the following reason: it establishes the potential for a Ucareo distribution network running north to south from the source area in the present day state of Michoacan, through the open north and south access routes into the Toluca Valley, and ending at Xochicalco or regions further south. This is the most direct route from the source to the Xochicalco center. If we maintain that the La Campana-Tepozoco site controlled the southern exit to the valley we begin to understand the connection between the Santa Cruz Atizapan obsidian and those recovered from Xochicalco. The diversity of tools and the identification of several workshops at that site suggests that raw materials may have even passed through the Toluca Valley and then been returned as finished tools. A comparison of Xochicalco ground platforms and the Santa Cruz Atizapan unground platforms suggest that this was very unlikely. Xochicalco artisans imported cores with flat platforms and then ground them against stone prior to removing flakes. Most blades at Santa Cruz Atizapan exhibit flat platforms, as do the few prismatic cores recovered. Interpreting the relationship of Xochicalco and the large regional sites in the southern Toluca Valley is a first order task for future obsidian analysts in the region.

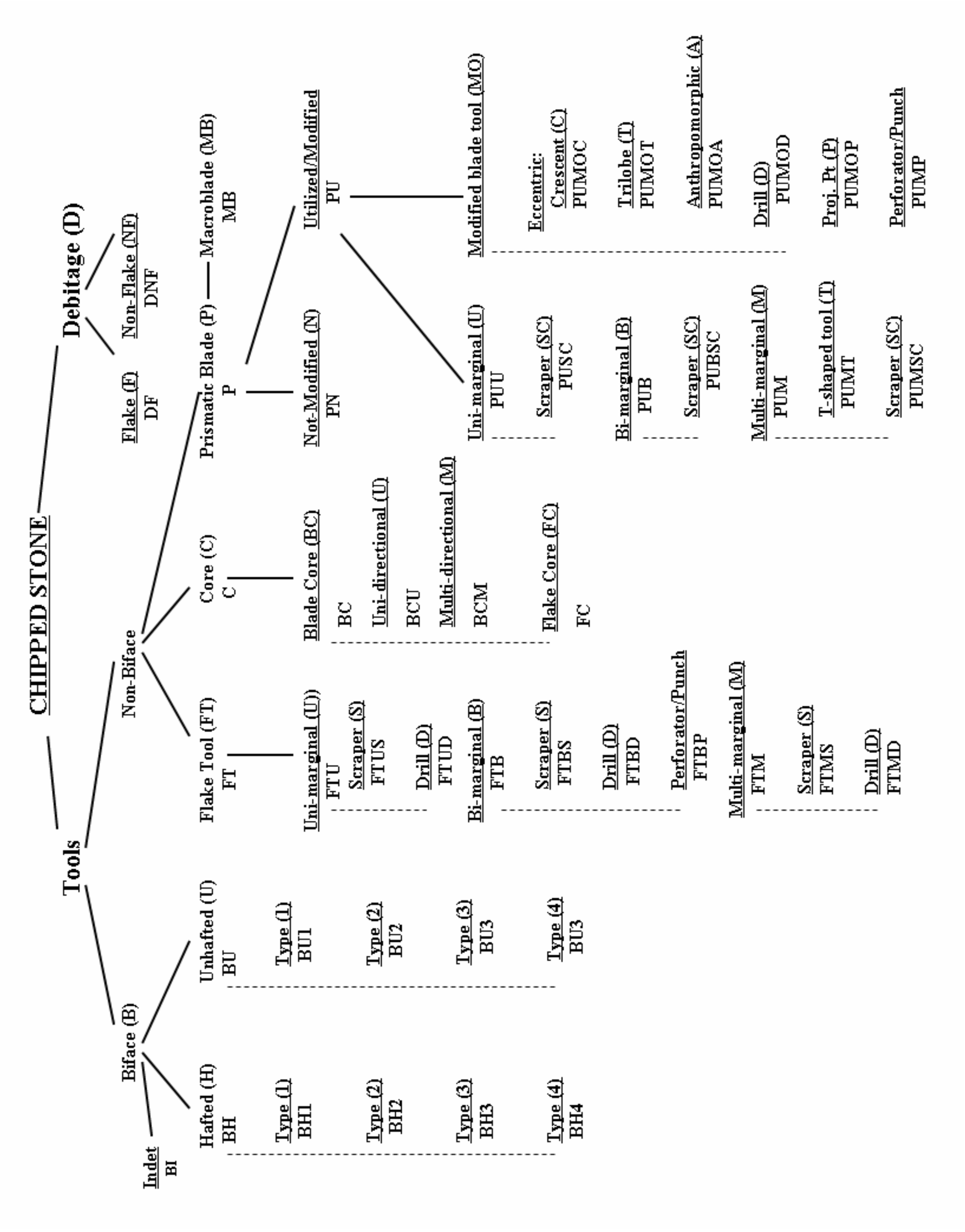
So we end our journey with our lake dwelling settlers, several hundred years later. Generations have passed and the large urban centers continue to grow. The platform mounds are continually remodeled, flooded, repaired and eventually abandoned for other nearby platform mounds. At some time around AD 900 the lakes begin to rise and continually flood the platform mounds until a decision is made to abandon this settlement area entirely. Where this population went or how many of them may have been stricken by one disaster or another is not completely known. We do know that the region was abandoned for quite some time after this and only saw a gradual increase in population during the Aztec Empire period.

CONCLUSIONS

This dissertation had its origins in the archaeology of the 15th century Aztec period. I began my research into Mesoamerica's past through a summer of washing, labeling and analyzing obsidian prismatic blade fragments from Aztec period households excavated in the eastern Toluca Valley. At that time I did not know that it would lead me to this wider study of Classic and Epiclassic period obsidian ten years later. But now I see those blades in a different light and with renewed appreciation for their simple yet phenomenal technological sophistication. I have since studied those blades again, and it was a completely different experience.

Despite the growth of knowledge that has come with a dissertation project of this size, there remains much more work to do regarding Toluca Valley obsidian research. This project attempted several approaches to the study of obsidian and some, as described in the text, were not as successful as others. The use-wear study was an acknowledged setback and it will take a serious investment of time and energy to rectify this situation. Familiarity with local materials is first and foremost, and the materials must be archived using methodologies that will preserve signs of wear yet not overwrite them. The potential for the discovery of regional obsidian sources that were in use in the past is the most exciting prospect. I have no doubt that such materials circulated within the Toluca Valley on some scale. The analysis of the regional site survey materials already collected in the 1970's could potentially identify the use of local obsidians. These same collections are left to be analyzed to better define the model for regional obsidian distribution proposed in this study. If this study has contributed anything to the understanding of the Mesoamerican past, I hope that it is an increased awareness of the decision making capabilities of outlier, fringe, or peripheral peoples. We often assume that these labels mean more than simply geographical distance from something else. As was the case for the population of Santa Cruz Atizapan being further away from the seat of power can have some absolute advantages. They not only survived the collapse of one of the New World's first great cities, but found alternate natural resources, thrived and waited for the "center" to come to it. In the Epiclassic period they were part of the "center" albeit a much smaller one.

Appendix A


CHIPPED STONE
Tools
Debitage (D)
Flake (F)
DF
Non-Flake (NF)
DNF
Biface (B)
Indet
BI
Hafted (H)
BH
Type (1)
BH1
Type (2)
BH2
Type (3)
BH3
Type (4)
BH4
Unhafted (U)
BU
Type (1)
BU1
Type (2)
BU2
Type (3)
BU3
Type (4)
BU3
Non-Biface
Flake Tool (FT)
FT
Uni-marginal (U))
FTU
Scraper (S)
FTUS
Drill (D)
FTUD
Bi-marginal (B)
FTB
Scraper (S)
FTBS
Drill (D)
FTBD
Perforator/Punch
FTBP
Multi-marginal (M)
FTM
Scraper (S)
FTMS
Drill (D)
FTMD
Core (C)
C
Blade Core (BC)
BC
Uni-directional (U)
BCU
Multi-directional (M)
BCM
Flake Core (FC)
FC
Prismatic Blade (P)
P
Macroblade (MB)
MB
Not-Modified (N)
PN
Utilized/Modified
PU
Uni-marginal (U)
PUU
Scraper (SC)
PUSC
Bi-marginal (B)
PUB
Scraper (SC)
PUBSC
Multi-marginal (M)
PUM
T-shaped tool (T)
PUMT
Scraper (SC)
PUMSC
Modified blade tool (MO)
Eccentric:
Crescent (C)
PUMOC
Trilobe (T)
PUMOT
Anthropomorphic (A)
PUMOA
Drill (D)
PUMOD
Proj. Pt (P)
PUMOP
Perforator/Punch
PUMP

Appendix B

Santa Cruz Atizapan Obsidian Analysis Variables **

modified 4-2002

**These variables are primarily for the analysis of prismatic blade tools. It also serves as a general inventory of all objects. Other tools are analyzed in detail using tool specific variables—see respective variable description sheets.

For **Other tools** only investigate variables 1) - 8)
Bold = designates code used in database spreadsheet

1) SITE NUMBER **(SITE)**:
Santa Cruz Atizapan T1 (1997 field season), Santa Cruz Atizapan T2 (2000 field season), Santa Cruz Atizapan T3 (2001 field season).

2) CATALOG/BAG NUMBER **(BAGNO)**:

3) PHOTO **(PHOTO): Y/N**

4) OBSIDIAN TYPE **(OBSIDTYPE):**

Green:

1--**Green translucent**

2--**Yellowish Green translucent**

Combined with 1

Gray:

5--**Gray transl. –opaque- glassy or resinous**

13-**Dark Gray opaque, resin. w/some banding**

21--Chatoyant, banded, Green-gray

27-Opaque med-light gray, resinous surf. (NOT 13).

No Image/ Not used

22—Smokey Iridescent Green-gray

9--Light Cloudy Gray vitreous, translucent

Combined with 5

25—Greenish version of 14 (similar to 21)

No image/ Not used

15--Gray banded translucent

Combined with 16

Gray/black:

3--Gray/Black veined, transl. to transp., w/some clouding (similar to 7)

17—Light Gray w/greenish tint

4--**Gray/Black banded resinous opaque**

12--**Gray/Black banded, translucent, w/impurities or bubbles**

14--**Gray/Black cloudy/banded, opaque, chatoyant, glassy**

26--**Chatoyant gray with occasional thin black banding**

Rare

Brown:

8-- **Light Smokey brown-cloudy, banded w/dark inclusions, translucent**.

10--**Brownish black**

18—**Clear, transparent brown/gray some inclusions**

16- Gray/Black/green banded translucent

19--Gray/black cloudy, slight banding as in 14 (but less intensive)

20—Iridescent brown

Black:

6--Black opaque

7--Black veined banded semi-translucent

Other:

11--Other, describe

5) MORPHOLOGICAL TYPE **(MORPHTYPE): SEE Appendix B**

6) TOOL NUMBER **(TOOLNUMB):** (add only to Tool objects and keep separate):

7) SIZE CLASS **(SIZECLASS):** Measure on metric grid.

8) COMPLETENESS (**CMPLPRCNT**):
Estimated completeness of artifact:
1) <25 percent
2) 25<50 percent
3) 50<75 percent
4) 75< but not complete
5) Complete
6) Indeterminate

THE REMAINING VARIABLES ARE FOR PRISMATIC BLADES ONLY

(+) = *ANALYZE FOR FLAKE TOOLS*

-

+ 9) BLADE SECTION PRESENT (**BLDPART**):
   1) Complete
   2) Proximal
   3) Medial
   4) Distal

10) WIDTH COMPLETENESS (**WDTHCMP**L): width of initial blade, not edges extensively modified.
   1) Complete
   2) Not complete

+11) MAX. LENGTH (**LNGTH**) mm:
Note: All measurements are taken to 2 decimal points.

+12) MAX. WIDTH (**WIDTH**) mm:
Note: All measurements are taken to 2 decimal points.
+13) MAX. THICKNESS (**THICK**) mm:
Note: All measurements are taken to 2 decimal points.

+14) WEIGHT (**WEIGHT**) gm:
Note: All measurements are taken to 2 decimal points.

15) COMMENTS (**COMMENTS**):

+16) STRIKING PLATFORM **(PLATPREP):**

1) Cortical	5) Flaked
2) Flat	6) Indeterminate
3) Complex	
4) Abraded	

17) DORSAL RIDGES PRESENT (**NMBRRIDGE**): Number of ridges visible

9= Indeterminate

18) DORSAL RIDGE CONSISTENCY (**RDGECONSIS**):

1) Parallel
2) Non-Parallel
3) Only one ridge present
4) Indeterminate

19) VENTRAL RIPPLE MARKS (**VNTRLLNES**):

1) Yes
2) No
3) Indeterminate

+20) BLADE TERMINATION **(BLDTERM):**

1) Feathered
2) Hinged
3) Stepped – include only if proximal end is present.
4) Plunging/Overshoot

21) PLAN VIEW **(PLANVIEW) (Shape of edges exhibiting wear/modification**):

1) Straight- no alteration	6) Indeterminate
2) Slight Concave-slight curvature	
3) Moderate- Heavy Concave	
4) Convex- outward rounded surfaces	
5) Multi-shaped— Concave and Convex edges.	

+22) BLADE EDGES PRESENT (**EDGPRSN**T): List number

+23) BLADE EDGES MEASURABLE (**EDGEMEAS**): List number

+24) RETOUCH/WEAR MODIFICATION **(RETCHWEAR)**: No. of modified edges

+25) MODIFICATION LOCATION (**MODIFLOCAT**):

1) Unifacial (all edges)
2) Bifacial (all edges)

3) 1 edge bifacial, others unifacial
4) Unifacial opposite faces—corkscrew pattern (poss. T-shaped tool type)
5) Bifacial on same edge but along different sections of blade edge (non-continuous).
6) Complex

+26) MODIFICATION INTENSITY (**MODFINTENS**): Percent of all present usable edges modified.

1) Light (1-33%)
2) Medium (34-66%)
3) Heavy (67-100%)

27) Edge Battering **(BTRDEDGE)** (cause of breaking on many blade frags):

1) Yes
2) No

28) Patterned wear/modification**(WEARPAT) (possible use?**):

1) Yes 2) No

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Vita

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From the fall of 1999 to the winter of 2001 Alex was employed by the National Museum of the American Indian in Washington, DC. While at the museum, he assisted with historical research for the inaugural exhibits of the museum, which opened in 2004. In the fall of 2004, he was awarded a one-year Preparing Future Faculty teaching fellowship at George Mason University in Fairfax, Virginia. In the spring of 2005, he was offered the position of Assistant Professor of Anthropology in the Department of Sociology and Anthropology at George Mason University.

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