Neighborhood Socio-spatial Organization at Calixtlahuaca Mexico

by

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ABSTRACT

This dissertation research examines neighborhood socio-spatial organization at Calixtlahuaca, a Postclassic (1100-1520 AD) urban center in highland Mesoamerica. Neighborhoods are small spatial units where residents interact at a face to face level in the process of daily activities. How were Calixtlahuaca's neighborhoods organized socio-spatially? Were they homogenous or did each neighborhood contain a mixture of different social and economic groups? Calixtlahuaca was a large Aztec-period city-state located in the frontier region between the Tarascan and Triple Alliance empires. As the capital of the Maltazinco polity, administrative, ritual, and economic activities were located here. Four languages, Matlazinca, Mazahua, Otomi, and Nahua, were spoken by the city's inhabitants. The combination of political geography and an unusual urban center provides an opportunity for examining complex neighborhood socio-spatial organization in a Mesoamerican setting. The evidence presented in this dissertation shows that Calixtlahuaca's neighborhoods were socially heterogeneous spaces were residents from multiple social groups and classes coexisted. This further suggests that the cross-cutting ties between neighborhood residents had more impact on influencing certain economic choices than close proximity in residential location. Market areas were the one way that the city was clearly divided spatially into two regions but consumer preferences within the confines of economic resources were similar in both regions. This research employs artifact collections recovered during the Calixtlahuaca Archaeological Project surface survey. The consumption practices of the residents of Calixtlahuaca are used to define membership into several social groups in order to determine the socio-spatial pattern of the city. Economic aspects of city life are examined through the identification of separate market areas that relate to neighborhood patterns. Excavation data was also examined as an alternate line of evidence for each case. The project contributes to the sparse literature on preindustrial urban neighborhoods. Research into social segregation or social clustering in modern cities is plentiful, but few studies examine the patterns of social clustering in the past. Most research in Mesoamerica focuses on the clustering of social class.

DEDICATION

In Memory of Mr. Joseph Matulevich. The toughest and most supportive teacher I ever had. He gave me an anthropology book in 8th grade because he thought I had the mind for it.

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CHAPTER 1

NEIGHBORHOOD SOCIO-SPATIAL ORGANIZATION

The neighborhood is a key social and spatial unit for understanding any city's social fabric. Neighborhoods are one of the primary social units that mediate life between the levels of the household and the polity. Researchers on modern cities have embraced the importance of neighborhoods and structure many studies around the neighborhood. Archaeologically, however, neighborhoods are under-theorized and poorly understood. How are neighborhoods organized? Neighborhoods are not interesting by virtue of their existence alone, but because of the wide variety of forms they can take. Neighborhoods throughout history have exhibited various degrees of clustering (internal homogeneity) along a number of different dimensions such as religion, class, race, place of origin, occupation, and position within the political hierarchy (Garrioch and Peel 2006; Marcuse 2002; Rapoport 1980; Sampson 2003).

Contemporary neighborhoods are influenced by a variety of ecological, cultural, and political forces (Sampson 2003). Throughout history, a variety of drivers have generated social and economic clustering in neighborhoods (York et al. 2011). Intra-neighborhood diversity contributes to vibrant, sustainable, and economically prosperous cities (Talen 2006). The ideal neighborhood is said to contain a heterogeneous mix of social and economic statuses (Congress for the New Urbanism 1996). Researchers try to understand the processes that produce clustering in modern cities. However, few archaeologists have examined assumptions about neighborhood socio-spatial organization (York et al. 2011). If archaeologists can devise methods to reconstruct the social organization of cities, including forces affecting social and economic clustering, they will be able to contribute to these discussions of urban society (Smith 2010a). I use neighborhood socio-spatial organization at Calixtlahuaca as the case study for this kind of research because, as described below, the social, political, and economic conditions of Calixtlahuaca would generate variation in social clustering if preindustrial cities are influenced by the same conditions as contemporary cities.

I discuss these conditions in Chapter 2. In particular, I test for social homogeneity by using material culture and economic similarities as proxies for social group membership. In this study, homogeneity of a social group within a neighborhood indicates the neighborhood exhibits social clustering. The presence of many forms of diversity is key to fostering productive urban neighborhoods in contemporary contexts (Congress for the New Urbanism 1996) and Calixtlahuaca was known as a diverse settlement. In this dissertation I use the term “social” to refer to society and the interaction between individuals and groups. Based on this definition institutions like social class and market systems are considered “social” because they impact the way individuals interact with groups and with each other.

The Postclassic Central Mexican city of Calixtlahuaca, occupied from 1100-1520 AD, was the regional capital of a multi-ethnic polity during a period of economic commercialization in central Mexico and most of Mesoamerica (Smith and Berdan 2003). A variety of administrative, ritual, and economic activities were carried out at Calixtlahuaca as a capital city. The city's location in the Toluca Valley, a frontier region between the Tarascan and Triple Alliance empires, provided access to multiple distribution networks. The city was conquered by the Aztec empire in AD 1478. Calixtlahuaca’s location may have provided some individuals with access to a variety of material resources. The Postclassic Period in Central Mexico was a time of population movements (Stark 2008) which may have changed the fabric of urban environments. These conditions created an environment where one would expect to see neighborhoods clustered along social or economic lines if prehistoric patterns mirror those described by Musterd (2005) and discussed in chapter two for contemporary social clustering. A potential socio-spatial pattern that I may find is a socio-spatial organizations similar to the calpulli. Ethnohistoric evidence shows that the calpulli, which will be described in more detail below, served as the neighborhood unit in both cities and towns in Late Postclassic Central Mexico (Smith 2008). Outside of the imperial capital, calpulli were socially heterogeneous in Morelos and the western provinces (Carrasco 1964; 1976; Smith 1993) and socially homogeneous in the eastern ones (Lockhart 1992: 108).

Based on variations in the density of occupation across the site surface discussed in Chapter 3, Calixtlahuaca may have had twenty neighborhoods and three large districts. The city was a multi-lingual and probably multi-ethnic capital on a political frontier between two powerful empires (Garcia Castro 1999; Tomaszewski and Smith 2011). The urban fabric of the city would have been socially and economically diverse regardless of the presence or absence of social clustering. My research asks, how were neighborhoods at Calixtlahuaca organized amidst this diversity? I examine neighborhood clustering by focusing on three facets of neighborhood socio-spatial organization: 1) The social class differences of neighborhood residents; 2) The shared taste for various decorated ceramics and vessel forms of neighborhood residents, which may signal an expression of membership in a social group or category; 3) The potential for neighbors to interact with one another while attending the same markets, as expressed in similar proportions of obsidian objects from the same geological sources. The material patterns I identify in these aspects of neighborhood socio-spatial organization signal differences in information flow and variable social networks. My Calixtlahuaca research requires a better discussion of the fundamental concepts: neighborhood and district.

Defining Neighborhoods and Districts

Mumford (1954: 257) defines neighborhoods as places where people live in close proximity to one another. An operational definition of neighborhood, which combines the sociological definitions of Glass (1948) and Suttles (1972), is the geographic area within a city where people engage in daily face to face interaction and which is distinct from other areas either physically or socially (Smith 2010a; Smith and Novic 2012). This definition has salience in archaeological research since many neighborhoods are identified by the spatial proximity of residential structures (Cowgill et al. 1984).

The neighborhood is clearly a spatial construction denoting a geographical unit in which residents share proximity and the circumstances that come with it. The neighborhood is spatial but does not inherently require the types of interconnection associated with communities. Neighborhoods may be identified by spatial proximity, but within that physical area, neighborhoods are conceived by some researchers as communities crosscut by institutions and roles. Chaskin (1997: 523) writes in his review of the theoretical underpinnings of the neighborhood concept that “the notion of neighborhood is rarely free of the connotations of connections that inhere to the term community.” The concept of community entails connections among its members: some combination of shared beliefs, circumstances, priorities, relationships, or concerns. A key observation by Amos Rapoport (1980:7) is that “it is not a question of whether neighborhoods exist or not. More frequently it is a matter of neighborhoods existing for some purposes and not of others." Network analysists, for example, have suggested that expectations for community-like solidarity in neighborhoods assume the "a priori organizing power of space and may give undue importance to spatial characteristics as causal variables (Chaskin 1997: 522-523) However, certain characteristics help bring residents together: homogeneity, community organization, and suitable physical settings and facilities (Brower 1996). The development of neighborhood boundaries is a negotiated process; it is a product of individual cognition, collective perceptions, and organized attempts to codify boundaries to serve political or instrumental aims (Chaskin 1997). Material manifestations of neighborhood boundaries are often evident in the inventory of types of structures, or they may be signaled through decoration or art. Districts are larger spatial divisions in a city that have an administrative role associated with the state or civic regime (Smith 2010a).

Whether or not social ties and interpersonal connections are an essential and defining feature of neighborhoods, many neighborhoods do facilitate these connections. It is through those process of residents negotiating these connections that neighborhoods develop and change. In the language of the social sciences, these ties and interactions build social capital, collective efficacy, and institutional resources. The routine activities by which the individual interacts with the social and physical environment are foundational to forming social ties (Sampson 2003; Lys and Soly 1993). Daily routine activities, from market purchase to ritual practice, provide a setting for neighborhood development to occur (Rapoport 1980; Sampson 2003; Sullivan 1980). Commercial exchanges, which underlie my research questions, leave markers in the archaeological record. While actual interactions cannot be reconstructed, archaeological materials show us the remains of activities that would have permitted social interaction within neighborhoods.

Purpose of the Study

The purpose of this study is to understand the different ways that urban residents organize themselves spatially in socially clustered or mixed neighborhoods. It is important to separate the concept of neighborhood from that of a social cluster. Neighborhoods are spatial units that do not necessarily imply close social relationships or similarities among residents. Social clusters involve the residential aggregation of households who share some social categorization. Neighborhoods can exhibit social clustering or not, and social clustering can occur at the sub and super-neighborhood scale. Social clustering in contemporary literature is studied primarily from the perspective of segregation. Segregation involves the social clustering of a minority group and is associated with various types of inequalities. Massey and Denton (1998: 293) define this type of clustering as "the degree of spatial clustering exhibited by a minority group-that is, the extent to which areal units inhabited by minority members adjoin one another, or cluster, in space (Massey and Denton 1988: 293). In my research I examine social clustering along the variables of social class, expressions of social identity group membership (although the specific type of social identity is not always clear), and market participation. I do not focus on inequalities and minority populations. Thus a direct use of Massey and Denton's (1998) definition of clustering is not appropriate. My definition of social clustering is the degree of homogeneity of a population within a defined spatial area. For my purposes the spatial area is a neighborhood, or region of the city in the case of my study of markets. The surface collections represent one or more households within the neighborhood, and they are the units tested for social clustering or mixing. All neighborhoods within an urban center do not necessarily show the same patterns of social clustering for a particular category or residence. For example, socio-economic elites (one type of identity group) may cluster where other identity groups based on socio-economic status are mixed. People with similar tastes in material goods living side by side may obtain comparable goods from different sources. Likewise heterogeneous mixes of social groups living near each other may share a common marketplace. Since social categories are rarely mutually exclusive, settlement patterns can be influenced by many choices which create variations in the material expressions of urban space.

This study fills an intellectual gap in comparative studies of intra-settlement urban socio-spatial organization. Many historical and archaeological studies of urban social organization focus on a small number of neighborhoods within an urban context (Eckstein 1995; Healan 1989; Stone 1992). Detailed studies of all neighborhoods within a city are not common, especially for archaeological cases. A dearth of detailed case studies creates two intellectual problems: 1) individual urban centers can be mischaracterized by a poor and biased sample of neighborhoods and 2) few examples are available for larger comparative research on a wide variety of urban issues. While comparisons can be made using a small sample of cities (Garrioch and Peele 2001; York et al. 2011), large scale comparative studies of urban socio-spatial forms cannot be made without additional cases with a large sample neighborhoods.

In Mesoamerica, only a handful of sites have any data on neighborhoods at all. Coverage of aspects of social organization in neighborhoods is also spotty for the

Mesoamerican contexts. The large and well research urban center of Teotihucan has a great deal of research on socio-economic and power dynamics within neighborhoods (Gomez-Chavez 2012; Robertson 2001; Manzanilla 2012) with some attention to ethnic clusters (Paddock 1983; Rattray 1990;1993) and health (Storey et al. 2012). Yet, the interconnections of these various attributes and neighborhood relationships on a city wide scale are not currently understood. Elsewhere in the highlands a few case studies exist for sites in Oaxaca (Blanton 1978; Feinman and Nicholas 2012; Kowalewski 1994) and the Tarascan imperial capital Tzintzuntzan (Pollard 1978; Stawski 2008), most of these concentrating on socio-economic variation.

Current neighborhood research focuses on identifying a spatial unit that can be called the neighborhood in Maya cities (Annereau-Fulbert 2012; Hare and Masson 2012; Hendon 2012; Lemonnier 2012; Okoshi-Harada 2012; Smith 2011). Only a single study systematically examines neighborhood social-organizational patterns across an entire urban settlement. At Coba, research focused on socio-economic differences alone (Kintz 1980). Two possible reasons for the limited level of understanding of neighborhood dynamics are the emphasis on surface visible architecture, and the limited coverage permitted by excavation. Large-scale application of geophysical prospecting can also generate comprehensive neighborhood data where conditions are appropriate (e.g., Benech 2007), but research of this type with the appropriate spatial coverage has yet to be applied successfully in Mesoamerica.

Many aspects of local and regional governance, effective facility management, and equity in residential life are outgrowths of the social relations in and among neighborhoods. Understanding the basics of how neighborhoods are organized is important to advance our understanding of ancient urbanism. But this will require a level of spatial coverage that is simply not possible with excavated one. Large-sample regional and international comparisons of variation in neighborhood form and function are required to fully understand ancient socio-spatial organization.

Research Questions and Objectives

What was the socio-spatial organization of urban neighborhoods at Calixtlahuaca? As a multi-ethnic polity in a frontier zone of the Triple Alliance empire, the social ties and interpersonal interaction that constituted Calixtlahuaca's neighborhoods were impacted by the larger social, political, and economic conditions. What expression did neighborhood socio-spatial organization take at Calixtlahuaca? I am interested in identifying those variables—particularly social class, some social identity groups, and market system participation—that showed patterns of clustering. My research addresses three key questions in order to describe neighborhood socio-spatial organization at Calixtlahuaca.

1) Were the residents of the same neighborhood of similar social class? Social clustering based on social class is a common pattern cross-culturally. We see this pattern at Teotihuacan (Robertson 2001), Tzintzuntzan (Pollard 1977; Stawski 2008), and emerging in Chang'an (Seo 1986; Xiong 2000). In contrast, neighborhoods at some Maya cities and Monte Alban were mixed in terms of the social class of their residents (Blanton 1978; Kintz 1980). How does Calixtlahuaca compare to these two patterns?

2) Did the residents in a given neighborhood consume the same suite of ceramic decorative types and vessel forms? This question focuses on the assemblage, the quantity of each type of good, belonging to the residents. Neighborhood residents, when given the choice, typically prefer to live by people who are similar to them (Schelling 1978). This involves some sort of shared social identity and such identities are formed through social networks and group interaction. Since group members must be able to recognize themselves, culture acts as the signaling mechanism. Material culture is used by humans in the creation and contestation of social identity. Bourdieu's (1977; 1984) discussion of habitus is often used to describe the recursive relationship between social identity and culture (Jones 1997). Material culture similarities can be viewed as shared culture and shared social identity.

3) Did the residents in a given neighborhood acquire goods through the same market system, with its marketplaces and distribution networks that supply the marketplaces? Neighborhoods are constructed through the kinds of day-to-day interactions that occur in streets and markets. Using the same markets can either reinforce socially clustered neighborhoods or foster a broader interaction sphere. When residents use the same vendors and have more chances to interact, then neighborhood communities will be stronger. Purchasing from the same vendor does not automatically mean that residents purchased the same goods or the same quantity of goods. A prime example of the effect of marketplaces and shops on neighborhood interaction can be seen in the Tang Dynasty city of Chang'an, China (ca. AD 600-900). As control over movement in the city, and the mandated use of a central market decreased through time, the neighborhoods of Chang'an saw greatly increased movement and the development of local shops (Seo 1986; Xiang 2000).

Research Design

The research design of this project has three components. The first component was fieldwork to collect artifact and spatial data. The second involved artifact sampling for physical and chemical characterization. The results of this characterization were analyzed spatially and statistically to address the three research questions discussed above. Finally, the results of these analyses are compared to the excavated assemblage to test for agreement between data sets.

The details behind the surface collections taken during two seasons of field work are described in Chapter 3. Systematic non-random 5m x 5m collections were made in the Southeast quadrant of a 100 sq meter grid for 5.2 square kilometers encompassing the Cerros San Marcos and Tenismo. These were used to delineate the boundaries of the city through a series of geospatial analyses. I identified dense artifact concentrations that suggest neighborhood units using geospatial models derived from the aforementioned analysis. Analysis of the surface collection assemblages associated with neighborhood units comprised the next phase of research. Initial artifact classification occurred during the field seasons of the Calixtlahuaca Archaeological Project under the supervision of Dr. Michael Smith. Once I mastered the project classification system, I reanalyzed the ceramics and performed an attribute analysis on decoration and vessel form. Dr. Bradford Andrews carried out a technological analysis of the full lithic assemblage from the survey and excavation.

The second component of the research focused on the chemical characterization of a sample of obsidian, the dominant material in the lithic assemblage, and the physical characterization of ceramics. This obsidian characterization was carried out by Michael

Glascock at the University of Missouri Research Reactor. I characterized the decorative class and vessel form during three years of laboratory research at the Colegio Mexiquense in Toluca, Mexico. I used these data sets to examine three issues. 1) Whether social clustering along social class could be found in Calixtlahuaca's neighborhoods. 2) Whether consumer preferences, as manifested by the items found in the assemblages, could be categorized into groups with salient characteristics that could be used as markers of social identity. Because consumer choices are limited by economic means, and groups categorized by specific characteristics could reflect differences in ability to purchase goods. However, as can be seen comparing the maps from Chapter 5 and Chapter 6, this is not the case at Calixtlahuaca. Determining whether these social identity groups (the groups who have salient characteristics that might have been be used as markers of social identity) cluster spatially addresses my second research question. 3) Whether neighborhoods near each participate in the same market system. This final question further relates to marketing and marketplace patterns within the city.

The third step in my research process was comparing my results to those obtained from excavated data. Using data from all temporally phased contexts in the domestic sample of the excavated materials, I replicated the analyses from the second component of my research. This allowed me to test questions of formation processes and their effect on surface assemblage reliability. The excavated materials showed similar patterns to those found in the surface data. This supports my interpretations based on the analysis of surface materials.

Looking Ahead

This dissertation is divided into eight chapters including this introduction. Chapter 2 discusses in further detail the literature surrounding the concepts on neighborhoods and urban socio-spatial organization presented above. It also contains a more thorough discussion of archaeological and historical case studies mentioned in this chapter. Chapter 2 also covers the background of the Calixtlahuaca Archaeological Project and previous research. I include additional cases to further illustrate the issues concerning neighborhood research.

Chapter 3 focuses on the methods and data that form the foundation of this research project. I provide a detailed description of how the neighborhood and urban boundaries were generated. The artifact classes and attributes are explained here and with appendices. This chapter contains a deeper discussion of the statistical methods applied in this research to address the research questions.

Chapter 4 is the first of four analytical chapters. It focuses on the first research question of whether neighborhoods exhibit clustering along the lines of social class. Spatial analysis of these results show that elites lived amongst commoners and not clustered together. However, the spatial distribution of elites does not correspond to elite control over neighborhood populations as in the Central Mexican capulli (Lockhart 1992). To determine this pattern I used two measures to identify elite and commoner residential areas. I combine an analysis of wealth with an analysis of indicators suggesting feasting behavior to identify residential areas of elites.

Chapter 5 examines several interrelated issues about social identity, shared consumer habits, and the spatial expression of social networks corresponding to research question 2. I use insights from marketing research to examine how consumer choices and social identity intersected in analytically meaningful ways. I analyze ceramics to identify five different shared consumer groups whose tastes suggested some form of shared social identity. Using statistical methods borrowed from ecology, I test whether or not residents of the same consumer groups cluster in neighborhoods. Only a few small neighborhoods in marginal areas show any degree of clustering in terms of social identity. Most neighborhoods were socially mixed residential areas whose inhabitants engage in networks that cross-cut the settlement. These results are confirmed using basic similarity coefficients within neighborhoods.

Chapter 6 uses economic theory on non-differentiated commodity markets to investigate whether neighborhood residents participated in a single market. This study addresses research question three, which concerns variation in consumer provisioning. Differentiated goods are those for which consumer decisions are predicated on differences between similar goods. These choices allow researchers to identify socially meaningful characteristics such as social identity or class from consumed goods. Differentiated goods were used in the analyses in Chapter 4 and 5. Commodities, in the non-differentiated sense, are goods that show no meaningful difference between two producer's products. Commodities were items like salt or obsidian, where one source can be interchanged with another without signaling anything specific about the consumer. Because consumers do not purchase these objects based on any specific characteristics, aspects like the proportion of sources of the object in the household assemblage are likely to reflect the composition of the market and not deliberate choices by the purchaser. For this reason, these goods are ideal for identifying exchange networks and markets at the site and regional scales. I use these concepts to understand variation in obsidian source utilization at the site which suggests two separate marketplaces with distinct differences in supply.

Chapter 7 compares artefactual categories between excavation and surface derived patterns. The key difference between excavation and surface materials is the temporal scales they represent. Since change through time is a given, each temporal phase relates to only part of the picture presented by the surface materials. All phases present in each excavation need to be combined to mimic the mixing processes reflected in the surface materials. I ran analyses similar to those used on the surface materials on the adjusted excavated sample and statistically compared the results from the two samples. Once I demonstrate the samples are comparable, I move on to a more synthetic discussion of all results.

Chapter 8 is the culmination of this research project. I synthesize the results reported in the previous chapters to arrive at a detailed understanding of neighborhood socio-spatial organization at Calixtlahuaca. Relationships between space and social class are not clean-cut in residential areas of the city. Social mixing in terms of social identities in neighborhood settings was the norm, given the assumption that proximity corresponds to interaction. This suggests that communities at Calixtlahuaca were diverse, with all the benefits and problems found therein. Alternately, neighborhood residents could call on varied social networks of co-identity group members for information and support. This is supported in by the way in which interaction within a social identity group influences consumer choices, as discussed in Chapter 5. The remnants of these choices are the basis of the analysis in this dissertation. This residential pattern suggests a socially mixed urban environment across the site. Despite the mixed communities and cross-cutting ties, neighborhood residents stuck to local marketplaces that did not have a homogenizing impact on neighbors. The market divisions seem to follow the natural division between Cerro San Marcos and the larger Cerro Tenismo suggesting it was not worth the effort needed to go to a different market. Why the two markets were supplied by different sources of obsidian is a question for further reflection and research. Ultimately, the presence of multiple loci of monumental architecture, multiple linguistic groups, and socially varied identity groups did not manifest in social clustering at Calixtlahuaca. Similarly, market access did not increase the socio-spatial uniformity of the city since variation in social class and identity group do not correspond to the market areas. The above summary provides a glimpse into the data and research on Calixtlahuaca's neighborhoods presented in further detail in the subsequent chapters.

CHAPTER 2

SOCIAL CLUSTERING AND MIXING IN NEIGHBORHOODS

An important feature of neighborhood organization is the degree of social clustering. Neighborhoods can be socially heterogeneous or homogeneous with respect to a variety of categories. This research focuses on economic clustering based on class and market access and clustering based on social identity. Three factors regulate the impact of group identities on the ability for neighborhood residents to share space: 1) salience, nature, and mutability of group identities themselves, 2) tolerance, 3) cross-cutting loyalties. These factors are shaped by structural features of the local context (de Souza Briggs 2004).

The subject of this research is social clustering at the Postclassic (AD 1000-1520) city of Calixtlahuaca. I define social clustering as the degree of homogeneity of a population within a defined spatial area. Social mixing is the opposite condition where members of neighborhoods share few social characteristics in common with each other. In urban environments like Calixtlahuaca the fundamental spatial unit above the household is the neighborhood, defined as residential units whose spatial location allows the possibility of face to face interaction (Smith 2010; Smith and Novic 2012). The socio-spatial form of urban residential organization, and how those forms relate to economic and political relations within the city, are key issues in the study of urbanism both past and present.

In studies of contemporary cities research has focused on how social clustering in the form of ethnic enclaves and racial ghettos has developed and is maintained. Urban ethnic enclaves have been studied as an outgrowth of international and/or rural-urban migration processes. Calculations of risks and costs in the migration process lead potential migrants to move where others of their group are already present (Massey 1990; Vatuk 1972). European patterns of social clustering are heavily influenced by economic policy and cultural similarity among ethnicities living together. Urban areas in countries with redistributive economies also tend to have less segregation. Segregation is commonly understood to be the separation of minorities and/or social classes into spatially disparate areas. Countries where the cultural differences among identity group are small tend to have less segregation as well. Increased segregation is found in urban areas undergoing economic restructuring, particularly where cultural differences are large. Cultural similarity appears to trump race in European clustering patterns (Musterd 2005). North American urban clustering patterns are often based on racial divisions among the population (Dawkins 2004; Jargowski 1996; Quillian 2002). In both European and North American urban contexts, high degrees of ethnic/race based social clustering are viewed as social ills. However, the reasons for this concern are different for each continent. European research emphasizes social participation and upward mobility of minority groups (Musterd 2005). North American research emphasizes the relationship among segregation, crime, and poverty (Dawkins 2004; Musterd 2005; Quillian 2002).

Connected to issues of migration and ethnic/ race-based clustering is the question of economic clustering in urban environments. Again, regional differences in economic and cultural systems influence patterns. In the European context, economic segregation plays a more powerful role in structuring spatial patterns (Musterd 2005). North American research on economic clustering attempts to tease apart patterns that are based on racial preference and those that are dictated by economic disparities (Dawkins 2004; Jargowski 1996; Quillian 2002). Economic variables are not sufficient enough to account for segregation patterns (Jargowski 1996). Race-based residential preferences and discriminatory practices to maintain segregated spaces have a stronger influence on North American urban socio-spatial organizations. Specifically, the preference of the politically and economically dominant white group for segregated living drives the pattern and behaviors to maintain segregation (Dawkins 2004; Quillian 2002). These are just some of the issues associated with social clustering and social mixing in modern societies.

York et al (2011) discuss the historic and prehistoric trajectories and drivers that contributed to the production of types of clustering patterns of various forms. The drivers that affected historical and archaeological urban forms were very similar to those that structure social clustering in modern contexts. Just like in modern contexts, the specific patterns produced are a product of wider social and cultural conditions specific to that place and time. Regional variation and its associated causes are yet to be explored due to a dearth of appropriate data sources. At Calixtlahuaca, I examine both class and social identity clustering in relation to the market structure of the city. To develop my expectations a more thorough understanding of neighborhood socio-spatial organizations is needed.

Neighborhood Socio-spatial Organization through History

We can see examples of the variation described above by looking across time and space (see Figure 2.1). French Algiers (1815-1962 AD) saw an ever increasing homogenization of neighborhoods along the axes of ethnicity and socioeconomic class

(Celik 1997). During the preceding Ottoman period (1524-1815 AD) residents of all groups interacted with each other in the streets and markets.

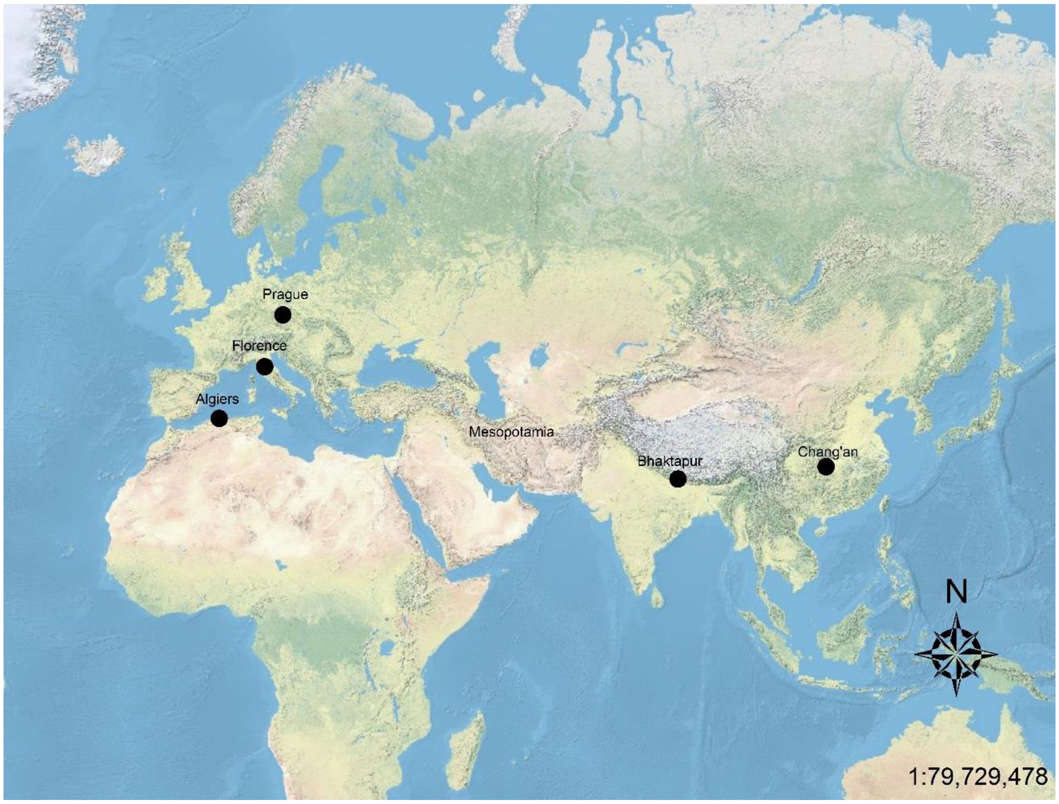


Figure 2.1. Maps of historic and archaeological cities discussed in this chapter.

As social clustering became more pronounced, interaction outside of narrow ethnic and class channels decreased (Miege 1985). Former Soviet cities who went from communist Soviet political regimes to more free market based systems in 1988 saw increased levels of socioeconomic social clustering after the regime change, post-1988 (York et al. 2011). In contrast, the earliest cities of Mesopotamia had neighborhoods heterogeneous in terms of wealth and craft specialization (Keith 2003).

The drivers of homogeneity, those processes and institutions that encourage social clustering, are diverse and produce various types of social clustering in neighborhoods. One of the most influential bottom-up drivers of homogeneous neighborhoods is simple individual and household preference (Schelling 1978). Sociological studies have shown that people prefer to live near people who are like them though this does not mean that the similarity will be ethnic in nature (Dahya 1974; York et al. 2011). Consumption Niche-neighborhoods (Forrest 2008) are a type of neighborhood packaged to attract people of a particular lifestyle and consumption choice. This would be an example of non-ethnic similarity driving social clustering. "Ethnic" quarters are created by the process of migration or movement within a city. However, unless there is mass migration or movements by government decree or some structural reason for clustering, then ethnic groups intermix (Greenshields 1980). This suggests that clustering based on ethnicity is not always based on the preferences of residents to live near co-ethnics, but must be due to some other structural process. Contemporary Los Angeles, for example, contains ethnic both spatial and institutional ethnic separation which suggests a structural component (de Souza Briggs 2004).

Pre-modern commercialization is another driver of neighborhood homogeneity relevant to this research. Pre-modern commercialization differs from capitalism in that it lacks wage labor and land markets (Smith 2004). An example of the driver or commercialization is the city of Chang'an, China had a highly regulated urban form with restrictions on movement during the T'ang Period (AD 581-907). Residents were restricted to purchasing from two state-sanctioned markets. Most neighborhoods were socially heterogeneous in social composition (Xiong 2000; Seo 1986). The Song Period (AD 960-1127) saw a relaxation of state regulations. Commerce sprang up in neighborhood shops and streets, and neighborhoods became more socially homogeneous by wealth and occupation (Heng 1999). Another example can be found in ancient Nippur in Mesopotamia where some neighborhoods had mixed class components but were connected commercially (Stone 1987). This driver, premodern commercialization, is the focus of two of my research questions: Do neighborhood residents cluster based on social class? And do they obtain their wares from the same sets of producers?

In some cities a number of factors played a role in the organization of neighborhoods. In ancient Rome, people were spatially mixed in terms of ethnicity, religion, and economics. Medieval Cordoba was spatially segregated along religious and occupational lines (de Souza Briggs 2004). These forms of social clustering occur in New World prehistory as well. The next section will examine neighborhood socio-spatial organization in Mesoamerica.

Neighborhood Organization in Mesoamerica

Work on neighborhoods in Mesoamerica made a step forward with the publication of *The Neighborhood as a Social and Spatial Unit in Mesoamerican Cities* (Arnauld, Manzanilla, and Smith 2012). The fourteen chapters covered theoretical issues concerning neighborhoods (Smith and Novic 2012, Blanton and Fargher 2012) as well as detailed neighborhood case studies in Classic Period Central Mexico (Manzanilla 2012, Gomez-Chavez 2012, Widmer and Storey 2012, Storey et al. 2012, Feinman and Nicholas 2012) and the Maya region (Hendon 2012; Lemonnier 2012; Arnauld et al. 2012; Hare and Masson 2012; Annereau-Fulbert 2012; Okoshi-Harada 2012; Arnauld 2012). Most of the chapters in this volume focus on describing and identifying neighborhoods with regard to political and economic organization. Some chapters present perspectives that easily fit into the themes of this research. Others are different ways of thinking about neighborhoods.

The most common alternative perspective to understanding neighborhoods in this volume is to examine the ways in which neighborhoods organize as political units, with a particular emphasis on collective action (Blanton and Fargher 2012; Feinman and Nicholas 2012; Arnauld et al. 2012; Okoshi-Harada 2012). All the cases in this edited volume have an implicit theme that a neighborhood must serve a function and must involve cooperation. Even if this is true, the purpose for which neighborhoods develop may not be uniform across time, space, or culture region. Starting to collect a database of well-studied settlements, like those described in this volume, is essential to being able to discern which aspects of social, political, and economic form and function are common to neighborhoods and why that is so However, with few exceptions (e.g., Teotihuacan), the chapters in *The Neighborhood as a Social and Spatial Unit in Mesoamerican Cities* provide very little information on the clustering of social factors besides social status. I will examine the information on social clustering below.

Neighborhood socio-spatial organization in regard to social clustering in Mesoamerica is limited to a few sites distributed geographically and belonging to various time periods prehistory. Some sites showed heterogeneous mixes in their neighborhood compositions. Other sites showed marked clustering along social and economic lines. Below are more detailed examinations of social clustering in Mesoamerica. The locations of settlements discussed in this section can be found in Figure 2.2.

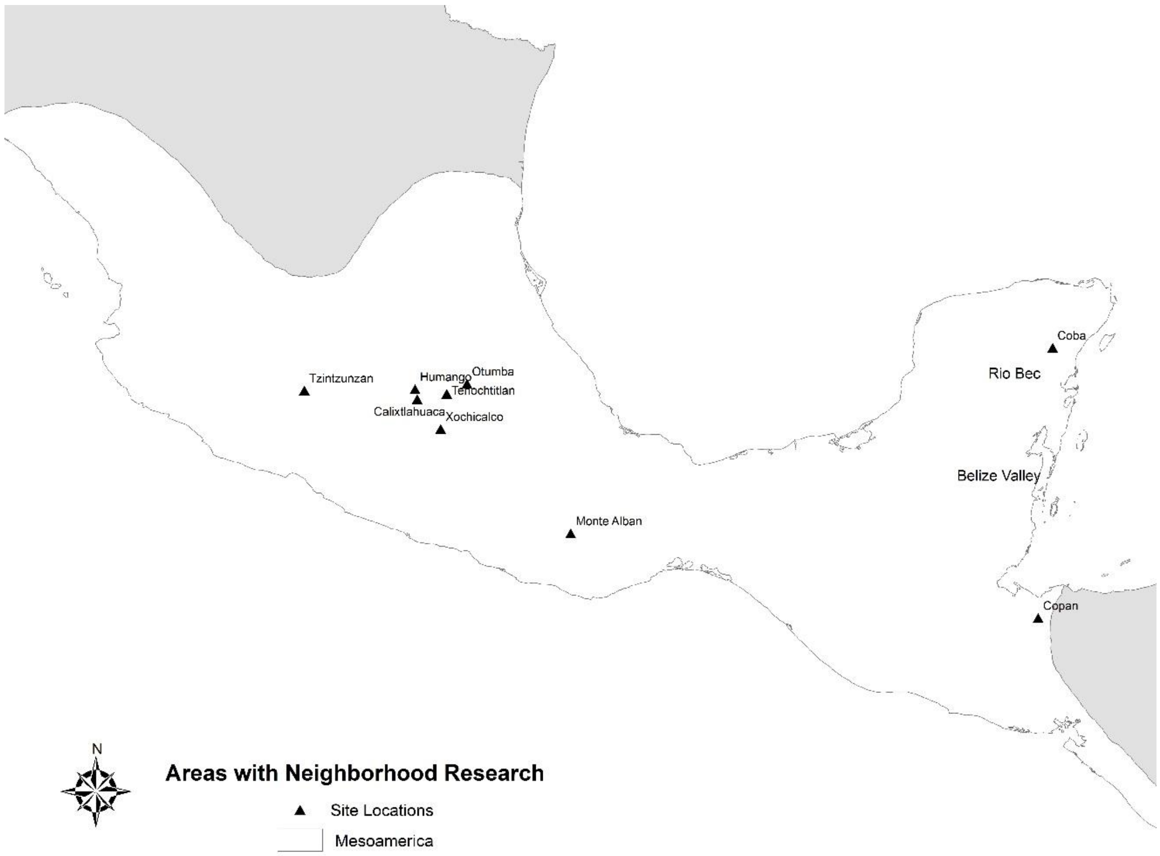


Figure 2.2 Map of Mesoamerican cities discussed in the text.

Social Clustering based on social class. During the Classic Period at Monte Alban, Blanton identified fifteen neighborhoods using architectural evidence. Districts were identified using topographic and anthropogenic barriers between units. These residential zones were mixed in terms of social class, with elite and commoners living close together.

Tzintzuntzan, in West Mexico, is a city where residential architecture was not abundant but for which neighborhoods could be identified using surface collections.

Neighborhoods at Tzintzuntzan show residential clustering primarily along the axis of social status. Pollard (1977) classified residential neighborhoods as upper elite, lower elite, or commoner in composition. Areas of ritual and public activity were closely associated with elite neighborhoods, as was evidence of prismatic blade manufacture. Interestingly, lower elites had more material culture in common with commoners than with upper elites and acted as a buffer zone between neighborhoods of upper elites and commoners (Stawski 2008). Tzintzuntzan is unique in that neighborhood socio-spatial organization was examined by two separate researchers who found similar results using different techniques. A different set of eyes reexamining data reaffirms the assessments archaeologists make from little data.

Ian Robertson (2001) identified a tendency for households of different socio-economic status to cluster into specific areas. He also noted an increase in clustering through time. Teotihuacan underwent major political shifts during its long history (Cowgill 1997) and these were probably accompanied by economic changes within the city as well.

The city of Coba had a number of neighborhood groups. The study of these neighborhoods were some of the earliest explorations of sociospatial organization in the Maya area. Coba's neighborhoods were identified by the distance between architectural units. Elites lived both in neighborhoods mixed with commoners, and in isolated residential units (Kintz 1983). The sociospatial distribution of other social categories have been examined in Mesoamerica as well.

Social Clustering based on shared group identity. Neighborhood and district organization has been described for both San Jose Mogote and Monte Albán in the Valley of Oaxaca. Blanton (1978) argues for neighborhoods and districts at early Monte Alban, where three zones could be seen spatially. These three zones had subtle differences in ceramic assemblage suggesting a shared neighborhood material culture and possibly identity (Blanton 1978: 38). In San Jose Mogote, Kowalewski (1994) describes residential neighborhoods separated by unoccupied space between residential clusters. By early 1450-700 BC, neighborhoods differed from each other in complimentary ways along the lines of craft specialization, use of Olmec style motifs, and stone tool production (Kowalewski 1994; 127).

Neighborhood-focused research is in its infancy in the Maya area, with a few case studies in Copan and the Belize Valley that describe neighborhood socio-spatial organizations in terms of status differences, migration, and craft specialization (Robin 2003) At Copan, the residential architecture formed groups that appear to correspond to the contemporary Chorti Maya residential *aldea* or *sian otot*. The *sian otot* serves all the functions the modern day neighborhood. Copan has twenty named potential *aldeas*, including Las Sepulturas and El Bosque neighborhoods (Fash 1983). Several researchers have initiated neighborhood analyses at various sites in the Maya area by identifying neighborhoods as spatial units (Lemonnier 2012; Hare and Masson 2012; Hendon 2012). Arnauld et al. (2012) look at the social, economic, and political relationships among neighborhoods in the Rio Bec region. While this new work is exciting because people are starting to examine relationships among neighborhoods, deeper analysis is necessary to understand neighborhoods in the Maya area.

At Teotihuacan neighborhoods are described spatially with occupational and ethnic identities (Manzanilla 2012), but few neighborhoods have been studied within the city to understand the complete urban landscape. Ethnic compounds and clusters of residents from distant locations such as the Gulf Coast, Maya Lowlands, Western Mexico, and Oaxaca have been identified at the city (Spence et al. 2005). Gomez-Chavez (2012) uses social relationships around production as the main criteria for identifying a true neighborhood. He argues that residential groups not organized economically under a mode of production are not neighborhoods at all but some other form. While an interesting analysis of how Teotihuacan's neighborhoods are socially integrated, this theoretical approach to neighborhoods presupposes a corporate social configuration common to all neighborhoods. Since it is definitional, then the evidence will always support the contention. Broader definitions, like the one used in this research, allow for the testing of hypotheses about how neighborhoods are socially cohesive if they are at all since the broader definitons do not assume social integration as an a priori assumption. Storey et al. (2012) attempt to examine health differences among neighborhoods at Teotihuacan but are limited by poor data from making strong conclusions.

Nahua society of Central Mexico, in both rural and urban contexts, was organized in a series of nested spatially defined communities (Smith 1993). The *calpulli*, co-resident named social groups (Lockhart 1992; Carrasco 1976), served the same community needs as the neighborhood (Smith 2010; Smith and Novic 2012). Tenochtitlan, the imperial capital, was oriented to a quadripartite grid with four main avenues extending from the central ceremonial precinct. Each quarter functioned as a large district with a centrally located temple and chief administrative official. Each quarter was further divided into *calpulli*. These calpulli had administrative and ceremonial centers of a much smaller scale than found at the quarter level (Calnek 1976). The organization of Tenochtitlan was a nested system of increased specialization as the units decreased in size. The interdependence, shared practices, and shared values of these units fostered strongly integrated communities (Calnek 1976, Calnek 2003). At the Aztec city-state of Otumba archaeological survey and excavation has revealed an interesting pattern of clustering based on the craft specialization of inhabitants probably related to *calpulli* (Nichols 1994: Charlton et al. 2000). Though there was internal variation in calpulli, membership was based on shared culture and thus can be a form of social clustering based on social group identity.

Social clustering along economic variables. Zones of craft specialization were described for some sectors of the Teotihuacan (Cowgill 1997, 2007; Spence 1987; Widmer 1991).Using surface collected materials, Folan identifies the various qualities of the neighborhoods of Humango, an Early Postclassic city north of Toluca. Research there focused on identifying high, medium, and low density occupation that was also active or non-active in craft-production (Folan 1981). Blanton (1978: 95) identified little craft specialization at the neighborhood level at Monte Alban, though there were zones of obsidian, mano, and metate production. The data for occupational clustering are not always available, but when they are present they provide both a view into socio-spatial organization and the economic organization of ancient cities.

Widmer and Storey (2012), Hendon (2012), Lemonnier (2012), Arnauld et al. (2012), and Annereau-Fulbert (2012) all focus on methods and criteria for identifying neighborhoods at Mesoamerican settlements. Frequently, social or economic integration is a key criteria for identifying neighborhoods. The primary evidence for both economic and social integration is usually architecture. As Hendon (2012) rightly points out, depositional differences that obscure surface visible architecture limit what can be said at various settlements. Some cities with good surface remains can be clearly identified as having mixed neighborhoods. Cities without such preservation are left with an inconclusive pattern. Calixtlahuaca is an example of a city with no visible residential architecture at the surface, and consequently the traditional ways of examining neighborhoods are not possible. At Calixtlahuaca I have used surface artifacts to analyze the spatial patterns in the city. This focus on artifacts allows specific questions about the social fabric of the city. Neighborhoods will not always be socially or economically integrated as seem in contrasts with both modern and pre-modern cases like the ones discussed here. Using definitions that assume social integration assume a quality of neighborhoods that should be empirically examined and excludes those cases that do not fit the definition

Absence of social clustering. Hirth (2000) identified neighborhoods and districts using architectural indicators at Xochicalco, Morelos. The presence of a temple, a high status residence, and other public buildings showed the location of the neighborhood center. District divisions which contained temple and palace architecture followed the general topography of the site, with neighborhood subdivisions marked by roads and ditches found around the settlement (Hirth 2000:235-236). These structures suggested that each neighborhood had some of its governance and ritual needs met through neighborhood institutions. The socio-spatial organization of these neighborhoods was relatively heterogeneous. While Schelling (1978) argues that people chose to be with others like themselves, the case studies above suggest that the type or degree of sameness may not be constant and socio-spatial patterns may be influenced by other features like economic structure. This form of socio-spatial organization where social mixing appears is also found at Calixtlahuaca.

Researchers understand neighborhoods in Mesoamerica predominately in spatial terms. We have a limited understanding of neighborhood social organization in Mesoamerica. We know that some neighborhoods were corporate units (Marcus 2009), but little else. Our knowledge of Teotihuacan neighborhoods is a well-documented exception. Imperial centers like Teotihuacan and Tzintzuntzan show patterns of social clustering along lines of social class. Both cities show craft specialization localized in neighborhood contexts. However, civic-ceremonial activities occur at the neighborhood level at Teotihuacan and not at Tzintzuntzan. Of the two cities, Teotihuacan is less homogeneous within neighborhoods.

Highland centers like Xochicalco and Monte Alban have socially mixed neighborhoods, as doe known Aztec cities and the Lowland Maya. What these urban zones share are the presence of civic-ceremonial activities at the neighborhood level. While civic-ceremonial activities also occur at the state level, these lower level civic-ceremonial loci were centers of neighborhood building. Administrative choices that required administrators to live by those administrated created situations that fostered social heterogeneity. Fargher et al (2011) provide examination of neighborhood and city administration in Mesoamerica but do not relate these categories to socio-spatial forms.

The pattern at Monte Alban and in the Maya area show a greater degree of social mixing which is what would be expected in a society with a mostly heterogeneous culture, one where there is variation in social groups and social classifications, and lower levels of inequality. The elites existed and had more access to resources but the degree that the majority of the population would have benefited from redistributive practices of having intermixed elites is hard to quantify.

Comparative work like Musterd (2005) use changing economic and cultural conditions through time to understand the process of clustering. Analytical work into the cause of these socio-spatial forms requires similar diachronic views. Economic restructuring is not dependent on the economic system. What is required is periods where economic conditions change and some portion of the population has to shift economic strategies to survive. Situations like political unrest or collapse would produce these kinds of economic ruptures. A more nuanced analysis of change through time in political, economic, and socio-spatial terms may allow researchers better understanding of what drove those patterns. The first step is gathering synchronic and diachronic data on urban places in Mesoamerica.

History of the Calixtlahuaca Polity: Ethnohistory

In 1478, the Aztec ruler Axayacatl conquered the capital of the Matlazinca in the Toluca Valley in order to check the aggression of the Tarascan empire (Tomaszewski and Smith 2011; 25). The capital city was known as Matlazinco (Tomaszewski and Smith 2011). Matlazinco is a term also used to describe the valley as a whole, and an Oto-Mangean language spoken by the valley inhabitants. Given the various colonial sources referring to the rulers of Matlazinco with the rulers of t city of Calixtlahuacan (Carrasco 1999) and the multiple uses for the word “Matlazinco”, researchers suggest that Calixtlahuaca is the Matlazinca capital conquered by Axayacatl . This is reinforced by statements that Calixtlahuaca was the Precolombian capital in colonial lawsuits (Tomaszewski and Smith 2011; Smith, et al. 2003; Smith 2013).

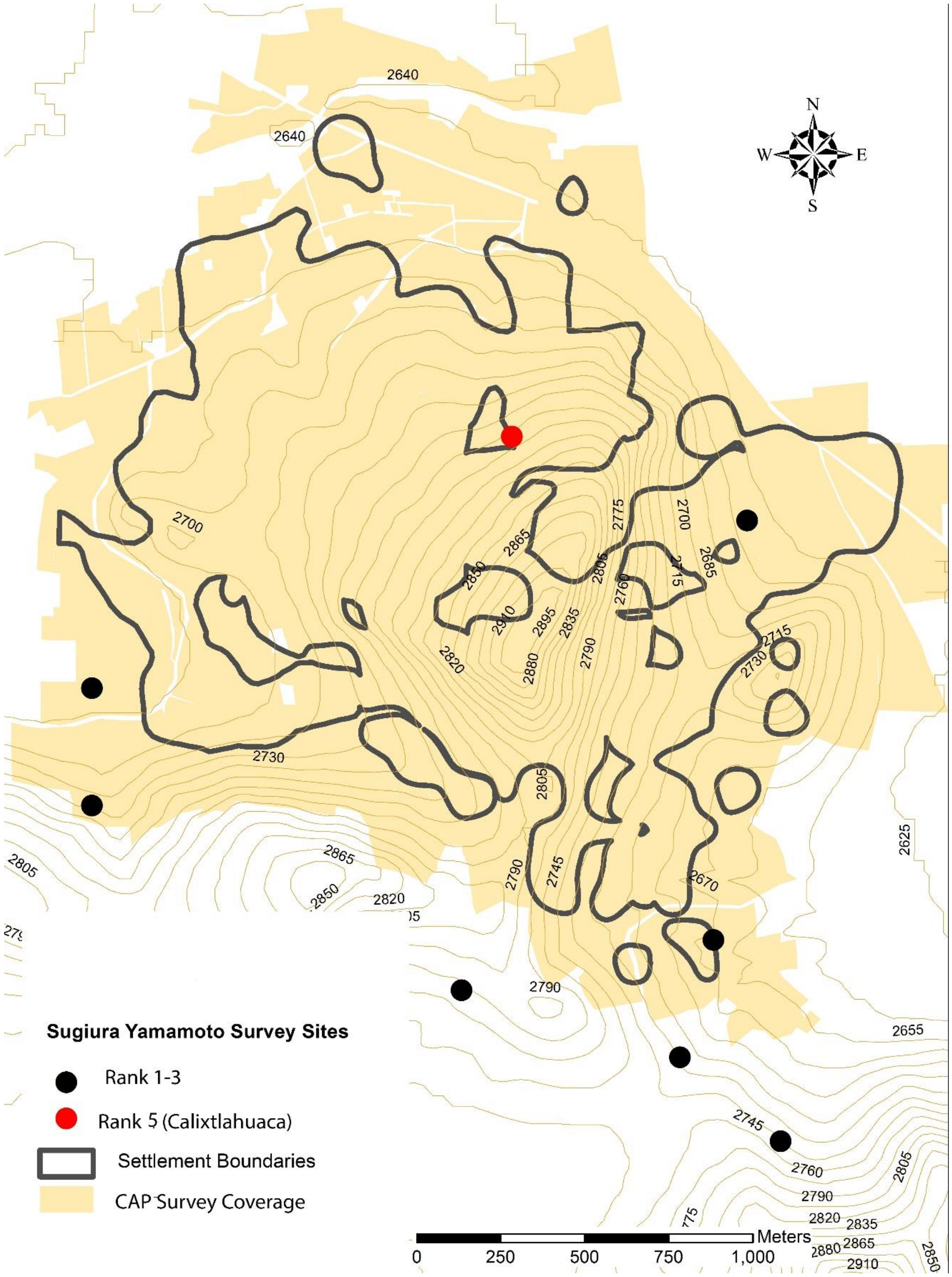
After Calixtlahuaca/Matlazinco was conquered, the nearby Tollocan was established as the capital town of the Triple Alliance tax province of the same name (Berdan and Anawalt 1992; Carrasco 1999; Tomaszewski and Smith 2011). Immigrant groups from the Basin of Mexico moved in to repopulate parts of the Toluca Valley (Carrasco 1999; Tomaszewski and Smith 2011). Those Matlazinca who remained offered military resistance to Mexica domination (Tomaszewski and Smith 2011).

Prior Archaeological Research at Calixtlahuaca

The archaeological site of Calixtlahuaca is located on the slopes of the Cerro Tenismo next to the modern day town of San Francisco Calixtlahuaca. The monumental architecture at the site is dispersed across the northern face of Cerro Tenismo and Cerro San Marcos, with structures located on the summit, lower slope, and valley floor. Prior to the start of the Calixtlahuaca Archaeological Project ("CAP") in 2006, two archaeological projects were carried out at Calixtlahuaca, directed by Jose Garcia Payon and Yoko Sugiura. Garcá Payón excavated and restored the monumental architecture of the site in the 1930s (Garcá Payón 1936; Garcá Payón 1979; Smith, et al. 2007; Smith, et al. 2003). His excavations included several temples, the royal palace (which he incorrectly labeled as a "calmecac" (school), and a possssible elite residential compound known locally as the *panteón*. Garcá Payón's project focused on the large, monumental components of the city. His work included the excavation and reconstruction of the largest circular Ehecalt temple in Mesoamerica. Within this excavation, Garcá Payón uncovered a lifesize ixiptli of the god Ehecalt that is emblematic of Aztec art. The official

Instituto Nacional de Antropología e Historia (INAH) archaeological zone encompasses an area of 119 ha surrounding the area of dispersed monumental architecture.

In the late 1970s, a long term settlement survey project directed by Yokio Sugiura Yamamoto documented the archaeological sites located in the Toluca Valley (Sugiura Yamamoto 2000). She recorded five Postclassic settlements within the area surveyed by the CAP (Figure 2.3)



2.3 Map of survey area which is total area surveyed by the CAP (the boundaries of the city are discussed in detail in Chapter 3) and Suigira Yamamoto's site locations

She ranked each settlement in her survey on a scale of 1 to 5. Rank 1 sites were small hamlets with no monumental architecture while rank 5 sites were the dominant centers in the settlement hierarchy with extensive monumental architecture. Calixtlahuaca was recorded as a rank five site because it contained extensive monumental architecture and a settlement area of 213 ha. A 228 ha rank 3 site, defined as one containing architectural mounds and visible evidence of residences, was recorded over a small hill named Cerro San Marcos located east of Cerro Tenismo. The other three settlements were recorded as rank 1 and 2 residential sites identified through visible rock alignments and artifact concentrations. The rank 1 and 2 settlements were generally recorded as below 26 ha in size. The sizes listed in Suigira Yamamoto's survey for these locations indicate significant overlap between sites making it difficult to present extents visually. There is no indication of how site are separated in her reports.

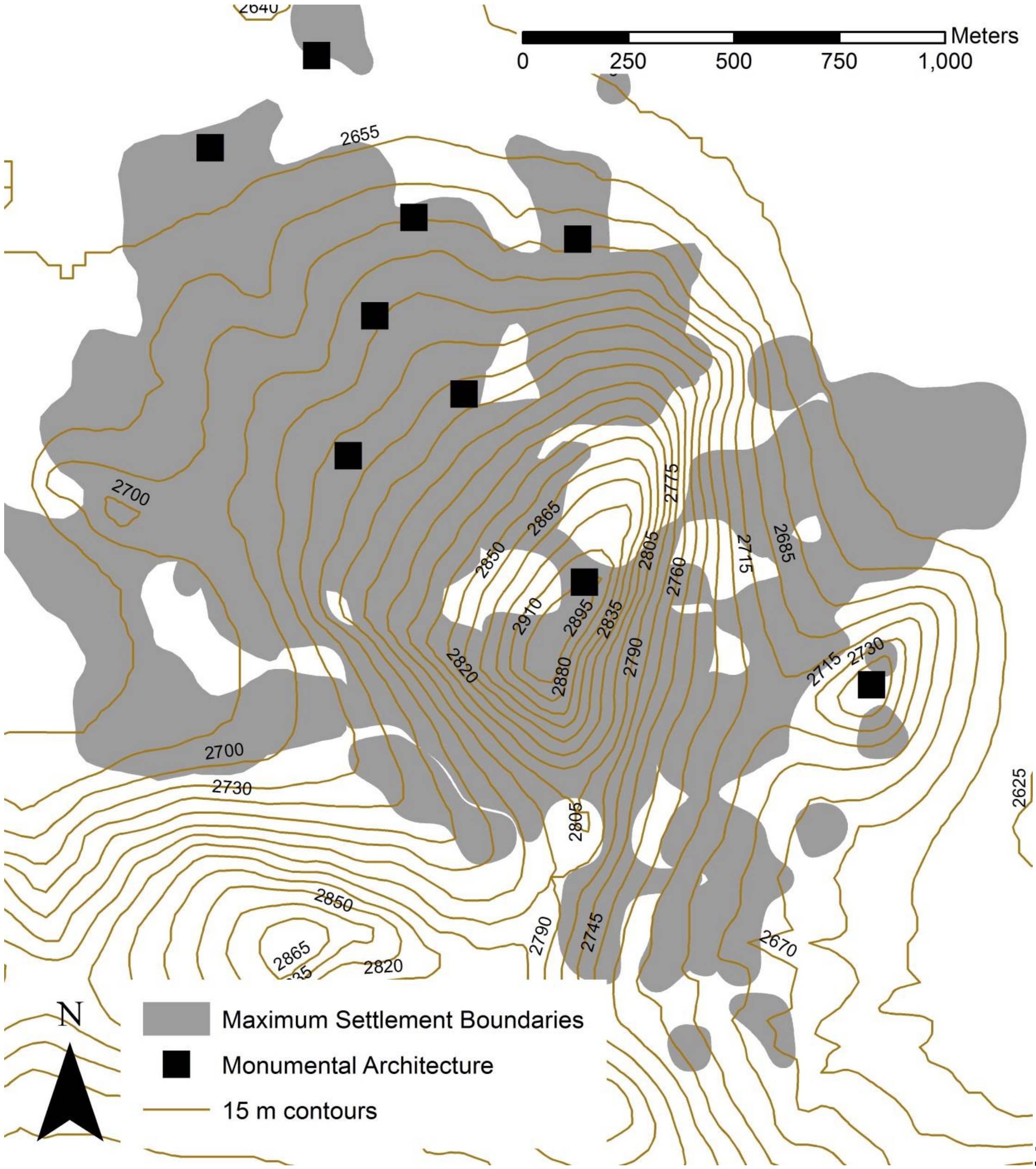
This fieldwork documented the presence of significant residential zones at Calixtlahuaca, but did not investigate them further. The two largest of Sugiura Yamamoto's (2000) sites correspond in location but not size to the East and West residential areas of the city discussed in Chapter 3. The some of the smaller sites are also subsumed by the CAP survey boundaries for Calixtlahuaca. However, several hamlet sized sites are located both outside the urban boundary and the survey area. The Calixtlahuaca Archaeological Project, which the present work is part of, is described in Chapter 3.

CHAPTER 3

ASSESSING NEIGHBORHOODS ARCHAEOLOGICALLY

The Calixtlahuaca Archaeological Project (CAP) was initiated by Michael Smith and included several studies, including the one discussed here, whose aim was to address six research goals focused on questions of urbanism and empire. These goals were to understand residential choice and maintenance, how the economy functioned both locally and internationally, how the neighborhoods and residences articulated with the urban history, how did the city articulate to the larger Aztec world, the effect of empire on the city, and the sociospatial organization of the city. Two of the goals were aimed at addressing Calixtlahuaca's relationship to the broader world and overall historical and political context. Two of the project goals focuses explicitly on urban issues at the city. These goals include understanding how the city was built and maintained given its position on the slopes of Cerro Tenismo and the spatial and social organization of the city. The research presented in this dissertation addresses the project goal of understanding the spatial and social organization of the city. Neighborhoods are important intermediate units where multiple households can interact to manage local political and social problems. They are the building block upon which the urban society is built. The explicit focus on urbanism is important for understanding how urban societies developed and functioned in ancient Mesoamerica. Examining the differences between modern and pre-modern urban processes are key to developing effective interventions to improve urban ills. The final two goals of the CAP project take the urban focus and expand it to larger regional and polity oriented questions. The project focuses on the way that the urban economy integrates into larger macroregional networks. Finally, how does this information on urban household and neighborhoods articulate with the political and historical socio-spatial organizations of the city and polity (Smith 2013)?

The CAP survey seasons provide the data for this dissertation and are discussed in more detail below. These data were collected during the 2006 and 2007 field season. The excavation season occurred in 2007. Michael E. Smith directed the residential excavations and Aleksander Borejsza directed the terrace excavations. The initial results of this research have been published in Smith et al. (2013). Ceramic classification for both the excavated and survey materials occurred from 2006 until 2012. Figure 3.1 shows the results of the survey analysis in identifying the urban settlement limits. Monumental architecture was not used as a signature of residential settlement in the analysis of settlement limits described below. As a result, one monumental structure that was devoid of surface artifacts in its vicinity, was not included within the boundary. The statistical and spatial analysis of the artifact data that was used to produce Figure 3.1 indicated that this monumental structure was located in one of two "dead zones" where artifacts were almost non-existent. While the structure was likely used for ritual purposes, the area around it did not meet the criteria discussed below for inclusion as part of the settlement boundary based on artifact based analysis.



3.1

Map of Calixtlahuaca and terrain

Outside of the analysis done specifically for the survey component of the project, Adrian Burke and the Missouri Research Reactor (MURR) performed XRF analysis on a sample of the obsidian from the excavations. Jennifer Meanwell used petrography and MURR used INAA to examine the sources for the clay fabrics providing information on exchange at the city. Bradford Andrews did the technological analysis for the excavation and survey lithic materials. The sculptural materials were examined as a part of Emily Umberger's research (Umberger 2007, Umberger and Hernandez n.d.). Additional analysis on other artifact categories were performed by other project members and will be presented elsewhere.

Preliminary research based on the survey data were published in Smith et al. (2007) and Smith et al. (2009). These articles discusses the preliminary boundaries identified through the survey. This information is superseded by the data presented in this chapter (Smith et al 2013). In addition to an article on architectural and terrace findings, Huster and Smith (2015) published a chronology based on the excavated materials. Recently, a Spanish language study concerning the domestic ritual artifacts at Calixtlahuaca was released (Huster, Smith, and Novic 2014). Huster's (2015) dissertation focusing on urban household economy at Calixtlahuaca addresses several of the above research goals of the project. Further publications are planned for studies based on both the excavated and survey materials. The rest of this chapter deals with the CAP survey materials and methods used to address project questions on social and spatial organization at the city.

Calixtlahuaca Archaeological Project Survey Methods

The goals of the CAP survey were 1) to identify the limits of settlement for the ancient city of Calixtlahuaca, 2) to collect a sample of surface artifacts from which activity areas and other aspects of urban socio-spatial organization could be identified, and 3) to locate areas with high potential for intact subsurface residential deposits. This dissertation focuses the first and second goals of the survey.

The survey took place during the 2006 and 2007 field seasons. Michael E. Smith was the principle investigator for both seasons. I acted as the field director during the 2006 survey season which was when the majority of data were collected. A smaller 2007 field season was supervised by Angela Huster during the spring before excavations began. This second season captured data on the southern sparsely inhabited extremes of the settlement. The initial survey methods were designed by Michael E Smith and then modified in the field with the assistance of Angela Huster, Maelle Seargerent, Mellissa Ruiz-Brown, Peter Krofges, Brian Tomaszewski, and myself. This chapter discusses how the first goal of identifying settlement limits was accomplished and sets up the data and methods used in later chapters addressing the second goal of identifying urban socio-spatial organization.

Two separate but interrelated sampling strategies were used to maximize coverage of the land surface. These strategies provided two separate artifact density measures for examining the limits of settlement at the site. The first measure was based on visual inspection of survey units defined by topography and modern land use. These units were called “observations”. The second measure was the actual sherd counts from systematic non-random surface collections. Survey was stopped when several hundred meters were traversed with no or very few artifacts appearing on the surface.

Survey teams of two to three archaeologists and one local guide recorded information on visibility, land use, slope, state of erosion, and artifact density for each observation. Most of the terrain covered was terraced agricultural and pastoral land. A description of the different categories listed above can be found in Appendix A. Observations usually covered the geographic area of a agricultural field or terrace. Observations that were not fields or terraces were patches of land with clear boundaries and uniform use. These observations were numbered sequentially from 0001 to 1622 and covered the full 5.3 km^2 area of the survey. The size and shape of the observation area was drawn on printed field maps based on digital orthophotos (scale 1:50,000) of the area obtained from the State of Mexico. The field maps were hand digitized in ESRI ArcGIS (ArcView) at the end of each day. Recorded attributes were entered into a MS Access database and linked to the ESRI shapefiles to check survey coverage before the start of the next day's fieldwork.

The survey area was divided into both a 100 meter and 50 meter grid for sampling of surface collections. The 50 meter grid divided each 100 meter grid unit into quadrants. A 5m x 5m square collection unit was laid out in the southeast quadrant of each one-hectare square. These served as the non-random systematic surface collection sample. The goal of these collection squares was to recover large samples of surface artifacts from throughout the area of the site. The locations within each in the southeast quadrant were selected by the survey crew in an area of heavy surface artifacts. We rejected the use of random sampling to select collection locations because that would have produced many collections with small numbers of artifacts. Collection squares were laid out on all terrain types including slopes and corn fields. Measuring tapes were arranged into squares, with five meters on a side. Within each square, every visible artifact larger than a thumbnail was collected and analyzed. The GPS points recorded for each surface collection were given an identification code that consisted of three numbers, which ranged sequentially from 1 to 900, and a letter, which would indicate the type of surface collection. Non-random systematic surface collections were labeled with a C. It is through the C-number designation that artifact data are joined in the GIS for spatial analysis.

Lithic and ceramic artifacts were recovered from 528 non-random systematic surface collection units from a 5.3 km^2 survey area. Many surface collection units did not have any artifacts. Of the while 528 non-random systematic collection units recorded, more than half (360 units) did not have artifacts.

Prior to collecting, the same types of visual assessments of surface conditions and artifact density were recorded for the surface collection locus as had been done for the observations. The location of each surface collection was recorded using a Garmin E-Trex Legend GPS device. The GPS point recordings were transferred to an ESRI shapefile using the Minnesota Department of Natural Resources (DNR) Garmin Extension program (Tomaszewski 2006). Additional surface collections and observation were made in situations where there was an opportunity to examine open trenches, construction cuts, especially dense artifact concentrations, or visible architecture to aid in addressing other project goals.

Survey teams were trained to make visual assessments by studying archtypical tracts of land exhibiting the attributes in question. All project members were trained simultaneously and individual team compositions were changed frequently to diminish the opportunity for strongly divergent classification criteria to take hold. Visibility was assessed on a four point scale corresponding to percentage of ground cover visible

Artifact density was on a five point scale using the categories none, trace, scanty, light, moderate, and heavy (Table 3.1).

Density	N = Surface Collections	Mean Sherd Count (5 x 5 m)
Heavy	11	851
Moderate	85	303
Light	168	153
Scanty	199	36
Trace	136	6

Table 3.1 Density categories

These categories were tested for congruence using artifact counts from surface collections identified as belonging to each visual artifact density category. Visual artifact density measures will be discussed in more detail below. We identified twenty-five different land use types (Appendix A). These land use types fall under three general land use categories: agricultural/pastoral (which includes terraces), modern urban usage, and natural uncultivated landscape (eg. forest, bedrock outcrops).

Preliminary classification of obsidian and ceramic artifacts was carried out during survey field season. Data on artifact size, degree of erosion, identification of vessel or object form, source material, and surface treatment were recorded where available. The lithic materials, including the obsidian, were later reanalyzed by Bradford Andrews. Chemical geological sourcing of the obsidian took place at the Missouri Research Reactor (MURR). I performed a more detailed attribute analysis on the ceramic materials in later lab seasons. However, I will be concentrating on the ceramic artifacts that are also used for the analysis discussed in subsequent chapters.

Defining Boundaries

A very general conceptual definition of a "boundary" is any physical, temporal, emotional, cognitive, and/or relational limit that defines an entity as separate from another (Ashforth, et al. 2000, 472). Boundaries are real because individuals perceive them as real; therefore, individuals act according to their perceptions of reality. This occurs regardless of any physical marker of the boundary. Sometimes the physical marker of the boundary, such as a fortified wall, is an objective reality that is reinforced by beliefs and customs associated with it. Other times no marker is present, but the beliefs and customs based on the perception of the boundary continue to exist. Because individuals behave as if these boundaries exist, the perceived differences between the things separated may become more pronounced through time (Ashforth, et al. 2000; Bourdieu 1977; Kooyman 2006). This behavior reaffirms the boundary and, in cases where material culture is associated with the bounded activity, marks the boundary in ways that can be perceptible to others.

Archaeological discussions of settlement boundaries include debates between site and non-site archaeological approaches to survey. On one hand, sites are conceived of as "discrete and potentially interpretable" loci of cultural materials. In this definition, sites are bounded entities whose boundaries are marked by relative changes in artifact density (Plog, et al. 1978, 389). Supporters of the non-site approach critique this view as being a construct imposing order on and creating an entity out of the varying spatial distributions of surface artifact. This construct is one that inappropriately warps the empirical realities of the archaeological record (Dunnell 1992). The charge is that, by focusing on sites as reified entities and not as concentrations of artifacts within a mosaic of artifact distributions, researchers miss important components of the archaeological record (Alcock 2000; Bintliff 2000; Gallant 1986). In situations where the behavior of interest is a low intensity activity that may leave few archaeological signatures on the landscape, a site-less approach is more suitable. Some research questions, however, require the identification of a bounded site in order to proceed in a fruitful manner. Research on the topic of ancient urbanism requires the identification of spatially discrete urban populations.

The central purpose of my project is to understand prehispanic urbanism by focusing on the understudied residential sectors of the ancient city of Calixtlahuaca (Smith, et al. 2007). In order to begin addressing questions of urban layout, socio-spatial organization, economic organization, and urban/hinterland relations, boundaries between spaces must be identified. If urban areas are marked by intensive occupation resulting from a relatively dense nucleation of city residence (Sanders and Webster 1988; Smith 1989), then resulting artifact distributions should be perceptibly higher than surrounding "background noise" from low intensity activities or sparse occupation (Gallant 1986; Smith, et al. 1994). If there are separate loci of settlement that are perceptibly discrete, of the kind that would register as separate sites through site based survey, these should be discernable as peaks of high artifact density spatially distinct from the urban signature of Calixtlahuaca.

Regardless of how the ancient Matlazinca and Mexica perceived their political boundaries, differences in settlement intensity and distribution normally will leave different artifact distributions across the landscape. Peaks and troughs in this distribution will be perceived by researchers as distinct changes in the artifact density of the survey unit. How can these perceivable differences be quantified in a non-subjective manner?

As discussed above, arbitrary limits for site and non-site areas are unsatisfactory because they ignore interpretably meaningful segments of the archaeological record (Gallant 1986; Plog et al. 1978; Dunnell 1992). Furthermore, such subjective limits rest on impressions of what a habitation signature should look like rather than any proven relationship. In order to address this problem I return to the issue of perception. If boundaries are realized through repeated behavior that creates them as separate and real entities, these should be consistently perceived by multiple individuals. Perceiving these boundaries does not discount the fact that these exist regardless of political boundaries. The altepetl, as a political boundary understood by the its residents, may or may not include other smaller non-contiguous named hamlets and villages. I am focused on defining the contiguous urban core through boundaries marked by behavior rather than walls.

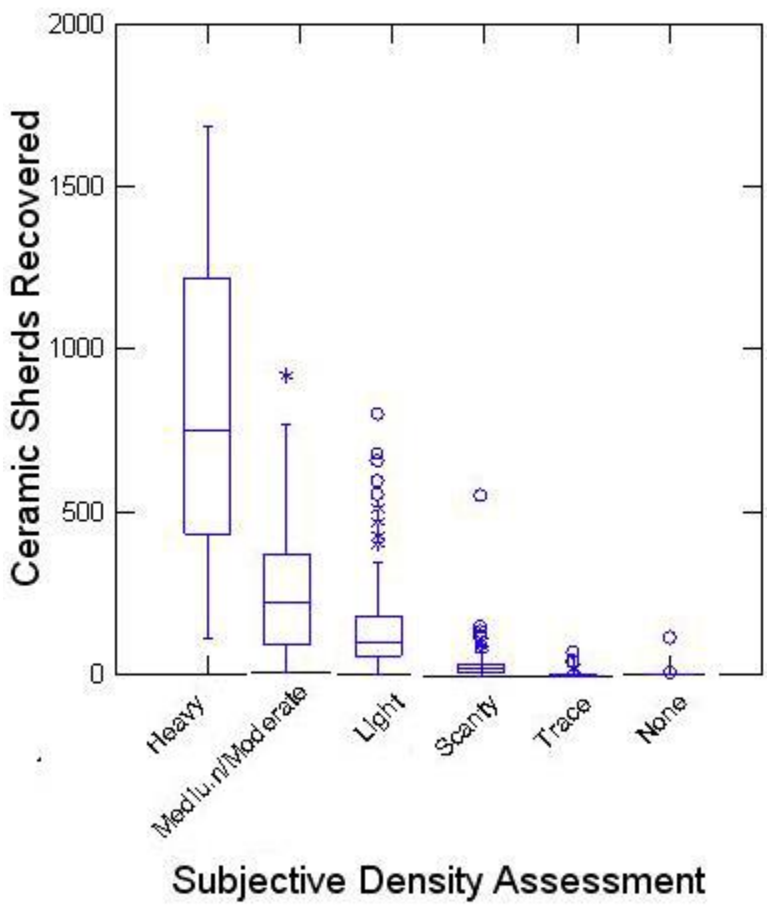
Researcher perceptions of changes the environment determine to varying extents where boundaries are found. If researchers do not agree on what visual scales represent, interpretations based on those scales can reflect on perceptions of data collectors more than objective measures of real phenomena. To examine researcher perceptions of change in the artifact distribution in the CAP survey, I explored survey team congruence in visual assessment and real artifact counts from surface collections. I used all non-random systematic surface collections, called sample W in Table 3.2. Table 3.2 is a list of all the artifact samples used throughout this dissertation and data they contain.

Sample	# of collections	Total sherds	Criteria	Analysis
A	138	2847	selected from sample Z where sherds for which vessel form data is available	
A1	125	2781	sample A as it intersects with sample C	
B	119	2803	selected from sample Z where 5 or more rim or appendage sherds that have available vessel form data are present	4.1
C	125	1201	selected from sample Z where only non-eroded sherds are counted	
D	76	1089	selected from sample Z where 5 or more non-eroded sherds are present, only non-eroded sherds are counted	
E	125		Intersect of sample A1 and sample C	4.1
E1	38		sample E collections with 10 or more non-eroded sherds	4.1
F	67	897	selected from sample Z, Sherd types condenced into classes, only for bowls, jars, basins, and comals. All collections with 5=< non-eroded sherds.	
F1	33	655	Sample F collections with 10<= non-eroded sherds.	5.1
F2	67	897	Sample F collections with Kmeans group assigned	5.2,7.2
F3	11	376	Sample of F collections with 20<=non-eroded sherds	5.3
G	138	2847	Selected from sample Z, sherds for which vessel form is available, sherd forms condensced into single categories for bowls, jars, comals, pitchers. Unidentified sherds removed from analysis. All other categories as collected	
G1	90	2604	Sample G collections with >10 sherds	5.6
G2	119	2803	Sample G collections with >5 sherds	5.7
W	528	29,865	all non-random surface collections, all sherds	All in 3
X	116	2393	rim and appendage sherds from surface collections with >=30 total sherds and >= 10 non-eroded sherds	

Y	22	454	rim and appendage sherds from surface collections with >=75 total sherds and <10 non-eroded sherds
Z	138	2847	The union of sample X and sample Y

Table 3.2 List of named samples used for all research.

By congruence I mean how consistently teams recorded the same range of sherd counts as the same artifact density category. This analysis is graphically depicted in Figure 3.2



3.2 Boxplot depicting observer congruence in visual assesments of surface units.

Survey teams were most successful at distinguishing “trace” levels of artifacts as the same general quantity of artifact per square meter based on the evidence seen in Figure 3.2. This suggests that survey teams were consistently able to perceive the same difference in artifact distribution since the artifact counts were consistent for the visual assessment they recorded. I interpret this congruence in visual assessment and real artifact recovery to indicate a real boundary produced by a perceivable shift in artifact usage.

In quantifiable terms, the "trace" density category was equal to ten or fewer sherds per collection area. This translates to a maximum artifact density of 0.4 sherds per square meter. It should be noted that for the purpose of observation units, a single sherd was sufficient to be recorded as a trace density, so this density could be far lower for some survey units. A surface collection of ten sherds or less signaled that its location outside of the settlement limits. In comparison with similar surveys of urban centers in neighboring Morelos, this limit is quite low. The Yautepec Valley survey used an arbitrary density limit of three sherds per square meter as distinguishing between site and non-site areas (Smith 2006). For the more intensive survey of the city of Yautepec itself, a density of 1 sherd per square meter was used to establish the survey limits (Smith, et al. 1994).

If I accept the common assumption that surface artifacts approximate 5% of the amount of material in the plow zone (Ammerman 1985; Odell and Cowan 1987), then each square meter of surface area in "trace" survey units would produce less than eight sherds if the plow zone was excavated. I feel it is unlikely, based on artifact density alone, that any of the urban settlement was excluded by using this value as the artifact density limit for settlement. Figure 3.2 shows a box-plot of the differences among density categories using the Observation and surface collection counts that have been discussed so far. Other factors, such as visibility, land use, and erosion may be impacting the surface artifact distributions observed by survey teams. I examine these factors and their impact on settlement boundary estimates below.

Factors Impacting Surface Artifact Distributions

Visibility, the ability to clearly see artifacts on the ground surface, is one factor that allows for or obscures the recovery of artifacts and the identification of sites on the landscape (Plog, et al. 1978; Schiffer, et al. 1978). These effects are often taken into consideration in the interpretation of surface artifact data through statistical analysis, experimental studies, and artifact index transformations (Alcock 2000; Barton, et al. 1999; Barton, et al. 2002; Barton, et al. 2004; Bintliff 2000; Fentress 2000; Given 2004; Millett 2000; Plog, et al. 1978; Schiffer, et al. 1978; Schon 2000; Stark and Garraty 2015; Taylor 2000; Terrenato 2000; Terrenato and Ammerman 1996). Criticism of artifact indexes and other transformations of survey data based on visibility question the assumption that the relationship between artifact recovery and visibility is a linear one (Given 2004; Schon 2000). Tests of this assumption have proven that, if any relationship between recovery and visibility is evident, the relationship is nonlinear (Barton, et al. 2002; Schon 2000; Terrenato 2000; Terrenato and Ammerman 1996). By extension, simple transformations of raw artifact counts are not advisable as they can be misleading (Given 2004; Schon 2000). At best, researchers should assess the strength of the relationship between visibility and recovery to better interpret spatial patterning.

In cases where a relationship between visibility and artifact recovery had been identified in earlier studies (Terrenato and Ammerman 1996; Thompson 2004), the relationship is such that maximum data recovery occurs when visibility is between forty and ninety percent. The visibility classes at Calixtlahuaca were divided into quartiles. These quartiles represented a visual assessment of the ground surface by project members based on the percentage of visible bare soil. The more bare soil with no vegetation, the higher the visibility. For this reason, grassland was often classified as t having no visibility and in the first quartile. A parcel with young corn with broad leaves would register as in the second or third quartile because, while the leaves were large, it was possible to see a large amount of bare soil. Other materials besides vegetation could reduce visibility, such as cement pavements or built objects like houses. Since our visibility classes are divided into quartiles, I combined the last three quartiles (above twenty-five percent visibility) together as representing the best visibility.

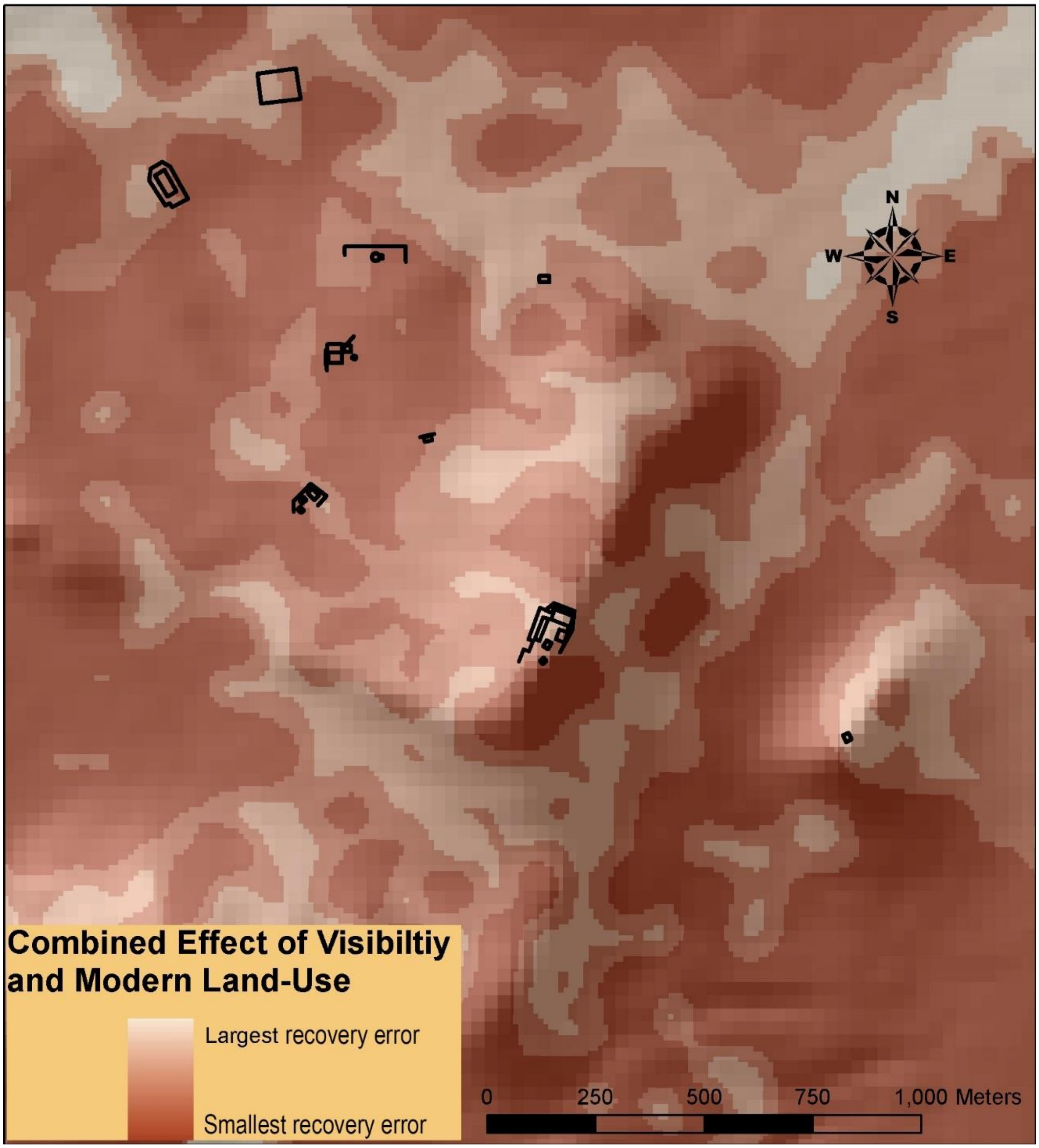


Figure 3.3 Areas where chances of error are highest in estimating urban boundary. Larger recovery error indicates areas where the chance that visibility and/or land use obscure the real artifact count are higher. The reverse is true of areas with smaller recovery error.

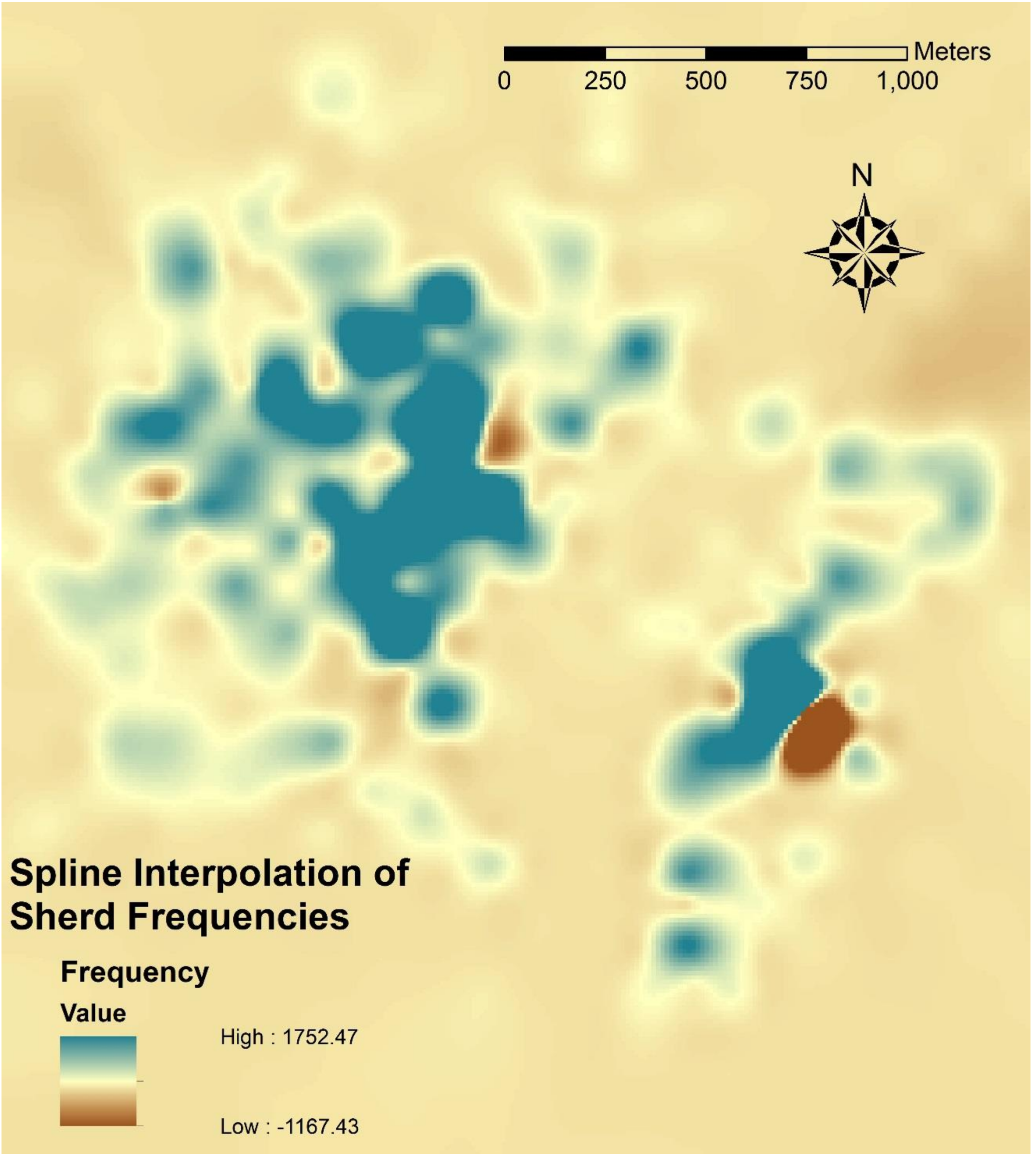
Figure 3.3 shows the parts of the survey area that are most effected by the obscuring effect of visibility and modern land use. This map is a spline interpolation of values assigned to visibility (higher the values have less visibility) combined with modern land use (use that obscures artifacts has a higher value). The combined values show where the chance of error in recovery of artifacts is highest.

I assessed the relationship between visibility and artifact density using the surface collection data from sample W. I grouped artifact counts according to the modal values associated with the artifact density categories discussed above. This served as an approximation for the visibly assessed density categories recorded for observations. I ran a Chi-square test on the resulting contingency table (Table 3.3).

Density	Poor Vis	All Other Vis
Trace	155	40
Scanty	17	17
Light	26	69
Moderate	8	42
Heavy	1	24
N	207	192

Table 3.3 Contingency table comparing the relationship between artifact density and visibility

The results of statistical analysis suggest that a relationship between visibility and artifact recovery exists and that this relationship is moderate in its strength based on the Cramer's V statistic. To examine the nature of this relationship, I applied Mostellers' standardization to the contingency table to determine if there was a pattern in cell contributions. Mostellers' standardization transforms the contingency table so that the cell values are expressed as a proportion of the total sample. In short, as visibility improves so does the quantity of artifacts recovered.



3.4 Map of settlement showing both areas where secure and less secure assessments of population presence are made.

Figure 3.4 shows the areas of Calixtlahuaca with high and low artifact densities. This pattern shows that high density collections are located along the northern flank of Cerro Tenismo and low density collections most other places in the survey area. In particular are two “dead zones” where the frequencies of artifacts are so low that the projected values dip deeply into the negative. One of these areas is on Cerro San Marcos near a small monumental construction. Because high density artifact distributions tend to be highly obtrusive (sensu Schiffer et al. 1978), the detrimental effect of visibility on data recovery is most pronounced in areas of naturally low density. Places with high artifact density will register as being occupied, regardless of barriers to visibility. Low population areas are likely to be found at the edges of urban areas and signal the edge of the urban area. Low population presence areas are likely to produce fewer artifacts than high population areas thus producing a low density signature. Since low artifact densities indicate the edge of the settlement and high density areas will be visible even in poor visibility conditions, then it is not likely that a low density collection indicates a high populated area. This suggests that overall spatial patterning of archeological materials is not greatly impacted by visibility (Barton, et al. 2002; Gallant 1986; Terrenato 2000; Terrenato and Ammerman 1996; Thompson 2004). While it is possible that low density surface collections in low visibility areas are reflecting the real structure of residential settlement at Calixtlahuaca, other possibly artifact-obscuring factors such as erosion and modern land use must be considered before settlement boundary estimates can be generated.

Contemporary land use is another factor that has the potential to obscure artifacts from the observer. While some of this impact is a result of the poor visibility conditions produced by contemporary land use, visibility alone is not sufficient to account for differences in recovery rate (Barton, et al. 2002). Contemporary urban settlement may hide the remains of prehistoric settlement beneath houses, shops, roads, and cement sidewalks. Bulldozing, grating, or leveling with fill can also modify the number and content of surface materials in a manner that is not taken into account by visibility (Given 2004). Overgrown vegetation can hide artifacts on the surface; however, the effect of vegetation is different in a forest compared to an agricultural field. Agricultural practices of tilling can pull up fresh artifacts to the surface at each plowing, increasing the artifacts available on the surface when compared to non-cultivated areas (Ammerman 1985; Odell and Cowan 1987).

Both modern occupation and long term non-cultivation (e.g. forested land) should have similar detrimental effects on artifact recovery. The opposite would be true of agricultural areas. For these reasons I collapsed land use categories relating to modern occupation and extensively uncultivated areas together for statistical analysis. Pastoral lands were usually fallow terraces and thus included as agricultural land. A Chi-square statistical test, the same methods as described above, showed a statistically significant pattern in the table produced (Table 3.4). In this case, the relationship between artifact recovery and land-use is moderately weak based on the Cramer's V produced but still evident.

Density	Agricultural	Natural	Modern Occupation
Trace	37	76	82
Scanty	12	13	9
Light	44	36	15
Moderate	24	19	7
Heavy	15	3	7
N	132	147	120

Table 3.4 Surface collections classified by land use and density category to show the relationship between the two.

Implications for the Settlement Boundary Estimate

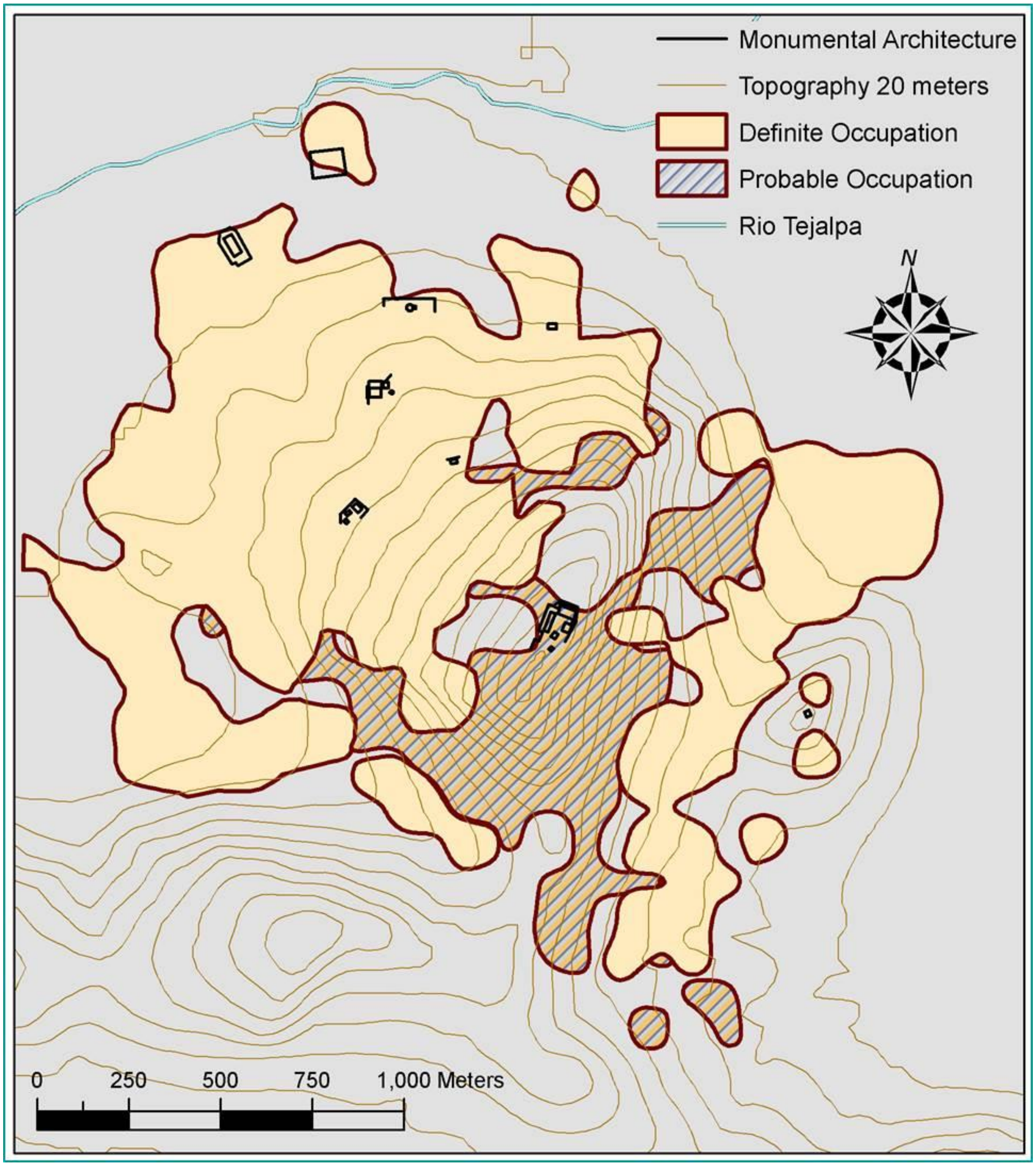


Figure 3.5 Spline interpolation of ceramic density figures.

I established in the previous section that the relationship between artifact recovery, low visibility, and non-agricultural use is moderate to moderately weak. As a result, the general patterning exhibited by the raw artifact distributions is likely a reflection of intensive prehispanic settlement rather than a result of poor survey conditions. Care should still be taken in identifying the location of the urban settlement boundary. The propensity for low density surface collections to be encountered in areas of low visibility and non-agricultural use may be a result of the obscuring effect of these landscape attributes. Given the above analysis of artifact recovery in relation to the factors of visibility, land use, and erosion, it is possible to identify areas where the potential for data error is highest (Figure 3.3). The areas where potential data error was highest are incorporated into the model for Calixtlahuaca's urban boundary as the area of probable occupation (Figure 3.5).

As discussed above, the boundary between the "trace" level (0.4 sherd per square meter or less) and areas of higher density was used to identify the location of the settlement boundary. The settlement boundary was based off a spline interpolation of the artifact counts from surface collection data points. The interpolation was converted into contour lines representing the shift in sherds per square meter. The trace level contour was used for the initial boundary. This boundary was overlaid onto the observations and checked that areas assessed with no sherds and those with trace sherd counts were on the appropriate side of the boundary. In this way, evidence from both observations and surface collections were used to generate the boundary.

The area inside the site boundary with higher probability for error in recovery (Figure 3.5) was labeled as an area of "probable occupation". In labeling this portion of the overall settlement as probable, I am acknowledging the potential for the actual settlement limit to be obscured by the effects of visibility, land use, and erosion. Collections from agricultural areas or zones of optimum visibility were labeled as the area of "definite occupation". The survey conditions in these areas are better suited for artifact recovery.

The resulting bounded area provides the minimum settlement size estimate for the city of Calixtlahuaca. Two spatially distinct areas of high artifact density comprise the 264 ha settlement (figure 3.5). Between the two loci of high artifact density is a region with steep sloping topography. Given the steepness of the slope, it is possible that erosion has destroyed the surface signature of a prehispanic occupation in this area. The area between the two high density loci contains a light to moderate occupation. It cannot be completely discounted that a small population inhabited this area in the past. If the area between the high density loci is included in the settlement size estimate, Calixtlahuaca was a maximum of 299 ha. The prehispanic settlement at Calixtlahuaca was thus 180-232 ha larger than the official INAH zone.

Defining Neighborhood and Zone Boundaries

Neighborhood Units

The complex depositional structure of the modern terraces created a situation where the surface artifacts typically originated in a "catchment zone" larger than their immediate spatial context on the ground. It is therefore highly unlikely that individual surface collections represent the remains of a single household. Smaller Pre-Columbian terraces had been dismantled to create larger modern terraces for plow based agriculture

(Smith et al. 2013). This produced a palimpsest of temporal periods and individual households. However, since none of the modern terraces were larger than the hectare from which a surface collection sampled, surface collections almost certainly represent the remains of one or more households living in the immediate vicinity. Although individual households can rarely be isolated in the surface collection data, the larger spatial units included in each collection can be aggregated into neighborhoods.

Neighborhood units were identified using a three step process. First, I used sample W (Table 3.2), which contains the data from all sherds from all collections, to interpolate a raster from the sherd counts associated with the shapefiles of surface collection locations. This means the GIS created a data encoded picture of the artifact distribution based on all collected ceramic data. A table containing the sherd totals was joined to the shapefile through the GPS point identification code. A spline interpolation was performed using the sherd frequencies (figure 3.4) A spline interpolation is best for gently varying surfaces (ESRI 2008), which is the case when looking at sherd frequency fall offs.

Second, I used the interpolated raster to generate contour lines of sherd density. The contour equaling three sherds per square meter or seventy-five sherds per collection, was selected to define the neighborhood limits. A three sherd per square meter density was used to identify the boundaries of Yautepec, Morelos (Smith et al. 1994) and would be sufficient to identify more intensely occupied areas of Calixtlahuaca. I converted the contour file into a polygon shape file. The urban boundaries had been determined using a similar method, with the contour equaling one sherd per square meter or twenty-five sherds per collection being selected as the starting point for the limits of ancient settlement.

Urban neighborhoods are residential areas of where residents live near enough for potential intense face–to-face interaction can occur. As a result, a higher concentration of houses allowing for that kind of interaction would be expected within a neighborhood than without at Calixtlahuaca. Smith (2011) has argued that neighborhoods in low-density Mesoamerican cities can be isolated as spatial clusters of houses, and this principle provides the rationale for my methods of identifying neighborhoods from surface collections. Spatial clusters are groups structures or objects that are located in close proximity to each other in space. Since low density tropical cities, like found in Mesoamerica and Southeast Asia (Fletcher 2009; 2011; Isendahl and Smith 2013), contain neighborhoods that are dispersed spatial clusters that are non-contiguously distributed across a settlement. Frequently, the land between neighborhoods are used for significant urban agriculture. The spaces of with low density sherd counts are very likely these spaces between neighborhoods not used as residential space and can be used as a neighborhood boundary. Using a limit of 3 sherds per square meter, this method identified twenty neighborhoods at Calixtlahuaca. It is important to note that the neighborhoods defined this way do not cover the entire surface of the site; I did not simply subdivide the site into smaller zones. By building my neighborhoods from the spatial distribution of artifacts, parts of the site surface were left outside of the identified neighborhoods. Areas where the neighborhood contour was pinching in were taken to be natural division in the neighborhoods.

Figure 3.6 Buffers around neighborhood polygons with surface collection locations.

The third step was to incorporate lower frequency surface collections into the neighborhoods that bordered them. Since surface collections with thirty or more sherds were targeted, some of the sample collections were outside the neighborhood boundaries. These surface collections may represent house groups that were occupied for a shorter length of time or by fewer people. Some of these were located in close proximity to the neighborhood boundaries. These house groups likely engaged in neighborhood activities with nearby inhabitants. To include these surface collections into the neighborhoods, I generated a buffer of 100 meters around the neighborhood boundary polygon (Figure 3.6). I then expanded the neighborhood boundaries to include those surface collections within a hundred meters of the prior boundary (Figure 3.7).

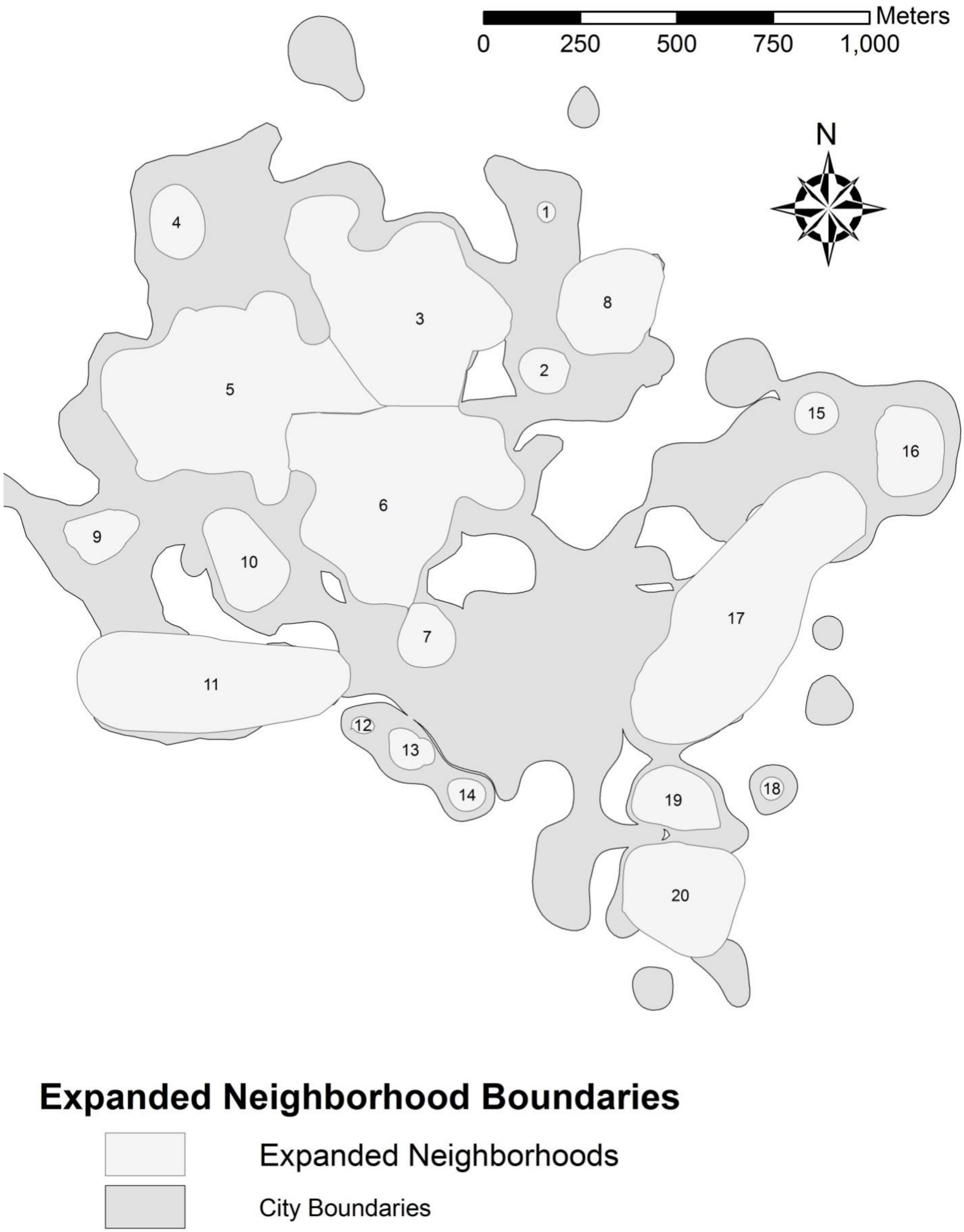


Figure 3.7 Expanded boundaries of neighborhood polygons

Urban Zones

My next task was to large scale socio-spatial patterning, above the level of the neighborhood. There is no monumental core of the city as is common elsewhere in Mesoamerica. The monumental architecture is dispersed across the northern half of the city. Clear districts are not easily discernible at the site. The spatial relationship among the temples, palace, and residential population does not allow for easy divisions of the site. Testing a concentric model (Marcus 1983) of urban form is difficult at Calixtlahuaca because of the lack of an urban core. The sector or multiple nuclei models may have more salience. I examine two alternative patterns for districts: zones based on distance from monumental architecture and zones based on the topography of the settlement.

The first method to identify spatial zones is an adaptation of the concentric model, based on multiple "centers" as defined by the major monumental architecture at the site. This model is based on the assumption that the temples and palace played some kind of role in structuring the spatial patterning of settlement. I generated a series of four buffers around the locations of monumental architecture at multiples of 250 meters (Figure 3.8). These are labeled zones one, two, three, and four. Neighborhoods are assigned to the zone in which the majority of their territory lies (Figure 3.9). There are no neighborhoods in Zone Four, though there is some settlement.

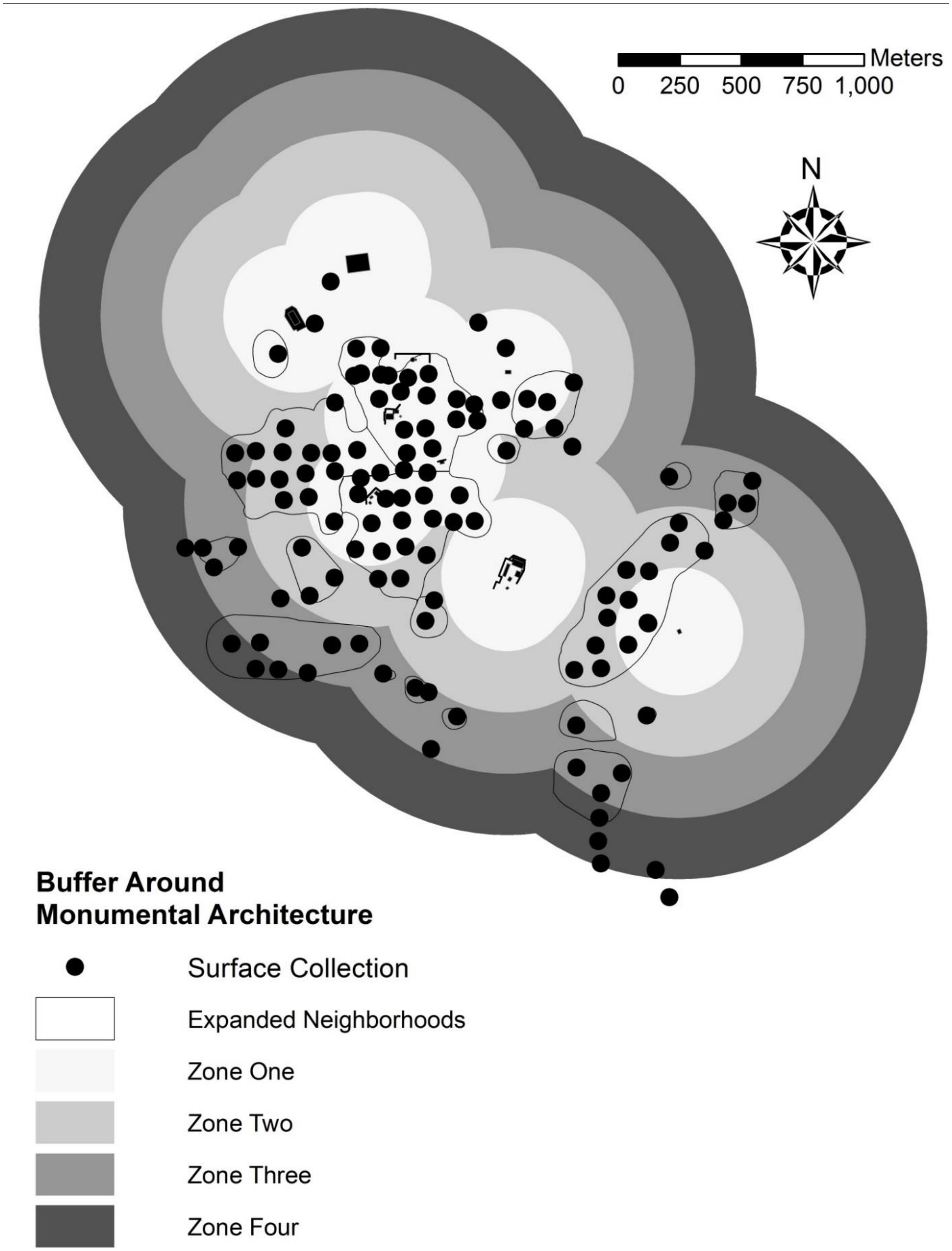


Figure 3.8 Buffer around Monumental Architecture

Figure 3.9 Neighborhoods in Zones 1-3

The second model is based on travel costs. Just as residents are assumed to interact more frequently with others in the same neighborhood than with outsiders, this model assumes that social interaction in larger spatial zones follows the same pattern. The site is divided naturally into topographic zones whose divisions—cliffs and steep slopes—would have inhibited movement. Much of Calixtlahuaca is built on Cerro Tenismo, a cinder cone that creates a ridgeline naturally dividing the settlement into three divisions (figure 3.10). These zones defined by this division are labeled the Northwest Zone, the Southwest Zone, and the East Zone (figure 3.11).

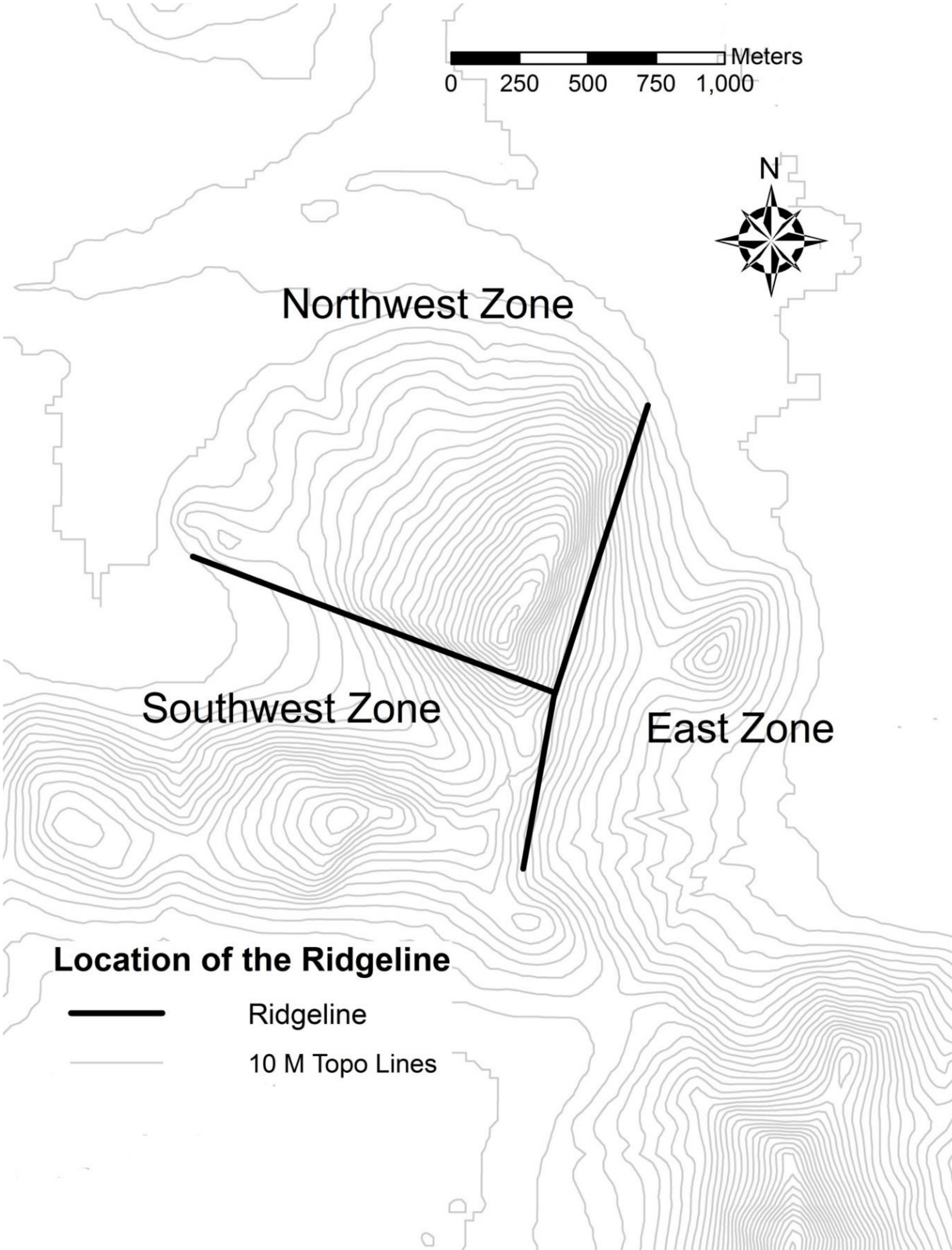


Figure 3.10 Topography in relationship to ridgeline zones.

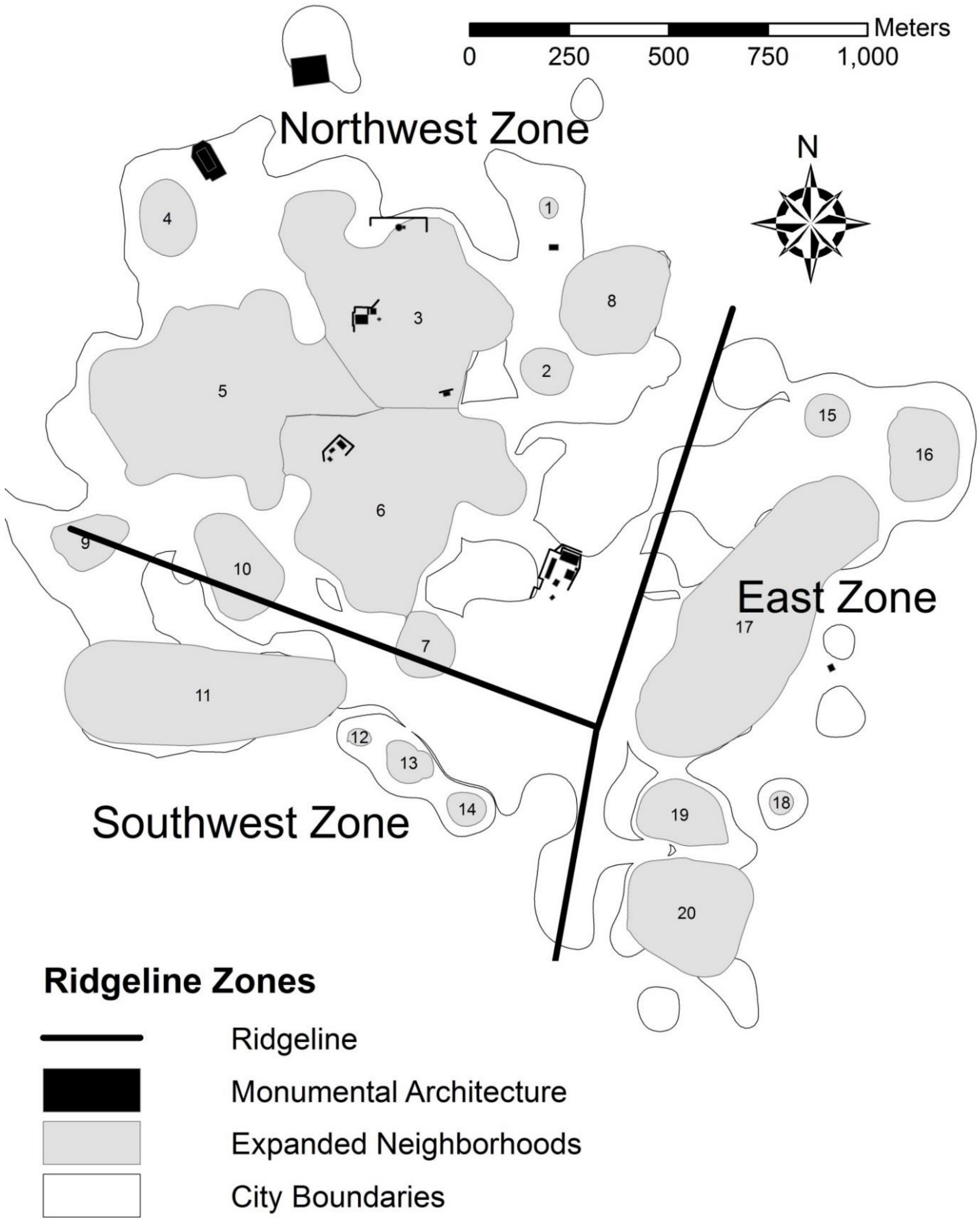


Figure 3.11 Ridgeline Zones: NW, SW, and E

Description of the Artifact Sample

We collected a total of 2,120 pieces of obsidian and 29,865 sherds for all 528 collections in sample W. I analyzed in detail a subset (sample Z), the 138 collections that are within the boundaries of the neighborhood limits. This work was done during two month lab seasons between 2007 and 2009 and a five month lab season in 2010. These collections are the non-random systematic collections collected using the methods described above . Forty-five percent of the ceramic artifacts in this sample are so eroded that surface treatment cannot be determined; however, basic vessel form can be identified for many of these. I classified all rim sherds, all appendages, and censer fragments recovered during the survey for my initial sample of 138 collections. I use data on obsidian color and source to address the question of whether residents procured items from the same production source. These data were analyzed statistically using the commercial software package Tools for Quantitative Archaeology (Kintigh 2009) and the results were loaded into ArcGIS and joined to the surface collection shapefiles.

Artifact Data

Ceramics. I collected data on two ceramic variables: 1) vessel form and 2) decorative type. The decorative type of each sherd is identified using the Calixtlahuaca Archaeological Project typology which was based on variations in paint color, decoration and general vessel form (Huster 2015). I reduced these features to basic values that could be identified on the majority of eroded sherds (table 5.1). Vessel form was characterized using the slope of the vessel wall and other characteristics. These can be found in Appendix B. Chapters 4 and 5 use data on these variables to examine spatial patterns wealth and consumer preferences.

Lithics. Small amounts of basalt and rhyolite were recovered in the surface collection units. These were not found in enough surface collection units to allow for meaningful spatial analysis. The dominant type of lithic material in the surface assemblage is obsidian. Two types of obsidian dominate the Calixtlahuaca surface collections. 1) Green obsidian which is almost certainly from the Sierra de las Navajas source in Hidalgo, Mexico. 2) Dark gray obsidian which may be from any of a number of nearby sources or from Michoacan or Central Mexico. I chemically sourced a sample of gray and green obsidian using XRF, a non-destructive technique (Smith et al. 2007), to examine the distribution of obsidian from different sources across neighborhoods. The Archaeometry Laboratory at MURR, which has a substantial database of Mesoamerican obsidian sources, carried out the XRF sourcing study (Glascock 2012). The goal was to analyze nine pieces of gray obsidian from each of the twenty neighborhoods. Ten pieces of green obsidian were sampled from the whole collection to confirm that the green obsidian came from the Sierra de las Navajas source. A total of 200 pieces were to have been sourced. This is 9.4% of the total obsidian collection. However, due to size constraints of the XRF machine and the small size of the survey obsidian, only 155 pieces were actually sampled, or 7.3% of the total obsidian collection. The results of the chemical characterization will be compared across neighborhood units in Chapter 6.

Statistical Methods

Both simple and complex statistical methods are used throughout this study. I emphasize exploratory data techniques, various clustering and cluster analysis methods, and standard statistical significance tests. Spatial clustering was explored using both GIS displays and hypothesis testing measures based on artifact counts.

Exploratory data techniques. Statistical means appear frequently as a summary statistic describing populations (usually neighborhoods or larger zones) and are the simplest of measures. I employ histograms to characterize a typical individual, to explore the nature of variation, and to display the shape of a distribution (Shennan 2006). I use histograms in Chapter 4 to identify different social classes at Calixtlahuaca. In this case, the shape is the most important aspect of thr histogram since I am looking for breaks within the distribution that might have meaning. The groups created by these breaks I test for coherence using Analysis of Variance (ANOVA).

Clustering and analysis of clusters. K-means clustering is used to group surface collections into clusters based on the proportion of each decorative type in the sample. K-means clustering analysis is a non-hierarchical divisive method that tries to minimize the distances within clusters while maximizing the distance between clusters given a set number of clusters (Kintigh and Ammerman 1982, 39). These are not spatial clusters but are rather groups containing similar distributions of various artifact types or categories. I use Tools for Quantitative Archaeology (TFQA) (Kintigh 2009) which creates clusters by minimizing the squared sum error (SSE). A plot of these for each cluster reveals the point at which the largest decrease in SSE occurs, thus suggesting an optimal number of clusters. I use this method to judge the best cluster level. The clusters are defined in this instance without regard to spatial relationship (see Robertson 2001 for a similar approach). The goal is to see which of the surface collections are most alike in terms of consumer preferences (see Chapter 5).

One of my major concerns is the degree to which neighborhoods show spatial clustering of inhabitants with similar attributes. Since I already know that my unit of analysis is the neighborhood or zone, I can examine the concentration of residential groups intermediate between household and neighborhood. This is done using the Simpson's C statistic of cluster dominance (Howell and Kintigh 1996). Cluster dominance is a statistical test of whether or not a category is found in a high enough concentration to be able to say that the neighborhood exhibits social clustering. If the Simpson's C measure is above .65, then the neighborhoods or zones can be said to be clustered. This statistic is calculated using TFQA.

A secondary test of social clustering uses the Brainerd-Robinson coefficient, again calculated using TFQA. The Brainerd-Robinson coefficient is a multivariate method developed specifically for comparing the similarity of assemblages with multiple types (Brainerd 1951; Cowgill 1990; Peeples 2011; Robinson 1951; Shennan 2006: 233). The more similar two assemblages, the higher the value, on a scale of zero to 200. I use the Brainerd-Robinson coefficient to confirm the results of my Simpson's C analysis by comparing neighborhoods and zones. I also use the Brainerd-Robinson coefficient to match excavated assemblages with their corresponding K-means derived consumer group (see Chapter 7).

Statistical Inference Tests. Statistical inference tests are ways of testing whether or not two or more samples are different enough in terms of central tendency and variation to be considered separate populations. The alternative, often called the null hypothesis, is that these samples are more likely to be drawn from the same population. These statistics yield a p-value, which is a statement of probability. I consider a p-value below or equal to 0.1 a rejection of the null hypothesis, which means that the populations are different.

The standard test of statistical inference is the T-test which uses information about the mean and standard deviation to calculate the p-value. This type of statistical test is ideal for comparing two samples (Shennan 2006). I calculate pair-wise t-tests using Mystat 12, the freeware version of Systat statistical software, while comparing survey and excavation results in Chapter 7. For the analyses in Chapters 4, 6, and 7, I had more than two samples to compare statistically. Since these were not multivariate comparisons, I was able to use ANOVA to analyze the variance present in multiple samples to determine if they come from the same population (Blalock 1972). This statistical analysis was easily done in Microsoft Excel using the Data Analysis Pak allowing several iterations to detect if one sample weighted the results.

Conclusion

The materials and methods described above are used to examine questions of socio-spatial organization at Calixtlahuaca. Understanding the formation processes and recovery issues that resulted in this pattern of surface materials allows for a nuanced identification of urban, neighborhood, and zone boundaries. The variables and artifact types recovered permit, once classified by multiple characteristics, the examination of socio-spatial organization in the neighborhoods and larger zones of the city. This is done using multiple clustering, exploratory, and hypothesis testing statistical methods. These allow me to rigorously address whether neighborhoods at Calixtlahuaca exhibited social clustering in terms of class, social identity, or access to resources in the following chapters.

CHAPTER 4

SOCIAL CLUSTERING ALONG CLASS LINES

While there is some debate, most archaeologists agree that there are two distinct classes in Mesoamerica: elite and commoners. Some argue for an emergent middle class, particularly in the case of the pochteca traders of Aztec Central Mexico (Sanders 1992). While slaves were known for the Postclassic and were likely present in earlier time periods, that segment of Mesoamerican society is not well understood. Generally, archaeologists think in terms of elites and commoners. Elites are the "segment of a social system that enjoys measurably more prestige, power, and/or wealth than society at large (Sanders 1992:278)". Commoners were the remaining ninety percent of the population.

In Mesoamerica, membership into the elite class of people was generally an accident of birth. Elites were born into high status kinship and descent groups. This is especially true among the Aztecs of Central Mexico. The elite members of Aztec society were the *pipiltin* or "children". The pipiltin were children of royal or noble personages (Lockhart 1992: 102). Members of this class held administrative positions within the political system and held special privileges codified in various sumptuary laws. They were among the principal landowners, they collected rent from the dependent commoners, and they were trained in rhetoric, law, calendrical systems and other esoteric knowledge (Leon-Portilla 1992:142-143). Rank within the *pipilli* was determined by genealogical closeness of kinship to the *tlatoani* or "king" (Leon-Portilla 1992).

The majority of the population in Postclassic Central Mexico was composed of agricultural specialists known generally as the *macehualli*. The *macehualli* owed taxes and rent in labor and materials to the lords among the *pipilli* (Leon-Portilla 1992;

Lockhart 1992). The term *macehualli* had both social and political connotations meaning both "commoner" and "subject." This segment of society included both land holding and dependent, landless peasants (Lockhart 1992: 95-100). Artisans and craftspeople were also members of the *macehualli* (Leon-Portilla 1992: 152-153).

Spatial Pattern of Mesoamerican Elites

As we saw in Chapter Two , there is variation in the way that neighborhoods are organized in Mesoamerica. This is also true of the spatial distribution of elites in Mesoamerican cities. In Xochicalco, Mexico, elites were mixed with commoners throughout the city (Hirth 2000). Monte Alban saw residential zones with a mixture of elite and commoner housing (Blanton 1978). At Maya Coba, elites lived mixed with commoners or in isolated groups (Kintz 1983). In contrast, Ian Robertson (2001) determined that , for Teotihuacan, there was a subtle tendency for elites to live together in certain areas of the city. Similarly, at Tzintzuntzan, in West Mexico, elites and non-elites lived in separate sectors of the city (Pollard 1977; Stawski 2008).

The case for the Aztecs is not clear. Politically, the elite were integrated with the *calpulli*, or neighborhoods, among the Western Nahua more so then in the Eastern Nahua, and elite residences may have been present in the calpulli of some cities (Lockhart 1992: 102-110; Smith 1993)

Identifying Elites

Much theoretical thought on social class and status is founded on the fundamental works and ideas of Karl Marx and Max Weber. Karl Marx presented class as being the entrenched differences in access to scarce resources and power of separate segments of society. These classes acted with class interest to maintain or increase access to the scarce resources. Classes shared interests because members of the same class occupied the same structural position within society and with regard to the means of production. These positions shape class members experiences and predispose class members towards certain actions that benefit the class as a group (Coser 1977). Similar experiences and actions of class members would require the use of similar objects to meet those needs. While some researchers feel that Marx's ideas are not applicable in pre-capitalist societies, the highly commercialized economy in Mesoamerica allow for class development, if not consciousness, to develop.

Max Weber's view of class has traditionally been viewed as a division of status and economic components of society. A recent retranslation of Weber's important essay *The distribution of power within the community: Classes, Status, Parties* redefines a key word that changes some aspects of understanding (Weber 2010). Instead of the word "status" in the essay, the original German word "stände" is kept. The German word "stände" does not have a direct translation in English. There is a German word that means status and Weber did not use it in his original text. The word "stände" has much in common with the French word "estate" and "reflects a style of life and assumption of rights that go" with this position (Weber 2010). The distinction that the translators make between class and "stände" is that "'classes' are stratified according to production and acquisition of goods, 'stände' are stratified according to the principles of consumption of goods as represented by specific 'lifestyles' (Weber 2010 footnote)." Honor and prestige are important for members of a "stande" but so too are power and economic control needed to maintain the "lifestyles". "Stande" have obligations that maintain the status and power individuals have as part of the position.

Weber's essay (Weber 2010) defines classes as having a causal component that is exclusively economic and found in shared commonalities in the conditions of the commodity and labor markets among class members. "Stände" are relational, ethnic, and professional. While status is a component of both class and "stände", status is a stronger component of "stände" than it is a component of class. Economics drive class in both Weber and Marx's theories of social stratification. Weber describes a form of social stratification where economics are important but not the key aspect. For example, sumptuary laws will be found in places where "stände" like systems occur because economic access to resources is not regulated in a class based system. In a class based system economic success provides the only requirement to social and political privilege. Since having the economic resources automatically permits one the right to privileged goods, sumptuary laws preventing low class (and thus resource poor) individuals from gaining access are not needed. Sumptuary laws occur where there is a non-economically derived social ranking with a specific lifestyle to maintain but high-rank individuals are unable to maintain a monopoly on economic accumulation.

These are idealized representations of two stratification systems. In practical terms, social stratification may have components of both systems acting at the same time. This is particularly true in conditions of fluctuation between one system to another. In the case of the Aztec, social rank was relational, ethnic, and professional in the case of the pochteca. Sumptuary laws were present as was a developing commercial economy without the crucial aspects of a labor and land market. Aztec society may have been in transition from "stände -like" social organization to a more class based system.

Social rank is reflected in consumption and in ways of manipulating everyday practices for economic or political power (Babić 2005). Archaeologically, elites are most readily identifiable from architectural remains (Blanton 1993). Elite houses and compounds will be the most elaborated and largest domestic structures in a community. Ceramics offer another avenue of identifying elites. Feasting is the communal consumption of food and drink (Dietler and Hayden 2001:3) and often has sociopolitical ramifications and purposes in pre-modern societies. While not always a reflection of wealth differentials, feasting as a political act is relevant for studies of elites that do not equate elite as simply those who have wealth. The role of feasting in studying social stratification is particularly useful when examining systems that are not exclusively or primarily organized into classes. Here is where the lessons of Weber's (2010) "stände" and its impact on the artifact record are important. Household feasting, or the household consumption rituals, involve "social gatherings within the context of the household that include the consumption of food, drink and other goods" (Smith 1987:313). Serving wares are used publicly, and they communicate status and group membership to others (Smith 1987:313). Elite households would hold more household feasts if they were successful in using feasts to gain political power and, as a result, have more serving wares in the artifact assemblage (Smith 1987;Garraty 2000) because they would be expected to as elites. In other words, higher proportions of serving ware should be found in and near the remains of elite houses.

Due to the dearth of surface visible housing at the Calixtlahuaca site, I use ceramics as the main mechanism for identifying elite locales and neighborhoods. Christopher Garraty (2000) compared six different indices for accessing Aztec eliteness using data Aztec period Teotihuacan. Of these, the indices that measure the proportion of decorated sherds per assemblage and the proportion of bowls and other serving ware per assemblage were very effective. These two types of indices can be applied to my survey data. In the following three analyses, I will identify candidates for elite house groups and examine their distribution across Calixtlahuaca's neighborhoods and possible districts. The results will show that, while elites were present at Calixtlahuaca, they were not clustered into any one neighborhood, but dispersed across many neighborhoods.

Analysis 4.1 First attempt at identifying elite house groups

The goal of this analysis is to identify surface collections that correspond to elite house groups. This attempt was unsuccessful in identifying the divisions between elites and commoners. I calculated a bowl to jar ratio using the data from sample B (table 3.2). This measure is commonly used to measure feasting archaeologically because it expresses variation in serving vessels to utilitarian storage vessels. Sample B consists of surface collections with 5 or more sherds that have vessel form data. As can be seen in Figure 4.1, the histogram has three natural breaks. These were the tentative group divisions. These were tested by comparing the proportion decorated with the bowl to jar ratio.

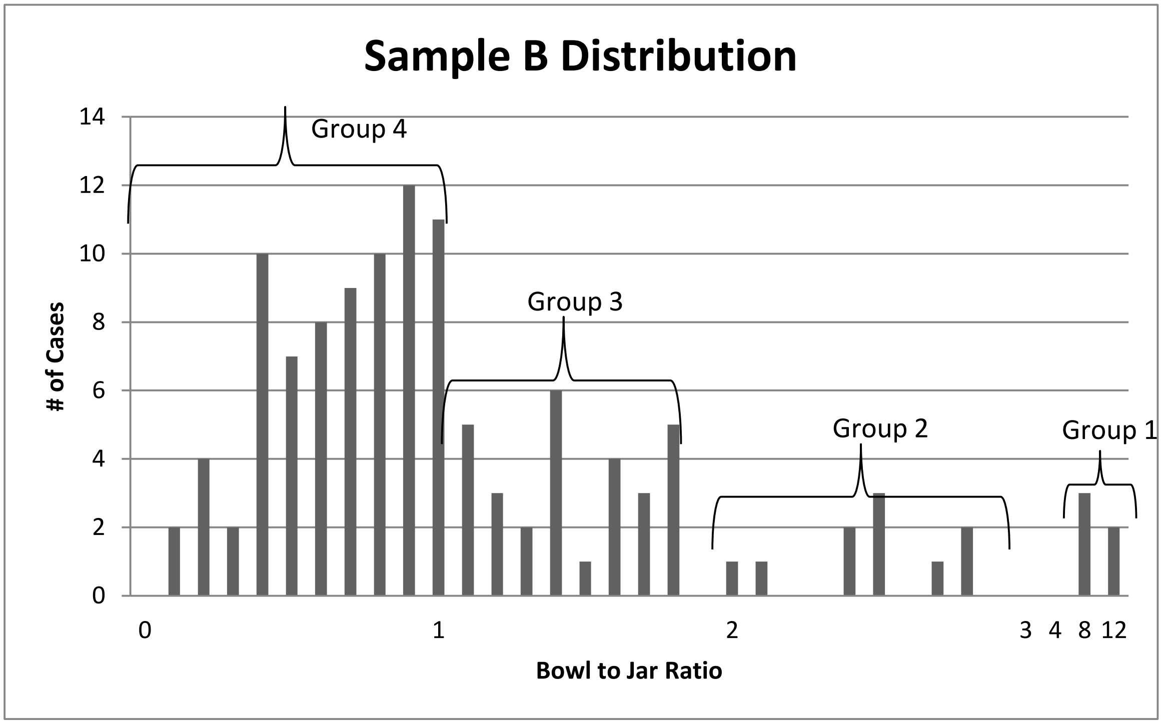


Figure 4.1 Histogram of Sample B showing groups from Analysis 4.1

Decorated Percents				
	Group 1	Group 2	Group 3	Group 4
N=	5	10	40	55
Mean	60.4	37.0	35.3	32.7
Median	64.3	45.0	35.3	33.3
StDev	28.7	18.9	10.8	15.3

Table 4.1 Frequency of decorated ceramics for groups in Analysis 4.1

ANOVA was used to determine if the mean decorated percent (Table 4.1) of each group was statistically significantly different. The α value for this analysis was set at

0.05. At that level, the four groups are not different for statistical purposes. However, the p value of for this ANOVA is 0.05044, which is extremely close to the α value. Looking at the means, those of Groups Two, Three, and Four are very similar. I ran ANOVA on those three groups and got a p value of 0.81, strongly suggesting that these three groups are not significantly different from each other.

Analysis 4.2 Reduction of Four Social Class groups to Two

Returning to the histogram of sample B data, I divided the sample into two groups (Figure 4.2). Group One, again, consisted of collections with a bowl to jar ratio above three. Group Two consisted of surface collections with a ratio between zero and three. Group Two includes all those collections that were part of Group Two, Three, and Four of Analysis 4.1. The ANOVA of mean decorated percent of Group One and Group Two generated a p value of 0.006, well below the α set for the ANOVA. In short, Group One and Two are probably from different populations.

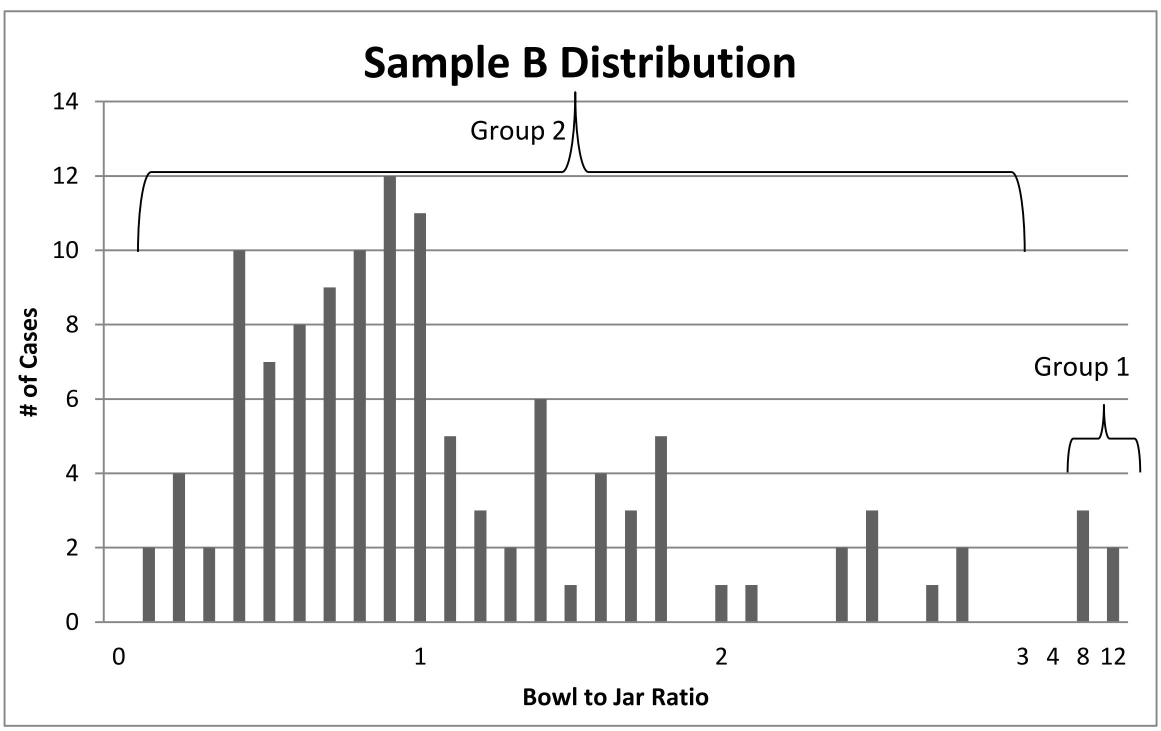


Figure 4.2 Histogram of Sample B showing groups from Analysis 4.2

Group One has a mean percent decorated of 60.4% (Table 4.2). A higher percentage decorated suggests better access to higher value material goods. Concurrently, these surface collections represent house groups, an analytical term I use to represent the catchment of one or more houses for each surface collection, that have more than three times the number of bowls as they do jars. This suggest that the residents of the house groups were engaged in activities, such as feasting, that would require more serving vessels. Group Two has a mean percentage decorated of 34.1%. This lower number suggests a more restricted access to higher value material goods. These house groups have a bowl to jar ratio between zero and three, a more modest amount typical of daily use by a household. These patterns suggest that we have two populations represented in these surface collections.

Decorated Percents		
	Group 1	Group 2
N=	5	105
Mean	60.4	34.1
Median	64.3	34.8
StDev	28.7	13.6

Table 4.2 Frequency of decorated ceramics for groups in Analysis 4.2

Analysis 4.3 Spatial pattern produced by location of different groups.

In order to look for spatial clustering of the two social classes, I joined the Excel table containing the bowl to jar ratios for the surface collections to a shapefile of the geographic coordinates of the surface collections in ESRI ArcGIS. Figure 4.3 shows the spatial distribution of the two groups.

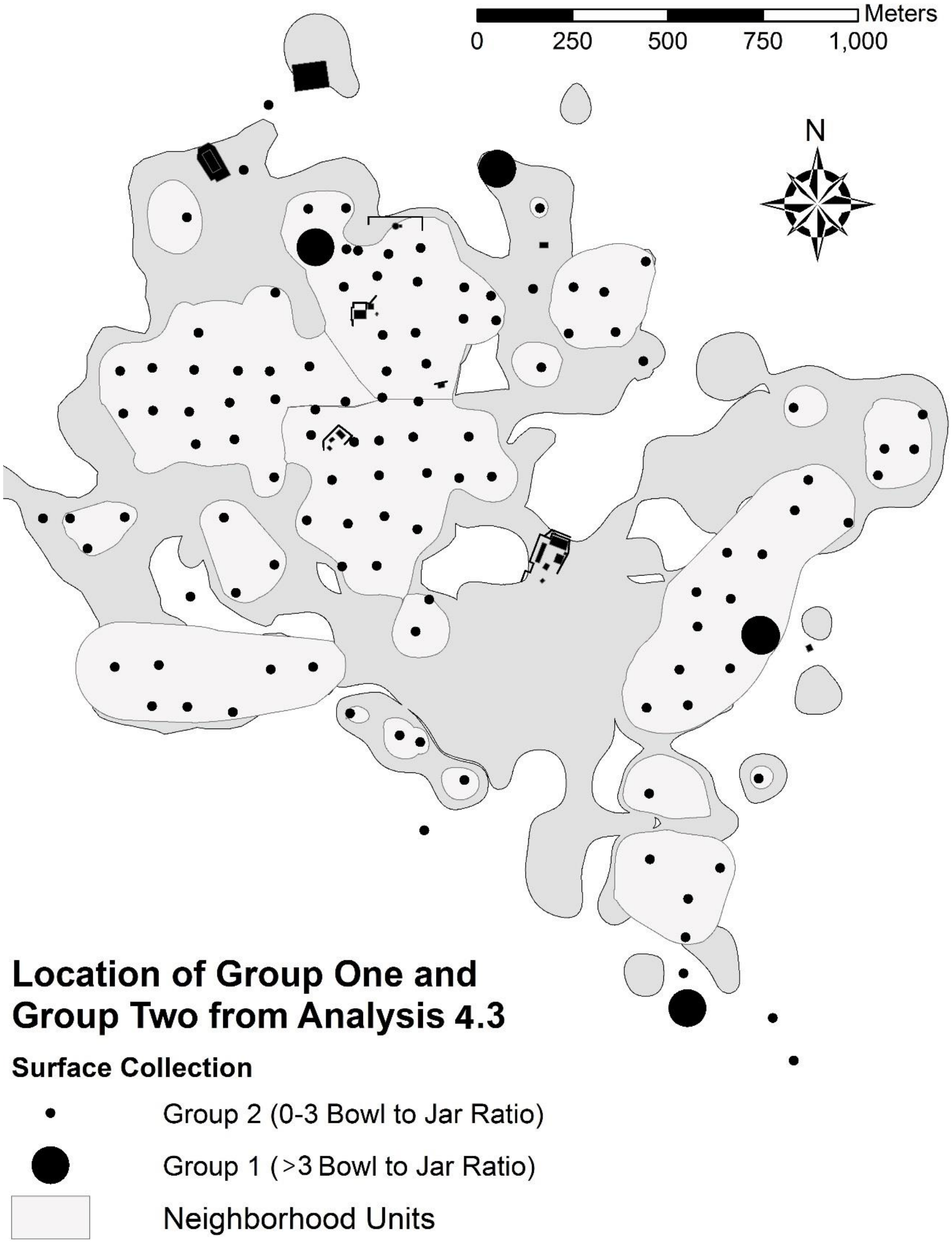


Figure 4.3 Location of group one (elites) and group two (commoner) from Analysis 4.3

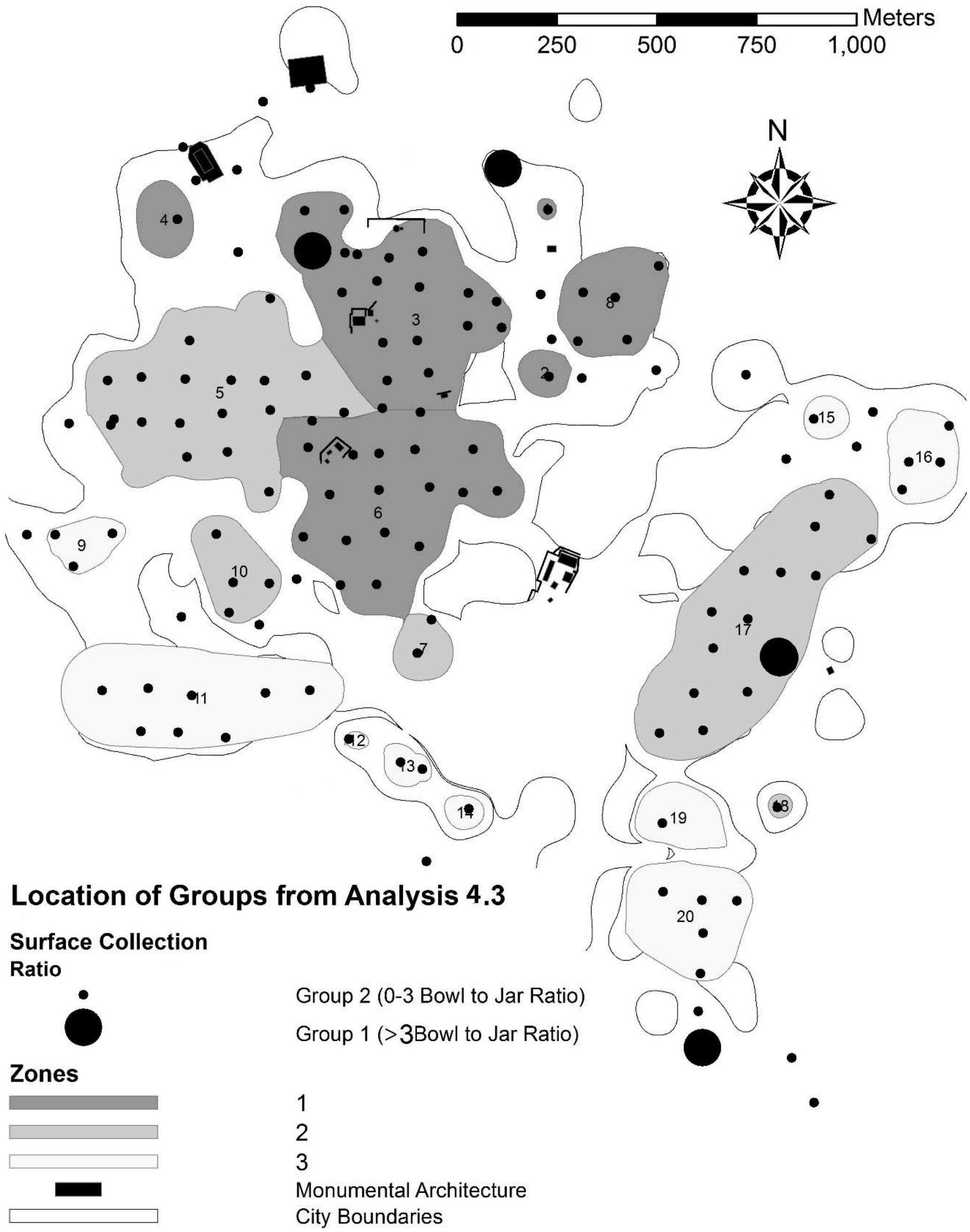


Figure 4.4 Location of group one (elites) and group two (commoners) from Analysis 4.3 in relation to urban zones

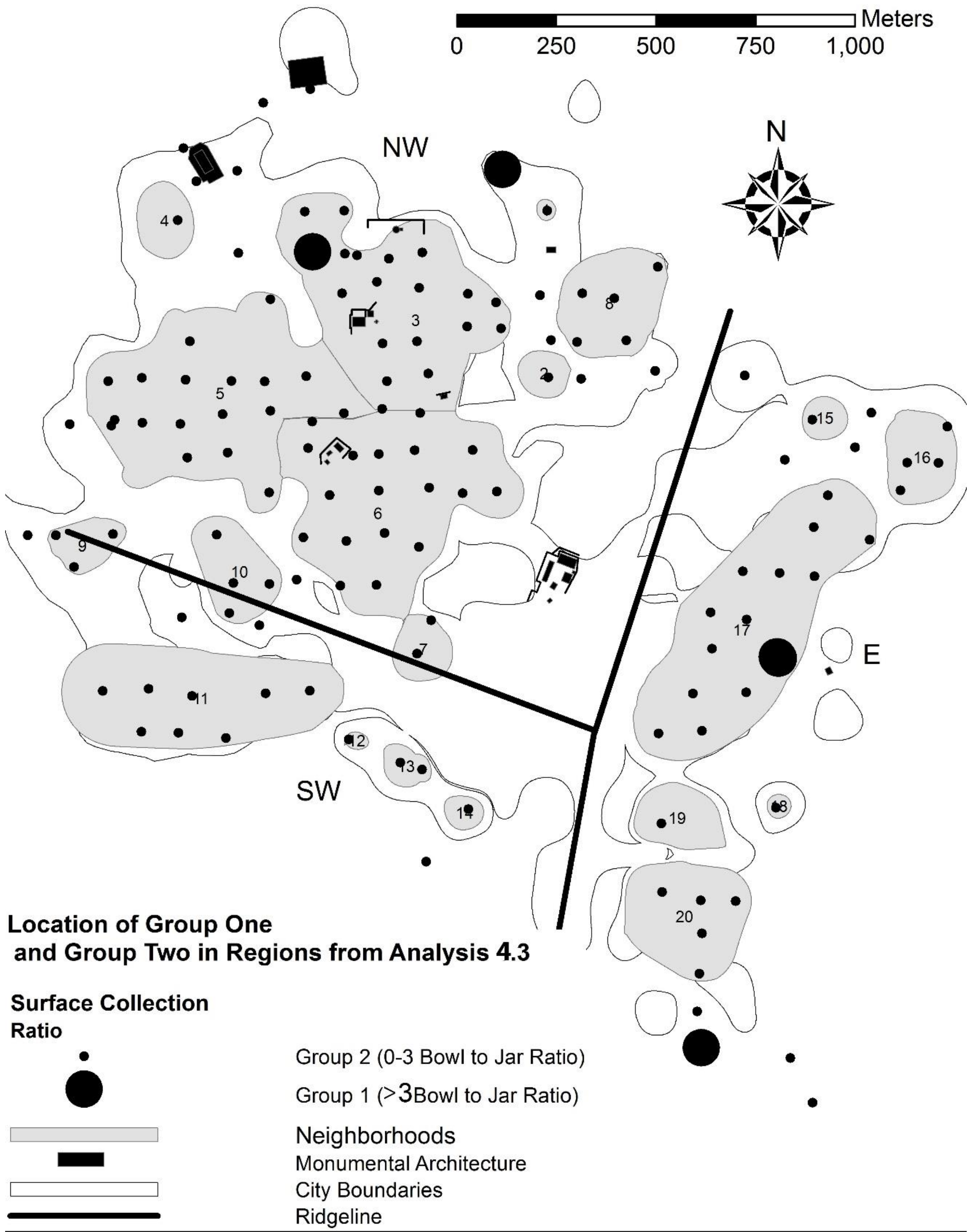


Figure 4.5 Location of group one (elites) and group two (commoners) from Analysis 4.3 in relation to urban regions.

Clustering is present in the sense that most surface collections belong to Group Two and thus dominate the neighborhoods of Calixtlahuaca. Members of Group One are fewer, (five). One pair of coordinates overlap, are less than a meter apart, and represent the same 1 ha area. The dot with the highest value was selected to represent that house group. Two group one collections are found within neighborhood boundaries and two are not. Two of the four cases are within Zone One, within 250 meters of monumental architecture. Another is located within 500 meters of the monumental architecture. The fourth example of Group One is found in Zone Four with other extra-neighborhood settlement (Figure 4.4). When looking at the ridgeline divisions of the settlement, two Group One collections are located in the Northwest Region and two are located in the Eastern Region (Figure 4.5).

Interpretation

Elites did not live separately from commoners but mixed in neighborhoods composed primarily of commoners. Elites made up 3.5% of the total population at Calixtlahuaca. This is not unusual in Central Mexico, since the average calculated from a sample of 13 settlements in Tlaxcala, Morelos, and the Basin proper ranged from 6-8% (Table 4.3).

Settlement	Region	% Elite	Source
Aztec in General	C Mexico	2%	(Nutini and Isaac 2010: 411)
General	V of Mexico	10%	(Warren 1971: 237)
Aztecs	C Mexico	5%	(Smith 2012: 134)
Average (N=3)		6%	

Cuexcomate-LPCA	Morelos	18%	(Smith 1992: 341)
Cuexcomate-LPCB	Morelos	9%	(Smith 1992: 341)
Huitzillan	Morelos	6%	(Cline 1993: 103-104)
Quauhchichinollan	Morelos	4%	(Cline 1993: 103-104)
Yacapitztlan	Morelos	1%	(Carrasco 1976: 110)
Average (N=5)	Morelos	8%	
Atlixco Valley	Tlaxcala	4%	(Dyckerhoff and Prem 1990: 173)
Huexotzinco	Tlaxcala	14%	(Dyckerhoff and Prem 1990: 173)
Ocotelulco	Tlaxcala	4%	(Anguiano and Chapa 1976: 130-132)
Quihuiztlan	Tlaxcala	4%	(Anguiano and Chapa 1976: 130-132)
Texmelucan	Tlaxcala	7%	(Dyckerhoff and Prem 1990: 173)
Tizatlan	Tlaxcala	11%	(Anguiano and Chapa 1976: 130-132)
Average (N=6)	Tlaxcala	7%	

Table 4.3 List of settlements in Central Mexico for which estimates on the percentage of elite are available.

The range of elites spans 4 to 18% of the population. While Calixtlahuaca 3.5% does place below the lower range for elite presence in Central Mexico, this low level of elite presence is not uncommon. Since there are considerably more commoners than elites, not all neighborhoods had elite residences. Most neighborhoods were exclusively commoner in character. The Northwest and Eastern Regions of the settlement are the most densely populated and where the largest neighborhoods are located. These were also the areas where the elite house groups were located, allowing them to interact with and , perhaps, influence the most people.

CHAPTER 5

SHARED MATERIAL CULTURE AND NEIGHBORHOOD SOCIO-SPATIAL ORGANIZATION

Calixtlahuaca was possibly home to Maltatzinca, Otomi, Mazahua, and Nahuatl speakers who may have also had distinct ethnic identities outside of shared language use. If Calixltahuaca was like other Central Mexican cities, a city-state based social identity was also part of individuals' identities. Neighborhoods, also known as calpulli, were the main supra-household organizing force in Central Mexican societies in the western Nahua area. These may have had strong social identities (Smith and Novic 2012). Social class, occupation, and extended familial social identities coexisted with those of language and city. Chapter 4 examined the distribution of social class on neighborhood and district clustering at Calixtlahuaca. This chapter examines the relationship between other social identities, social networks, and consumption practices on one hand and neighborhood and district residence on the other. Social networks influence the way in which people present themselves and their tastes as part of their social identities. The social identities are in part how we identify our social networks. Change to either social identity or social network is possible, but together they create the consumption preferences of the individual. Social identities and social networks inform each other through practice and, together, both influence consumption practices (fig 5.1).

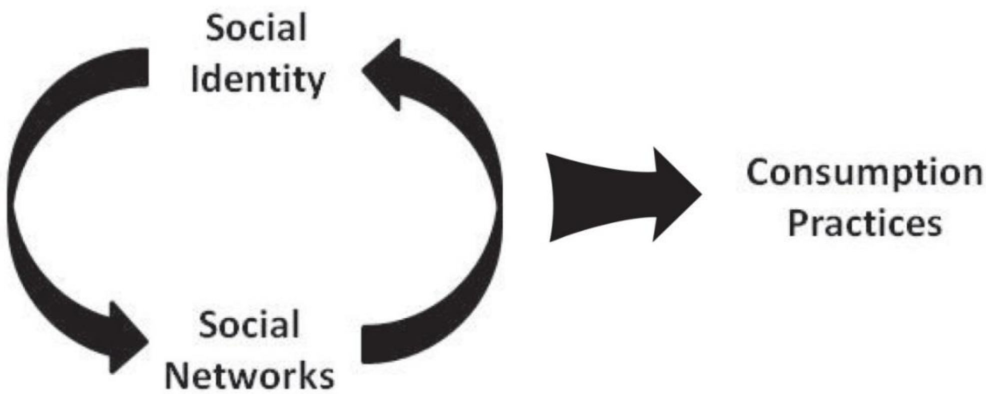


Figure 5.1 Relationship between Social Identity, Social Networks, and Consumption

Available supply and means, which are directly connected to the economic act of consumption, limits the range of choices available but does not dictate which of those choices are selected, how the chosen objects are used, or how the chosen objects are modified to meet consumption needs. Nor does supply supersede the influence of social identities and social networks, since presumably those networks and identity groups are limited by the same issues with supply and means. Consumption practices appear in the archaeological record and allow us access to the other two aspects of human relations (fig 5.2).

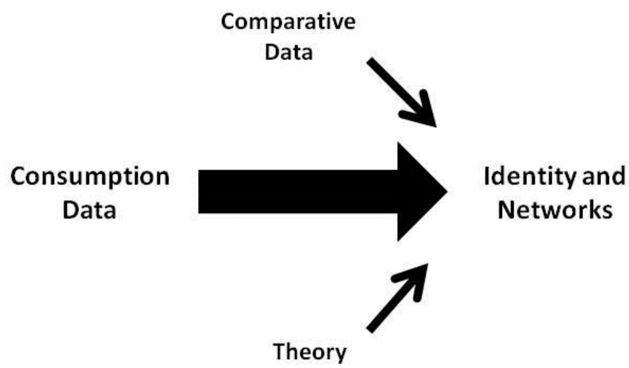


Figure 5.2 Reversal of relationship for interpretive purposes

Did Calixtlahuaca's neighborhoods ones have a well-defined social identity? Were extra-neighbohood social identities present that were important in the city's sociospatial organization? These are two questions addressed in this chapter. First, the theoretical underpinnings derived from consumption theory and modern market research on consumer behavior behind this analysis need to be presented.

Consumption Preferences

The central tenant of consumption theories is that people define themselves through the items they consume (Smith 2006; Smith 2007; Miller 1987). Consumption, specifically what is consumed, has meaning (Brewer and Porter 1993; Douglas and Isherwood 1979). Baudrillard articulated this belief as a semiotic critique of Marxist philosophy, which has become a foundation to Postmodern thought (Baudrillard 1970;

Best and Kellner 1991; Miller 1987). Pierre Bourdieu's (1984; 1986; 1998) concepts of habitus, taste, and the forms of capital connect consumption to everyday manifestations of social identity.

The development of institutional economics ended the classical view of the rational actor (Michie 1994; Wilk 1994). Cognitive science established the human mind as being ill-equipped for processing all information necessary for pure rational decision making (Henrich 2002). Concepts of collective rationality, structural rationality, practical rationality, and bounded rationality emerged to fill the theoretical gap (Nida-Rumelin 1997; Roth 1998). These alternatives have in common a shift away from self-interested optimization as the goal of economic behavior. Given recent re-evaluation of fundamental principles behind economic decisions, it is not tenable to claim that production is the driver of consumption (de Vries 1994) in non-capitalist market systems emphasizing a move away from production focused economic research. The use of consumer theory, the body of economic theory beloved by marketing, to understand consumers is uncommon among non-economists (Wilk 2002).

Consumption economics concerns itself with the choices and factors that determine how goods are allocated among the ultimate consumers, be they individuals or households (Magrabi et al. 1991). The items consumed include both those that are produced at home and those obtained through redistribution, reciprocity, and market behaviors. While it may seem intuitive, it is important to stress that consumption habits are variable in time and space and change depending on the nature of the activity. Many factors form the basis of consumption choices and all of the choices must be understood within the context of the cultural and natural environment of the consumer (Magrabi et al.

1991). The cultural understanding that economic decision makers have of their environment will affect consumption behavior more than objective measures of natural resources (Tilley 1981). The inability of individual decision makers to see large scale or long term implications of economic decisions is a focus of concern for those interested in econometric understandings of "rationality" (Nida-Rumelin 1997).

Consumers have limited information, limited ability to process information, multiple goals, and are constrained by social structure (Henrich 2002). Bounded rationality describes a scenario where choices are limited by human cognition and structural understandings of their physical and social environment. Given those limits and a specific set of goals, consumers make the most rational choice available to them (Gigerenzer and Selten 2001). An alternative perspective questions the existence of cost-benefit as the default reasoning behind decision making. The cultural learning model posits human decision making as following social concepts of appropriate behavior without deciding among alternatives. Decisions are based on learned behavior from prestigious or conforming role-models (Henrich 2002; Henrich and McElreath 2002).

Following the breakdown of the self-interested optimizer, empirically tested mid-level theories of consumer behavior became necessary. Consumer theory was quick to action, though economic anthropologists have been slow to respond (Miller 1995; Wilk 2002). The labor theory of value has become contested by consumer research. The scarcity or abundance of natural resources within a region does not translate into high and low economic value and associated levels of use in all situations (Graham 2002). Studies of commodity branding and value creation (Forster 2007) offer one promising alternative to understanding value.

Branding research offers some potential and has recently emerged in the anthropological literature to understand consumer choice. An example of the use of branding as a strategy in a non-capitalist market condition is the work of Wengrow (2008) in prehistoric Mesopotamia. Specifically, Wengrow (2008) argues that in large scale economies like present in Mesopotamia bureaucratic seals served as a type of brand. These brands made a statement about quality, authenticity, and identity. Forester's (2007) examination of value creation, economic action, and agency, by focusing on branding, allows researchers to question the development of these kinds of associations in the past. In my view, insights from branding research may help Mesoamericanists better understand salt consumption. In Mesoamerica different salt producers marked or packaged their product in distinct ways (Castellon 2008; McKillop 2002), as an integrating mechanism of the prehispanic macroregional economy. These data on salt producers and makers marks have yet to be synthesized.

Ideological preference does not translate to any specific consumption pattern (Carrier and Heyman 1997). Specific goods may not be preferred by all segments of a society (Barlett 1989; Emery 1999; Meadows 1999). Studies that assume universal preference do not provide an accurate description of the way status and class are expressed through consumption practices (example Costin and Earle 2002). Pierre Bourdieu (1998) details the way in which consumption choices are dictated by habitus. These choices indicate relative positions of "cultural capital" and "economic capital" and make statements, whether conscious or unconscious, about one's status within society (Bourdieu 1998: 5) . A commoner may not *want* goods that are desired by elites for reasons other than not being able to obtain said good. Goods can be used to maintain social relationships by reinforcing associations and marking important events (Douglas and Isherwood 1979). While aggregate choices, cultural values, and desires to maintain corporate membership structure consumption (Bourdieu 1998; Carrier and Heyman 1997; Douglas and Isherwood 1979), decisions are still made by individuals based on their motives and goals (Bourdieu 1998; Tilley 1981). Consumption decisions are often expressions of individual or group social identity.

Social Identity and Consumption

I am focusing my analysis on various social categories or social groups to which residents at Calixtlahuaca belonged and that affected their day-to-day lives. In chapter 4, I explored the socio-spatial patterns of social class membership, which did not cluster in neighborhoods or districts. Social groups formed around the category of language may have played an important part in social structure. Ethnicity is difficult to define satisfactorily or to identify archaeologically with the best of data. Surface collections in this study do not allow for the copious amounts of artifacts that are needed for the most thorough analysis of ethnicity. For this reason, I am **not** examining ethnicity in this dissertation. Nevertheless, I do need to refer to others' discussions of the topic because ethnicity is a frequently studied form of social identity. Other social groups based on categorical attributes may also be expressed in the socio-spatial landscape. Groups composed of shared occupation or new immigrants are two examples. These categorical groups are difficult to isolate and examine separately. In this chapter, the specific social groups whose membership is marked by material culture are not being discussed as separate things. I am not considering occupational identity, ethnicity, or religion as separate identity groups. While my foucs is not on the social groups themselves, I do analyze the ways members of these groups share consumption practices that mark group members as having a *social identity* (likely connected to the social group) in common. This occurs because social identity and social networks influence and reinforce each other as was discussed above.

While *identity* refers to one's feelings of self-ascription and inner "sameness", *social identities* are ascribed through interactions of people with social groups (Insoll 2007; Jenkins 2000). Social identities are created through the dialectic of similarity and difference (Jenkins 1994; Jenkins 1996). Some relevant characteristics of social identities are a) they are contested within the group and from without the group, b) internal group discourse defines the social identity as having absolute characteristics, and c) the definition is related to cross-boundary interaction, even struggle. Social identities tend to cross-cut other social identities (Cohen 2000). Complex societies are defined by multiple cross-cutting social identities (McGuire 1983), making it difficult to untangle the discourses of specific social identity groups.

Because group members must be able to recognize themselves, culture acts as a signaling mechanism. Culture can be viewed as the material used in creation and contestation of social identity. Bourdieu's (1977) discussion of *habitus* is often used to cope with the contradictory and recursive relationship between social identity and culture (Jones 1997). Research on bicultural and second generation immigrant populations reinforce the importance of social networks (group interaction) and social identity. Chinese co-ethnics had a stronger bicultural identity if they had a social network that included more non-Chinese (Mok et al 2007). Among second generation Nigerians in San Diego, ascription to an American and/or African-American identity was strongest among those whose social networks included more Whites or African-Americans (Balogun 2011).

Social networks may influence consumer decisions through word-of-mouth discussions about the best and worst places to shop. The power of word-of-mouth transmissions of information across social networks to influence consumer behavior is a phenomena being harnessed by modern marketing firms (Girboveanu and Puiu 2008;Goldenberg et al. 2001), and similar processes characterize non-western markets as well (Arnould 1989; Doran 2002). In fact, personal networks may have a stronger influence in societies where conformity is valued. It is through those networks that people determine which product is the one that conforms to expectations (Fong and Burton 2008).

Brubaker and Cooper (2000) deconstruct the concept of identity and suggest several “idioms” that lack the analytical baggage of a term with so many meanings. Additionally, terms like race, nation, ethnicity, citizenship, class etc,--which are types of identities and part of the identity discourse--have two functions. These terms are categories of both social and political practice (sensu Bourdieu) and analysis. They argue that the term “identity” has too many contradictory definitions making it not useful as an analytical concept. The many meanings for “identity” are all problematic because they imply the essential nature of identity to the human experience or, conversely, are contradictory because they negate the concepts effectiveness through those qualifiers. Ultimately, the mutable definition for “identity” is too weak to do the kind of analytical work required of it. (Brubaker and Cooper 2000).

A solution to this problem of an "identity" concept that is too broad to be of any analytical purpose is to divide the various concepts being subsumed under "identity" and separate them out (Brubaker and Cooper 2000). Brubaker and Cooper (2000) discuss a three groups of terms that substitute for identity: identification/categorization, self-understanding/social location, and commonality/connectedness/groupness. Two of these concepts--identification and commonality—are useful to archaeologists for a more nuanced analysis of various aspects of social identity, provided the right data are available. Due to the nature of archaeological data, Brubaker and Cooper's (2000) third conceptual grouping-- self-understanding and social location-- cannot be examined. For this reason, I will not spend much time on this third set of concepts.

Identification/categorization refer to the ability of a person to be identified or categorized by themselves or others. The concept of "identification" focuses on the process of identifying by an identifier, rather than on the condition being identified. Self-identification falls under this concept, but the processes of identification by self and other can be separate from each other or overlap. The processes associated with consumption and its ability to allow the identification of groups who share a network of interaction fall under Brubaker and Cooper's "identification" concept. Identification/categorization takes place in two spheres within archaeological research. The first is by way of ethnohistoric descriptions of how groups, such as the Aztec, categorized people around them. The second occurs when archaeologists as an outside observer use features of a households artifact assemblage to place them into a category like elite or commoner. The aspect of identity that is covered by self-understanding/ social location refers to the actor's internal understandings and social relationships. Archaeologists cannot get the internal understandings of past actors through the material record. In absence of historical documents, this facet of identity will not be addressed by this research.

Brubaker and Cooper (2000: 20) describe a separate trio of terms that describe related components of the "identity" definition that have salience for my research. Brubaker and Cooper discuss the concepts of 1)"commonality", 2)"connectedness" and 3)n"groupness"—as three separately c learly defined and interconnected concepts within one conceptual group-- being useful to better understand the conditional aspects of "identity". Burbaker and Cooper (2000: 20) make clear that while interconnected, these terms do separate theoretical work. "Commonality" and "connectedness" are related to the shared experiences and interconnections among people. These two concepts do not require a group condition to develop, but "groupness"- the belonging to a larger group- does require "commonality" and "connectedness" (Brubaker and Cooper 2000: 20). Neighborhoods are a clear example of how these three concepts operate. By virtue of living in the same residential area, neighborhood residents have some level of commonality and connectedness. However, this does not guarantee a salient neighborhood character will develop. Neighborhood groupness may or may not develop within the neighborhood and this has can relate to larger urban patterns and processes.

Archaeologically, it is difficult to discuss the degree to which shared patterns of material culture reflect "commonality" verses "connectedness" verses full-fledged "groupness". Connectedness would describe the social networks that affect decisions on consumption as suggested by the social network research on consumption described above. The commonality of these social networks is expressed by the degree of adherence to group consumer preferences. Groupness, the belonging to a salient group, can be inferred based on the presence of connectedness and commonality, but cannot be proven. If I find social clustering, the evidence of definite groupness is stronger because of the co-locality. The absence of clustering neither confirms nor denies the existence of salient groups. In so much as the consumer groups that I define as social identities are clusters of residents that are connected and have some commonality of other members of the group, then my social identities correspond to Brubaker and Coopers (2000) third cluster of terms to substitute for identity. Rather than repeat the trio of terms connectedness/commonality/groupness, I will use the phrase social identity groups to refer to groups identified by the material expression of belonging to a social network. Social group alone is not sufficient because identity and its expression through consumption are key concepts guiding my statistical analysis. Identity, whether knowingly or unknowingly marked, played a role in the consumption choice made by neighborhood residents. It is difficult to determine the degree to which connectedness and commonality played roles in these social groups..

Ultimately, this chapter is an exercise in Brubaker and Cooper (2000)'s concept of identification. Regardless how either how the ancient inhabitants of Calixtlahuaca self-identified or how they were identified by others with any emic reliability, it is through the process of identification that I am acting to identify residents into categories based on my observation of a set of traits. As such, a simplified term for the categories I place my surface collections into is warranted and I will use the term social identity groups.

Social Networks and Neighborhoods

As defined in chapter 2, a neighborhood is a geographic area within a city where residents interact with each other on a daily basis and which is socially or physically distinct (Smith 2010; Smith and Novic 2012). Social networks are a class of neighborhood social process (Sampson 2011). Social networks are also a key component of neighborhood social cohesion (Smith 1975; van Bergeik et al 2008). Social cohesion is the social forces that bind people together so that they live harmoniously and support each other's well-being (Smith 1975; Kearns and Forrest 2000). Social cohesion contributes to the social distinctiveness of neighborhoods and fosters community. Above I discuss the relationship among social identity, social networks, and consumption patterns. If, as argued by Sampson (2011) and Smith (1975), social networks are key to social cohesion, then consumption patterns would be similar in neighborhoods with cohesive social identities. However, neighborhoods are not guaranteed to have cohesive social identities. In that case, and extra-neighborhood identity may result from extra-neighborhood social networks.

As we saw in Chapter 4, a few studies of Mesoamerican neighborhoods suggest that neighborhood-based social identities are manifest in the material record. Early Monte Alban shows three zones (possible neighborhoods) that had subtle differences in ceramic assemblage suggesting shared consumption patterns within the zones (Blanton 1978: 38). These differences between zones and subsequent similarities within the zones suggest a shared social network or even social identity. By 1450-700 BC at San Jose Mogote, neighborhoods differed from each other in complimentary ways along the lines of craft specialization, use of Olmec style motifs, and stone tool production (Kowalewski 1994: 127). Particularly in regards to the use and presumably consumption of Olmec style motifs, these neighborhoods were differentiated in ways that suggest a developing neighborhood social identity. Teotihuacan in Central Mexico contains several barrios that contain clear social identities based on either ethnicity or occupation. Of the Mesoamerican cities, Teotihuacan had the most cases of clear social clustering.

If neighborhood-based social identities can be marked by similarities in consumption behavior by neighborhood residents, then one can expect extra-neighborhood social identities can also be marked by similarity among extra-neighborhoods residents. For the purpose of my discussion of neighborhood identity, the source or distribution network from which residents obtain their goods is not the prime determinant of which social identity group they are assigned. Multiple distribution networks may provide stylistically identical goods that are not distinguishable from each other. In that case, the two sources of good are not marking a social identity group because others cannot identify the objects as different—they do not convey social information to others about group membership. When the source of the good is distinguishable, access to the distribution network has social meaning. If similarities exist in the consumption patterns of a population, in this case urban dwellers, but groups with those similarities do not cluster spatially, then non-neighborhood social identities and social networks are being represented by those similarities. Whether or not we can say what these social identities represent is dependent on the quality of the data. However, it is still important to acknowledge extra-neighborhood loyalties that effect neighborhood socio-spatial organizations.

Identities based on polity and language group were frequently identifiied in Mesoamerica (Stark 2008; Berdan 2008). Calixtlahuaca is also known in the textual sources as Matlatzinco. Maltazinco referred to people in Toluca Valley, people in the city, and people who spoke the Maltatzinca language (Garcia Castro 1999). Because four languages were spoken in the Toluca Valley, not all people who were called Maltatzinco spoke the same language or lived in the same geographic place. Calixtlahuaca itself was likely populated by speakers of all four languages-Maltatzinca, Otomi, Mazahua, and Nahuatl (Garcia Castro 1999). What we know about social identities from Central Mexico comes from the imperial Mexica of Tenochtitlan. The Mexica defined the Nahua as wearing elegant clothing and capes, eaters of maize who prepared their food distinctively, cultivators, and artisans who had a series of positive stereotypes associated with them. Conversely, the Otomi, to Mexica eyes, wore good quality capes and breech clouts for the men and skirts and shifts for the women. They wore lip and ear plugs and had distinctive hair styles. They ate maize, beans, chile, salt, tomatoes, tamales, dogs, gophers, deer, skunks, snakes, and many lesser rodentia and insects. From the perspective of the Mexica, the Otomi were civilized but uncouth, covetous, greedy, gaudy, vain, and shiftless. The Matlazinca faired worse in the Mexica mind. They were said to speak a barbarous tongue and wore maguey capes and breech clouts. They ate maize, beans, amaranth, and drank atole and maguey wine, the latter to excess. They were characterized as strong and rugged, bewitchers, and disrespectful, but they could work the land well (Berdan 2008:118-119). Many of the traits that characterized the Nahua, Otomi, and Matlazinco to the Mexica were items of consumption.

The different language speakers living in Calixtlahuaca experienced multiple social identities at the neighborhood, city, and linguistic levels that would be present in the material record. We need to ask how these social identities might be expressed in the material record. First, are there consumption similarities at all among residents at Calixtlahuaca? Based on my arguments above, I would expect there to be groups of residents who share similar consumption patterns, but this needs to be demonstrated for Calixtlahuaca. Several possibilities exist, a) all residents could consume the same suite of goods in the same amounts. This would be suggestive of a uniform social identity among all people at Calixtlahuaca regardless of language spoken. b) On the other end of the spectrum, every resident may consume goods in unique ways suggesting that social identity is either not being marked in the types of consumption behavior accessible in the archaeological record. c) Somewhere in the middle, residents could divide into distinct groups in terms of consumption. This would suggest several distinct social identities being marked by consumption behaviors. The types of social identities might be indicated by the content of goods consumed, but only in the best case scenario.

A second, question is, if there is grouping based on consumption patterns, what is the spatial pattern of residents with the same consumption pattern? a) In a situation where a social identity rooted in belonging to the altepetl (the city-state) is the primary influence on consumer choice, there would be little variation in consumption patterns across the settlement since everyone shares the same social identity. b) If neighborhood social identity is influencing consumer choice, residents in the same neighborhood would have similar consumption patterns and differ from other neighborhoods. c) It is possible that district level identities would be manifest. These would show up as contiguous areas larger than the neighborhood having similar consumption patterns. d) It may be that, while residents shared consumption practices, residents with similar consumption patterns may not be located in the same neighborhood. This would suggest that residents share a social identity with others in the city, but that these are not influenced by co-residence. In such a scenario, the social network of the neighborhood would not be the primary social network. Some other level of social identity would be reflected in the consumption practices of Calixtlahuaca's inhabitants. This may also reflect less cohesion in neighborhood communities.

I examined decorated ceramic types and vessel form for evidence of shared consumption patterns using the methods outlined in chapter 3. I then examined these statistically for spatial clustering. I identify five distinct consumption groups, or groups where people consumed a similar suite of materials in similar proportions. I interpret these groups as representing five different social identities being marked by consumption preference. However, these consumption groups were not spatially clustered in the urban landscape. People lived side by side with individuals who presented different social identities than themselves. These groups of people were likely to interact with different social networks. The details and results of these analysis are discussed in the following sections.

Decorated Ceramic Types

Analysis 5.1 K-means Clusters for Decorated Types

This first analysis asks whether there were different consumption similarities among the residents of Calixtlahuaca, each consumption group would suggest a marked social identity of some sort. I used sample F1 for a K-means cluster analysis of the surface collections based on percentages of ceramic categories. The ceramic categories used in the cluster analysis was on are listed in Table 5.1. These categories were selected because the decorative traits could be identified on even partially eroded pottery. Solutions for one to ten groupings produced a Squared Sum Error (SSE) plot that deviated substantially from 100 random runs. Of these, the K-means solution for five groupings of surface collections had the largest reduction of percent SSE. The summary statistics of this solution are shown in Table 5.2.

Type	Decoration
plainware bowls	no decoration
plainware ollas	no decoration
E bowls	red on buff
B bowls	black and/or white on red
C bowls	polychrome on white
Aztec bowls	black on orange and Basin of Mexico imports
thick rim jars	plainware jar with a distinctive thick rim
basins	very large bowls with thick walls
decorated ollas	red and/or black on buff and solid red jars
other decorated	red on white, negative decoration, and red rim
rare decorated	decorations that do not occur in high enough proportions to receive a type.

Table 5.1 Decorated type descriptions used in this analysis

K-means	#Cases	Aztec	Comal	Plainbowl	Plain Olla	Basin	OtherDec	E	ThickRim	B	C	DecOllas	Total
1	9	0.0	2.0	23.6	***34.8***	0.2	***4.7***	14.2	5.6	8.3	***2.2***	4.4	100.0
2	4	0.0	2.0	5.6	13.0	***4.3***	0.0	***52.0***	11.0	7.6	2.0	2.5	100.0
3	5	***5.0***	***8.0***	***39.0***	8.0	0.0	1.8	21.4	4.0	7.0	0.0	5.6	99.8
4	7	2.5	1.6	22.2	16.2	0.0	0.0	4.9	***28.8***	19.7	0.7	3.5	100.1
5	8	2.8	2.0	6.0	6.4	2.6	0.7	23.9	15.8	***29.7***	0.9	***9.2***	100.0

Table 5.2 K-means Cluster summary statistics (Decoration) Ceramic types that dominate a cluster are shown in bold font.

All K-means groupings contain some percentage of the majority of ceramic categories. Each ceramic category can be found in multiple K-means groups. However, in each K-means group one or more decorative types dominated the assemblage; those are bolded in Table 3.2. Of these, K-means group 3 has the most obvious connection with a known social identity. K-means group 3 has the highest amount of comals and Aztec type vessels, whereas these objects make up a far lower contribution to other K-means groups. Comals are associated with tortilla making which is common in the Basin of Mexico, the heart of the Triple Alliance, but not at Calixtlahuaca. Aztec types are decorative styles that relate to the Basin of Mexico as well. This suggests that K-means group 3 residents were, in part, choosing to consume goods that labeled them as having a social identity connected to the Basin of Mexico, be it political or linguistic in nature. The other K-means groups likely refer to social identities marked through consumption as well. However, these assemblages do not correspond to known linguistic or urban social identities, and thus they are more difficult to interpret.

Analysis 5.2 Adding Collections with 5-9 Sherds to K-Means Groups for Decorated Types

This analysis increases the sample used for spatial analysis by adding surface collections with between 5-9 sherds. The size of sample F1 was thirty-three surface collections. While this is sufficient for statistical analysis, a larger sample would be better. Since K-means clustering uses proportions of a collection to calculate the cluster, a collection with less than 10 sherds does not have enough data to make a statistically viable cluster. For this reason, re-running the K-means analysis was not a robust statistical analysis. Adding these low count collections to the analysis adds additional cases to the K-means groupings using the Brainerd-Robinson coefficient of similarity to increase the number of cases in the sample used for spatial analysis. Surface collections with few sherds were assigned to K-means groupings based on the similarity of the surface collection assemblage to original groups generated by the F1 sample. This was done by calculating the Brainerd-Robinson coefficient for all surface collections in sample F with five or more sherds and this sample was called sample F2. The collections for which a K-means group was assigned after the initial K-means analysis were identified in the resulting Brainerd-Robinson matrix. These new collections were compared with the collections from the original K-means group. The highest similarity value between original and new collections was identified. The K-means group belonging to the original collection was assigned to its pair among the new collections with the highest similarity value. The summary statistics of the new groupings can be seen in Table 5.3.

Group	#Cases	Aztec	Comal	Plainbowl	Plain Olla	Basin	OtherDec	E	ThickRim	B	C	DecOllas	total
1	14	0.0	1.3	20.1	***38.5***	0.1	***4.6***	16.1	8.1	6.1	***2.2***	2.8	100.0
2	9	0.0	0.9	6.9	13.2	1.9	0.0	***49.5***	8.3	14.2	0.9	4.2	100.0
3	11	***8.3***	***7.3***	***39.8***	5.9	0.0	0.8	17.9	6.7	8.4	0.0	4.8	100.0
4	15	3.0	3.4	14.3	8.4	0.0	0.0	3.4	***48.4***	13.8	0.3	5.1	100.0
5	18	1.2	0.9	9.3	3.5	***2.4***	0.3	23.6	20.0	***28.7***	***2.2***	***7.8***	100.0

Table 5.3 K-means Cluster statistics with the addition of cases with five to nine sherds (Decoration)

The central tendencies of the ceramic categories present in the lowest percentages fluctuate more than for larger categories. However, group 2 differs in that basins drop out as being a high percentage category. Group 5 now has the highest percentage of basins in its assemblage, though the actual concentration has not changed much between this and the K-means groupings in analysis 5.1. This second analysis did result in Group 5 and Group 1 tying for the highest concentration of C bowls. All other relationships among decorative types and K-means groupings remain the same. These include the most pronounced differences among groups suggesting that adding low count surface collections into the groupings does not radically change the results of this analysis. As in analysis 5.1, the most obvious connection between consumption patterns and known social identity group is found in K-means group 3. K-means group 3, the group with comals and Aztec types indicating a Basin of Mexico focused identity. It is important to remember that social identities are not limited to ethnic identities but may be based on other qualities like occupation or religion. While the other K-means groups are probably signaling social identities, the exact social identities are not clear.

Analysis 5.3 Spatial Clustering of K-Means Groups for Decorated Types

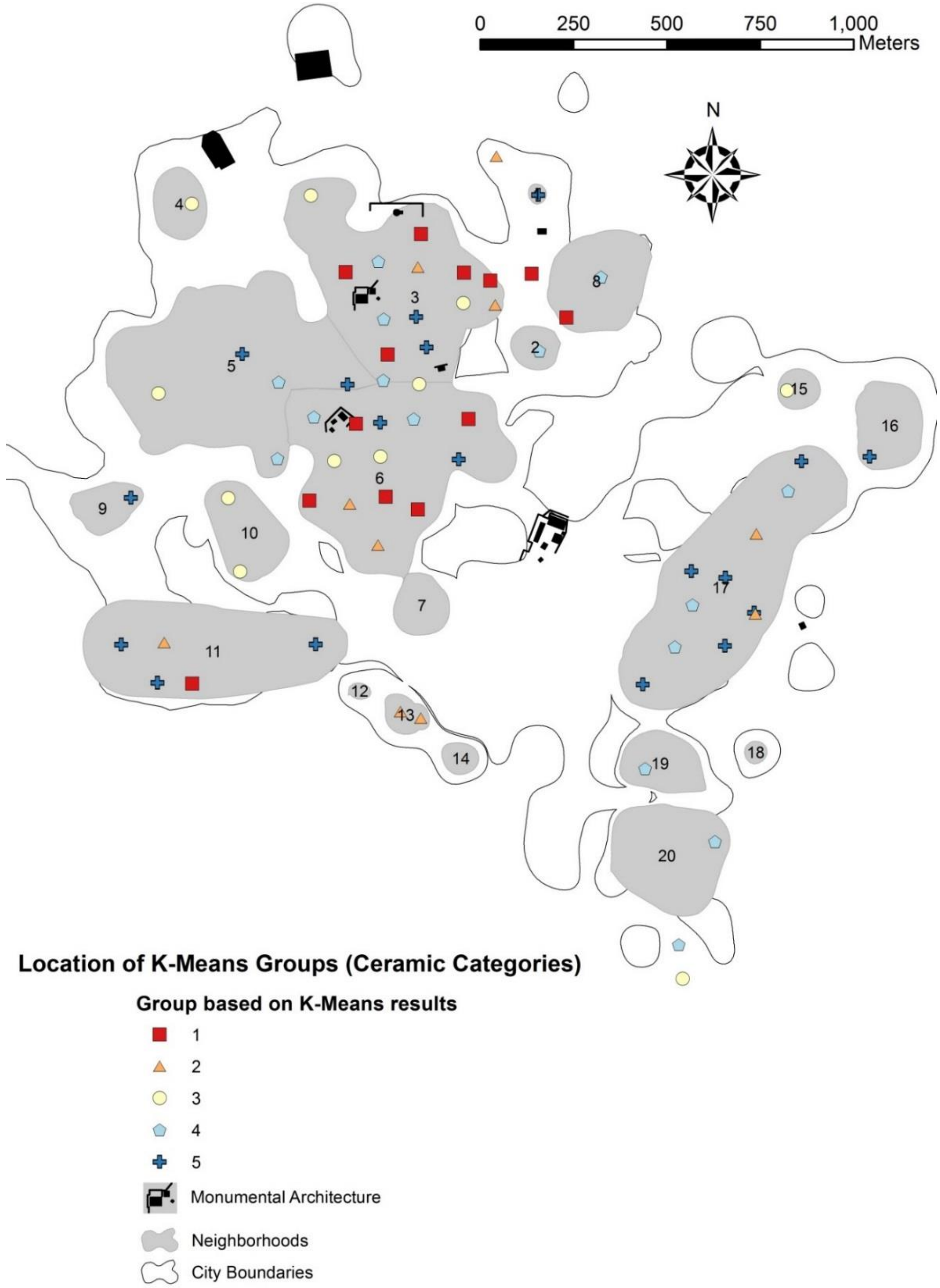


Figure 5.3 Location of Kmeans based groups from Analysis 5.3.

Having identified probable social identities being signaled by consumption patterns in the total assemblage, I now can address the main question of this chapter. Do residents in the same neighborhood consume similarly, suggesting a shared neighborhood identity, social cohesion, and shared networks? The answer is no. The spatial patterning of these K-means based groups can be seen in Figure 5.3. Neighborhoods could be completely homogenous, where all surface collections in the neighborhood come from the same K-means group, or they could be completely heterogeneous, where an equal number of each K-means group is present in the neighborhood. Most neighborhoods in fact include collections from a number of K-means derived groups suggesting that neighborhoods at Calixtlahuaca were heterogeneous.

The extent of clustering was tested with the Simpson's C statistic of cluster dominance or homogeneity. The value of the C statistic runs from zero to one, with higher values indicating more homogeneity of the cluster. The C' statistic is the value for the entire assemblage. The frequency of each K-means based group in each neighborhood unit was recorded. The probability of obtaining a value of C or higher was calculated by running 100 random runs. The results of this analysis are shown in table 5.4. The C' value of 0.43 suggests that the entire assemblage is more heterogeneous than homogeneous, though a small degree of social clustering is present. Only two neighborhoods have C values with a significantly low probability of obtaining those values by chance. Neighborhood 10 has a C value of 1.00, meaning extreme clustering. Both clusters in that neighborhood come from K means derived group 3. Neighborhood 17 has a C value of 0.44, very slightly higher than the C' value. K-means derived groups 4 and 5 dominate the neighborhood, though in roughly equal measure. K-means derived group 4 is marked by high amounts of thick-rimmed vessels, relatively high B bowls and plainware bowls, and no E bowls. K-means derived group 5 is marked by high amounts of B bowls, basins, and decorated jars. Both K-means derived groups share a propensity for B bowls.

Neighborhood	Group 1	Group 2	Group 3	Group 4	Group 5	C	p value
2	0	0	0	1	0	1.00	1.00
3	5	2	2	3	2	0.24	0.86
4	0	0	1	0	0	1.00	1.00
5	0	0	1	2	2	0.36	0.59
6	5	2	3	2	2	0.24	0.78
8	1	0	0	1	0	0.50	1.00
9	0	0	0	0	1	1.00	1.00
10	***0***	***0***	***2***	***0***	***0***	***1.00***	***0.17***
11	1	1	0	0	3	0.44	0.29
13	0	1	0	0	0	1.00	1.00
15	0	0	1	0	0	1.00	1.00
16	0	0	0	0	1	1.00	1.00
17	***0***	***1***	***0***	***4***	***6***	***0.44***	***0.02***
19	0	0	0	1	0	1.00	1.00
20	0	0	0	1	0	1.00	1.00
C'=0.43, p=0.05							

Table 5.4 Simpson's C results for spatial clustering in Neighborhoods (Decoration) Bolded values indicate neighborhoods with statistically significant cluster values.

By dividing the city into zones based on distance from monumental architecture, we can look to see if there is social clustering on larger scale (Fig 5.3). The C' value for entire site is low at 0.27. This suggests that the k-means groups are distributed close to equally across the proposed urban zones (Table 5.5). Only one of the zones produced a C value with significantly low probability. The C value for Zone 2 is 0.34. This is more homogeneous than the other sections of the city. This is caused by more K-means derived group 5 collections being present than collections of other K-means derived groups. The division of the city into geographic regions based on the natural topography of the area produces similar results (Fig 5.4).

Zone	Group 1	Group 2	Group 3	Group 4	Group 5	C	p value
1	11	4	6	7	4	0.23	0.41
2	***0***	***1***	***3***	***5***	***8***	***0.34***	***0.00***
3	1	2	1	2	5	0.29	0.37
C'= 0.27. p=.00							

Table 5.5 Simpson's C results for spatial clustering in Zones (Decoration) Bolded values indicate neighborhoods with statistically significant cluster values.

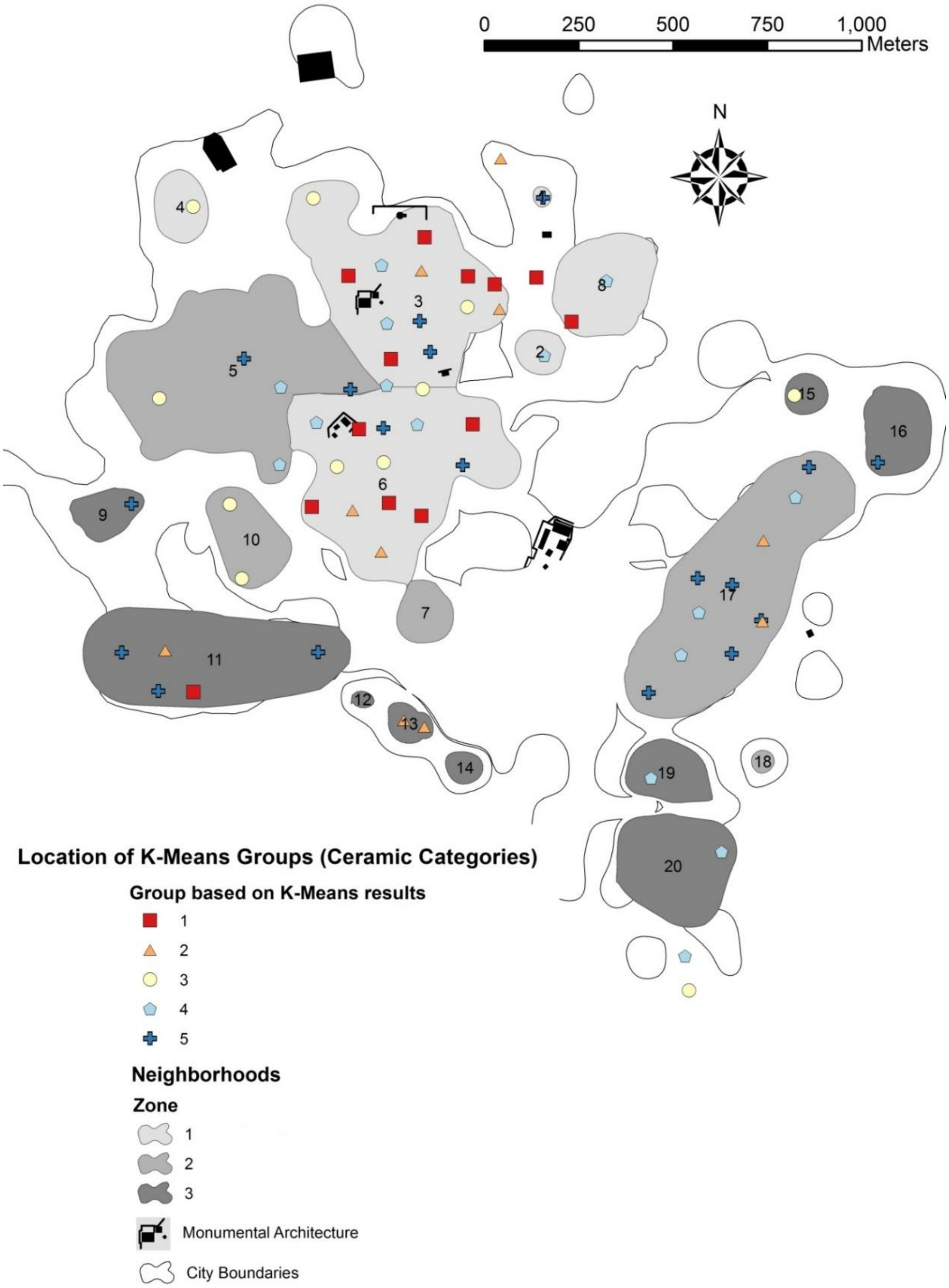


Figure 5.4 Location by Zone of Kmeans based groups from Analysis 5.3

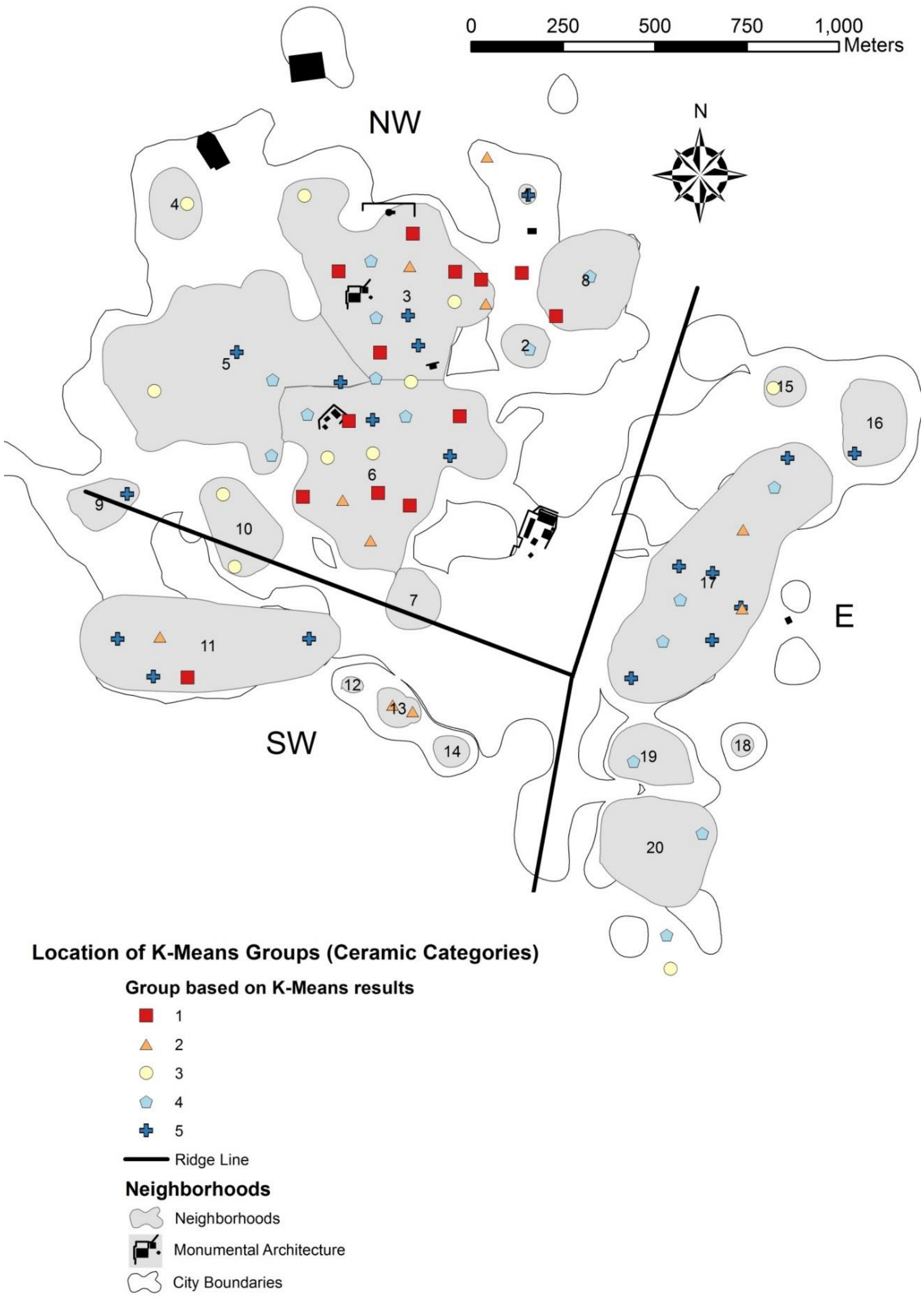


Figure 5.5. Location by Region of Kmeans based groups from Analysis 5.3

The C' value for the regional division of the city is 0.27, again suggesting that k-means groups are close to equally distributed across regions (Table 5.6). The East region of the city has a C value with a significantly low probability. The C value is 0.39, which is higher than the overall settlement suggesting a slightly more homogeneous urban region. The majority of surface collections in the East region come from K-means derived groups 4 and 5. As stated above, these groups have a high percentage of B bowls in their assemblage. It should be noted that Neighborhood 17, which shares the quality of higher amounts of K-means group 4 and 5 being present, is located both in the East region and Zone 2 and is the largest neighborhood in those divisions.

Region	Group 1	Group 2	Group 3	Group 4	Group 5	C	p value
NW	11	4	9	9	7	0.22	0.61
SW	1	2	0	0	3	0.39	0.36
E	***0***	***1***	***1***	***5***	***7***	***0.39***	***0.04***
C'= 0.27, p=0.01							

Table 5.6 Simpson's C results for spatial clustering in Regions (Decoration) Bolded values indicate neighborhoods with statistically significant cluster values.

Analysis 5.4 Checking for Sample Size Effects in K-means Groups for Decorative Types

The surface collections used in the above analysis had relatively low counts. Each individual collection has a small sample size and this may impact the results of analyses using low count surface collections. To check if low sample size influenced my results, I attempted to run analysis 5.1 with a different, higher count sample. Using sample F3, collections with more than twenty sherds, I ran a K-means cluster analysis. To check whether the results of the K-means clustering are likely due to chance and do not show interpretable patterns in the data, I again ran 100 random runs and plotted out the SSE of those runs. They were compared to the results based on the data I provided.

Unfortunately, no cluster configurations deviated substantially from those generated by the100 random runs. This result is likely due to the small number of cases with twenty or more sherds in this data set, another type of small sample size. Given that I have so few surface collections with greater than twenty sherds, it is not possible to check whether the patterns I identify using low count surface collections are an artifact of low counts. Another way of checking the validity of the patterns I have identified is by using another analysis for neighborhood similarity.

Analysis 5.5 Brainerd-Robinson Coefficent Test of Social Clustering

Another approach to social clustering is to examine the similarity of residents in the consumption of decorative type. To assess similarity I used the Brainerd-Robinson coefficient, which I calculated for pairs of collections within neighborhoods with five or more surface collections using the same ceramic decorative type variable as in all other analyses in this chapter. I then calculated the mean and standard deviation of the Brainerd Robinson coefficient for each neighborhood. These procedures were used to determine the mean and standard deviation of the coefficient for the urban regions and urban zones. The results of these calculations are shown in Table 5.7. Among the neighborhoods, most units have a low mean value (83 to 99) with the exception of Neighborhood 11, with a value of 116. This suggests that residents in Neighborhood 11 were more similar to one another, though not exceptionally so. Looking at the urban regions, the Southwest is the only value above 100 at 119. Considering this region is dominated by Neighborhood 11, it is not surprising that it has a higher median Brainerd-Robinson coefficient.

	Mean	Standard Deviation

Neighborhood 3	92	46
Neighborhood 5	87	62
Neighborhood 6	83	33
Neighborhood 11	**116**	30
Neighborhood 17	99	32
East Region	93	31
Northwest Region	83	41
Southwest Region	**119**	29
Zone 1	89	39
Zone 2	82	40
Zone 3	99	33

Table 5.7 Summary Statistics for the Brainerd Robinson Coefficient of Neighborhoods, Regions, and Zones (Decoration) Bolded values indicate neighborhoods with statistically significant cluster values.

No urban zone had a high median Brainerd-Robinson coefficient, suggesting that there was no marked similarity among zone residents in the consumption of ceramic decorative types. These data suggest that the surface collections from the spatial groupings of the city were neither very similar or very dissimilar from each other.

Ceramic Vessel Form

Analysis 5.6 K-means Clustering for Vessel Form

I began this analysis with sample G1. I am using this sample for K-means cluster analysis of sherds based on vessel form categories. Examining vessel form uses the use of specific forms rather than the decoration to examine similarity in social identity. The categories used are basin, bowl, plate, comal (tortilla griddles), globo (spherical shaped vessel), molcajete (grater bowl), olla (jar), pitcher, and tripod vessel. Solutions for one to ten groupings produced a SSE plot that deviated substantially from 100 random runs. Of these, the K-means solution for five groupings of surface collections had the largest reduction of percent SSE. The summary statistics of this solution are shown in Table 5.8.

K-means	#Cases	Basin	Bowl	Plate	Comal	Globo	Molcajete	Olla	Pitcher	Tripod
1	34	*0.11*	37.52	0.05	1.03	0.03	**2.04**	51.07	0.81	**7.35**
2	18	1.11	52.75	0.00	0.31	0.00	*0.64*	38.77	0.19	6.23
3	24	0.18	25.76	**0.44**	0.68	0.00	1.28	64.52	0.16	6.97
4	6	**2.22**	*10.18*	0.00	*0.00*	0.00	1.11	**81.76**	*0.00*	*4.72*
5	8	0.83	**68.69**	0.00	**1.57**	0.00	0.74	*20.15*	**1.47**	6.55

Table 5.8 K-means Cluster summary statistics (Vessel Form) Bolded values indicate cluster dominance of K-means groups.

Bowls, ollas, and tripod vessels dominated the assemblages of the five K-means groups produced. Plates, comals, pitchers, and globos were not present in all groups. When present, these forms contributed a small percentage of the total assemblage. All other vessel forms were found in all K-means groups. Group 1 has the highest percentage of molcajetes and tripod vessels in the assemblage. This is not surprising as many molcajetes were tripods and one would expect the forms to correlate. This group has the lowest amount of basin sherds of any group. Group 2 is notable for containing the lowest amount of molcajetes. K-means group 3 has the most plates. Group 4 has the most basins and ollas. This group also has the least amount of bowls. There are eight times as many ollas as bowls in this assemblage. In contrast, group 5 has the most bowls, comals, and pitchers and the least amount of ollas out of all groups. The ratio of bowls to jars is over three for these collections, suggesting that they may be the elite group identified in chapter four.

While all K-means groups had some differences, group 1 through 3 are actually very similar in their assemblage. Group 4 may suggest a type of activity that requires large basins and numerous jars. Group 5 likely represents elite consumption behavior. These patterns of consumption are not unexpected. Most people would use the same suite of objects in their home, though these may be decorated quite differently. Large bowls and numerous jars may suggest some sort of economic activity was occurring in the residences represented by those surface collections. And elites would need more serving vessels than commoners to wine and dine important persons and hold feasts to reinforce their relationships with commoners. The sample size used in this analysis is acceptable but a larger sample would be ideal. Accordingly, I added low count surface collections to increase the sample size (Analysis 5.7).

Analysis 5.7 Adding Collections with 5-9 Sherds to K-Means Groups for Vessel Form

Surface collections with between five and nine sherds were assigned to K-means derived groupings based on similarity to original groups created in analysis 5.6. This was done by calculating the Brainerd-Robinson coefficient for all surface collections in sample G with more than five sherds using parallel methods to those described above. This sample is called sample G2. The collections for which a K-means grouping was assigned were identified in the resulting Brainerd-Robinson matrix. New collections were compared with collections with known groupings. The highest similarity value between old and new collections was identified for each new collection. The group belonging to the pair of each high value comparison was then assigned to the new collection. The summary statistics of the new groupings can be seen in Table 5.9.

K-means	#Cases	Basin	Bowl	Plate	Comal	Globo	Molcajete	Olla	Pitcher	Tripod
1	44	*0.08*	37.39	0.04	0.79	0.02	**1.58**	51.79	**1.53**	6.77
2	25	0.80	52.66	*0.00*	0.22	0.00	*0.46*	38.59	0.14	7.13
3	30	0.15	25.82	0.35	0.55	0.00	1.44	64.05	0.13	**7.52**
4	10	**1.33**	*10.55*	*0.00*	*0.00*	0.00	0.67	**82.95**	*0.00*	*4.50*
5	10	0.67	**68.44**	**1.11**	**1.25**	0.00	0.59	*20.09*	1.18	6.67

Table 5.9 K-means Cluster statistics with the addition of cases with five to nine sherds (Vessel Form) Bolded values indicate dominant variable in that cluster.

The new table of form assemblage percentages is very similar to its predecessor. There is often a small reduction in percentage from the previous iteration, likely a result of more collections with smaller than average percentage contributions. In terms of comals, pitchers, and tripods, a shift in where the highest percentage is located has occurred. Group 1 no longer has the highest percentage of tripod vessels, though its percentage is still high in relation to other groups. More pitchers are also found in this group. The only other change is in group 5. Group 5 contains the second highest amount of pitchers and now contains the highest amount of plates. The group still contains the most bowls and comals and least amount of ollas. Group 5 still corresponds to an assemblage used by elites containing over three times more serving forms than other groups and likely represents and elite consumption pattern (see Chapter 3). The other interpretations remain the same. While we know that elites are not clustered in any particular way from the analysis presented in chapter 4, I now investigate whether there is any social clustering based on vessel form consumption.

Analysis 5.8 Spatial Clustering of K-Means Groups for Vessel Form

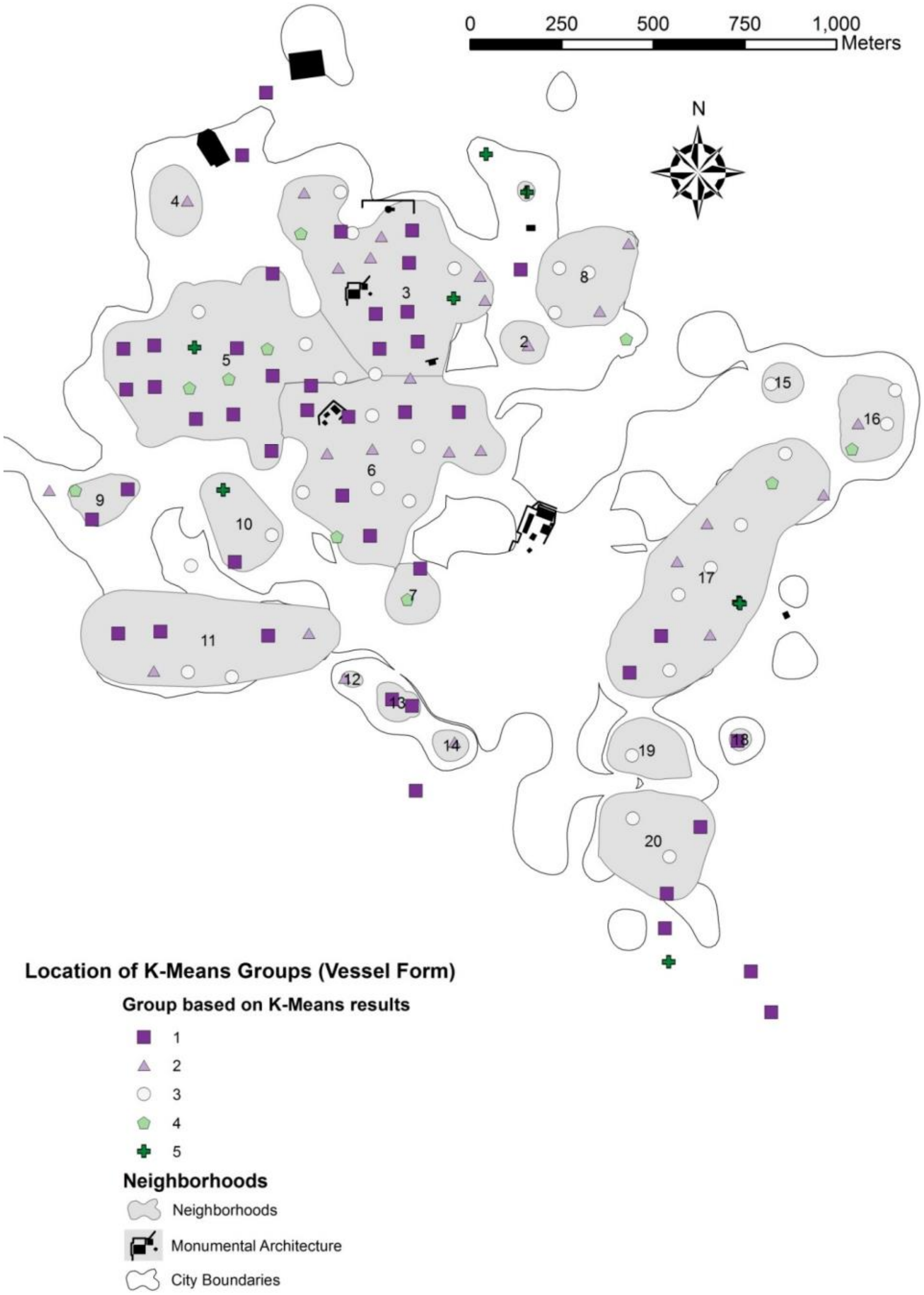


Figure 5.6 Location of Kmeans based groups from Analysis 5.9

The spatial patterning of these K-means based groups can be seen in Figure 5.6. The pattern appears to be fairly heterogeneous and most neighborhoods seem to be composed of a number of K-means derived groups. This was tested with the Simpson's C statistic of cluster dominance or homogeneity. The frequency of each K-means based group in each neighborhood unit was recorded. The probability of obtaining a value of C or higher was calculated by running 100 random runs. The results of this analysis are shown in Table 5.10. The C' for the entire site is indicative of a low degree of homogeneity; however, the probability of obtaining this result randomly is quite high (0.24). The results cannot be deemed statistically significant. I also examined the Simpson C statistic for the urban zones (Table 5.11) and urban regions (Table 5.12). While both resulted in low C' prime scores, suggesting a more heterogeneous environment, neither was statistically significant. These results suggest that the location of various K-means groups on the landscape is random. This random result may be an effect of the stochastic processes of the site formation and/or of a small sample size. However, given that the results of analysis 5.3 produced non-random results from a similar data set, it is likely that other forces are in play. In this case, consumption choices based on vessel form may not correlate with residence in a meaningful way to suggest clustering or dispersal of the social identities producing the consumption preferences.

Neighborhood	Group 1	Group 2	Group 3	Group 4	Group 5	C	p value
1	0	0	0	0	1	1.00	1.00
2	0	1	0	0	0	1.00	1.00

3	7	6	4	1	1	0.29	0.50
4	0	1	0	0	0	1.00	1.00
5	10	0	3	3	1	0.41	0.03
6	6	4	5	1	0	0.31	0.46
7	1	0	0	1	0	0.50	1.00
8	0	2	3	0	0	0.52	0.17
9	2	0	0	1	0	0.56	0.69
10	1	0	1	0	1	0.33	1.00
11	3	2	2	0	0	0.35	0.58
12	0	1	0	0	0	1.00	1.00
13	1	0	0	0	0	1.00	1.00
14	0	1	0	0	0	1.00	1.00
15	0	0	1	0	0	1.00	1.00
16	0	1	2	1	0	0.38	0.89
17	2	4	5	1	2	0.26	0.85
18	1	0	0	0	0	1.00	1.00
19	0	0	1	0	0	1.00	1.00
20	2	0	2	0	0	0.50	0.29
C'=0.41, p=0.24							

Table 5.10 Simpson's C results for spatial clustering in Neighborhoods (Vessel Form)

Zone	Group 1	Group 2	Group 3	Group 4	Group 5	C	p value
1	13	14	12	2	2	0.28	0.45
2	14	4	9	5	4	0.26	0.81
3	9	5	8	2	0	0.30	0.33
C'=0.28, p=0.51							

Table 5.11 Simpson's C results for spatial clustering in Zones (Vessel Form)

Region	Group 1	Group 2	Group 3	Group 4	Group 5	C	p value
NW	28	14	16	7	5	0.27	0.46
SW	7	4	3	1	0	0.33	0.30
E	8	5	11	2	3	0.27	0.65
C'= 0.28, p=0.55							

Table 5.12 Simpson's C results for spatial clustering in Regions (Vessel Form)

Conclusions

Consumption practices, social identity, and social networks are closely linked processes (see figure 5.1). Archaeologists find evidence of consumption practices and can use them to make inferences about the social identities and social networks of past people. The results of analysis on both decorative type and vessel form consumption suggest that social identity groups and related social networks played a role in people's consumption practices. However, these identities and networks were not expressed spatiially on the neighborhood or district. People with different social identities and social networks lived side by side. Residents had connections with others in different neighborhoods, suggesting that neighborhood relationships were cross-cut by relationships that may have spanned the city. Neighborhood cohesion was probably weak since residents were signaling membership to extra-neighborhood social identities and corresponding networks. Ethnohistoric data for the Aztec and associated peoples indicates that calpullis were an important organizing principle in Central Mexico. While there was stratification within the capulli and a heterogeneous distribution of social identity groups, the social identity groups were not distributed uniformaly across neighborhoods. In other words, each neighborhood contained a mix of social identities group but each neighborhood did not consist of the same groups in similar proportions. I would expect that if the social identity groups were just segments within a stratified corporate system they would appear in a repetitive pattern. It appears that capulli were not of great importance in terms of social identity and consumption, at least for Calixtlahuaca. In subsequent chapters, I will look at the way that domestic ritual and resource procurement impacts neighborhood clustering at Calixtlahuaca.

CHAPTER 6

THE NEIGHBORHOOD AND THE MARKET

Archaeological research on ancient markets and marketing systems has expanded greatly in the past decade (e..g., Garraty and Stark 2010; Feinman and Garraty 2010; Earle and Smith 2012; Hirth and Pillsbury 2013; Ossa 2013). While this body of research has greatly advanced the ability of archaeologists to identify markets and commercial exchange systems in the past, the linkages between market systems and urban social and economic processes remains underdeveloped. Most authors studying archaeological cases assume that if they can identify the presence of market exchange, then there must have been a single market system operating in the city or settlement that they study. Yet, just as neighborhoods within a city can differ in their social composition or consumption patterns, it is possible that neighborhoods or zones were served by separate or even independent market systems.

In this chapter I ask the question of whether the neighborhoods of Calixtlahuaca were served by a single, integrated market system, or by multiple independent market systems. By independent market systems, I refer to groups of marketplaces and vendors that have different distribution networks; that is, different systems of regionally-based suppliers. The statistical and spatial data on obsidian sources within Calixtlahuaca neighborhoods point to the operation of two distinct market systems at the site, one serving the eastern zone and the other serving the remainder of the city. Identifying market systems will tell us which neighborhood residents attended the same markets and were able to interact with each other at these markets. This allows the identification of another social area outside of the neighborhood where interaction impacts residential location and social networks. As discussed for neighborhood social identities, the ability to interact with other residents does not alone equate to a social identity group. Markets simply facilitate interaction among people. Since the marketplace on attends does not create social identity, the methods used to identify social identity groups will not be effective identifying market systems.

Few scholars have addressed the issue of variation in markets or market systems with in a city. Current research focuses on the degree, form, or presence of a commercialized market system in the city or region (Feinman and Garraty 2010; Smith CA 1976; Smith ME 2010). Within an urban context, the focus has been on identifying marketplaces in the city (Dahlin et al 2007; Stark and Garraty 2010). Distributional methods have been used to identify the presence of markets and the range of wider market integration (Braswell and Glascock 2002; Hirth 1998, Minc et al. 1994). The existence of multiple market systems within a city has remained subordinate to the question of whether there was a market at all. That multiple marketplaces could be tied into different distribution systems has not been addressed by Mesoamericanists.

Hirth's distributional approach uses site-wide homogeneity in household assemblage of commodity goods to indicate market exchange (Hirth 1998). The assumption is that in a settlement or society where markets were operating, all households would have equivalent access to most items for sale. In other words, all households would have had access to most commodities as long as they had the wants and income to permit their purchase. The impact of differences in wealth on absolute quantities of objects is accounted for through using proportions. This method has been used and refined to determine the presence or absence of markets in various archaeological studies of urban settlements (e.g. Garraty 2009; Smith 1999). Hirth's approach, however, can be broadened to address the possible existence of multiple market systems within a single city.

Inherent in Hirth's approach and its applications is the idea that all goods traded in a market behave the same way in terms of household consumption. *Non-differentiated goods and services,* which are goods and services that are completely interchangeable regardless of the producer, do indeed behave in the manner described by Hirth. Non-differentiated goods and services are often called "commodities" in modern market economies (Gordon et al. 1999). Key elements of non-differentiated trade goods are that the demand for the good is relatively stable across the market and the price among sellers is equal since each sells an identical product and must match competitors in price. Common non-differentiated goods in ancient Mesoamerica are utilitarian items such as salt, obsidian, corn, and plainware pottery. These are goods for which consumer demand is proportionally the same. Larger households or wealthier households may have more goods in absolute terms, but proportionally the demand should be similar across households.

Alternately, goods are *differentiated* when one producer's offering is preferred, on some buying occasions (or by some consumers all of the time), over a rival producer's offerings. This preference assumes that there is some difference between goods or services and that buyers react to these differences (Sharp and Dawes 2001: 743). Differentiated goods are functionally equivalent but have other attributes that separate or differentiate that product from similar ones. Decorated pottery is the differentiated good most commonly studied by archaeologists. Two bowls are functionally equivalent, for example, but the decoration on them may have symbolic differences that cause purchasers to select one over the other. The demand for a differentiated good will vary depending on the wants and needs of the household making the purchase. The price of a differentiated good is, like in all market transactions, closely tied to the demand for the item. Two functionally equivalent items will be the same price unless they are differentiated from each other. The difference in demand that creates the price difference is a result of variations of desire for the features contained by that product. Household are only willing to pay as much for any good as will allow them to meet the other wants and needs they consider more important. This is why demand is not **dictated** by price alone, a fact demonstrated in modern society by advertising, but demand and supply determine the price in a market. For differentiated goods, consumer preference and choice (Chapter 5) will dictate the proportion of each good in the household assemblage. Differentiated goods are often those that allow archaeologists to talk about social identities and relationships which are manifested in consumer choices. In market conditions, all households have access to all goods and may have small amounts of all differentiated goods. However, the proportion of goods with deeper social meaning will vary across households belonging to segmented communities, those groups sharing a similar consumer culture and motivations. While differentiated goods allow questions about socially meaningful categories, it is non-differentiated goods that permit researchers to understand market exchange both within and among urban centers. The economic features of differentiated and non-differentiated goods are completely separate from and unconnected to elastic and inelastic demand curves. Non-differentiated goods can be either elastic or inelastic and the same is true of differentiated goods. Demand curves are related to how strong the demand for an item is in relation to fluctuations in price. Differentiated and non-differentiated goods refer to the features that allow a consumer to choose between **functionally equivalent** goods.

Identifying the Number of Markets in Calixtlahuaca

This chapter focuses on obsidian as a non-differentiated good. Obsidian is non-differentiated because tools made from obsidian from different sources available to the inhabitants of Calixtlahuaca were both functionally equivalent and indistinguishable from each other. An obsidian blade from the Otumba source will cut equally well as an obsidian blade from the Ucareo source, these were and be virtually indistinguishable. The distances from Calixtlhauca to the major sources of obsidian in both Central Mexico and West Mexico are roughly equivalent, so that transport costs should not greatly affect prices or availability. The value of the good is different the good being differentiated or non-differentiated. The key is whether functionally equivalent goods can be distinguished from each other or not. Obsidian makes a good example of a non-differentiated good because obsidian tools are every day items available in relative abundance to all households across Mesoamerica (Moholy-Nagy 2003; Sheets 2000). Lapidary goods made of obsidian like lip plugs and ear spools would be both higher value and differentiated goods. I focus on the flake stone and core-blade obsidian technologies.

If Calixtlahuaca had only one market system distributing obsidian, there should be no spatial pattern in neighborhood assemblages of obsidian with regard to source. Most neighborhoods should have roughly the same assemblage of obsidian. This pattern is expected, given that the city is socially mixed in terms of wealth and social identity

(Chapters 4 and 5). There are no obvious social clusters that might have a preference for a particular market. On the other hand, if multiple market systems and networks exist there should be one or more clusters of neighborhoods that, as Hirth (1998) predicted, would have similar assemblage compositions for each separate market area.

The sample

I analyze the sources of obsidian by neighborhood to test the alternative spatial patterns outlined above. The results confirm the hypothesis that multiple marketplaces or distribution systems were present at Calixtlahuaca. I then further test this hypothesis by examining the distribution of imported ceramics in the city. The obsidian assemblage from the survey consisted of 2120 pieces. These pieces were recovered from 519 surface collections distributed across the site in a 1 ha grid (Chapter 3). Since few surface collections yielded more than five pieces of obsidian, I sampled the obsidian for source analysis at the neighborhood level. The target was to select twenty pieces of grey obsidian and two pieces of green obsidian from each neighborhood via a stratified random sample. While the goal of stratified random sampling was achieved, it was not possible to obtain the target number from each neighborhood.

Sample Selection. Michael Smith and Angela Huster selected the sample of obsidian from the surface collection for XRF analysis in the field during the 2011 laboratory season according to my instructions. I sent them a list of randomly selected surface collections representing neighborhoods. When only one surface collection with obsidian was available, that collection was selected. When more than one surface collection was available, the collections were selected using a random number generator until a pool of thirty pieces of obsidian was available for the neighborhood, or until all collections had been selected.

					collection		large pieces		sample		cat.
Neig	Unit	Locus	Lot	GPS	green	grey	green	grey	green	grey	nos.
1	300	161	1	C161	0	12	0	2	0	2	1-2
2	300	374	1	C374	2	16	0	13	0	13	3-13
3	300	1	1	C001	0	3	0	1	0	1	14-30
3	300	87	1	C087	14	19	5	5	1	5	x
3	300	407	1	C407	4	32	1	10	0	10	x
4	300	11	1	C011	1	4	1	3	1	3	31-34
5	300	34	1	C034	10	11	8	5	2	5	35-48
5	300	37	1	C037	8	5	5	3	1	3	x
5	300	211	1	C211	3	2	1	1	0	1	x
5	300	271	1	C271	3	3	1	1	0	1	x
5	300	574	1	C574	0	1	0	1	0	1	x
6	300	247	1	C247	1	11	0	4	0	1	49-68
6	300	291	1	C291	0	1	0	1	0	1	x
6	300	354	1	C354	1	29	1	17	1	17	x
7	300	297	1	C297	0	4	0	3	0	3	69-82
7	300	543	1	C543	2	4	2	10	1	10	x
8	300	53	1	C053	1	3	0	1	0	1	83-89
8	300	70	1	C070	0	1	0	1	0	1	x
8	300	321	1	C321	1	0	1	0	1	0	x
8	300	371	1	C371	1	9	1	4	0	4	x
9	300	197	1	C197	1	2	1	2	1	2	90-92
9	300	260	1	C260	1	0	1	0	0	0	x
10	300	139	1	C139	1	3	1	3	0	3	93-108
10	300	190	1	C190	0	18	0	8	0	8	x
10	300	338	1	C338	7	10	3	4	1	4	x
11	300	133	1	C133	1	1	1	1	0	1	109-117
11	300	534	1	C534	1	2	1	2	0	2	x
11	300	537	1	C537	3	2	3	1	1	1	x
11	300	563	1	C563	3	3	3	3	0	3	x
11	300	570	1	C570	0	1	0	0	0	0	x
11	300	571	1	C571	1	1	0	1	0	1	x
11	300	704	1	C704	1	0	0	1	0	0	x

13	300	551	1	C551	2	2	0	1	0	0	118-120
14	300	717	1	C717	1	1	1	1	1	0	121
15	300	396	1	C396	1	1	0	0	1	1	122-123
16	300	515	1	C515	5	1	2	2	1	2	124-127
16	300	517	1	C517	0	2	0	1	0	1	x
17	300	454	1	C454	7	18	2	10	0	11	128-144
17	300	466	1	C466	0	1	0	1	0	1	x
17	300	470	1	C470	1	0	0	0	0	0	x
17	300	488	1	C488	5	6	5	4	1	4	x
19	300	473	1	C473	2	6	1	5	1	5	145-150
20	300	743	1	C743	0	3	0	2	0	2	151-155
20	300	745	1	C745	1	1	1	1	0	1	x
20	300	758	1	C758	4	0	3	0	1	0	x
20	300	800	1	C800	8	1	5	1	0	1	x

Table 6.1 List of surface collections sampled from each neighborhood

The minimum size requirement for the Archaeometry Laboratory at the Missouri Research Reactor, where the XRF analysis took place, is that each piece be one centimeter wide and greater than two millimeters thick. Smith and Huster sorted the obsidian from the sampled surface collections by size (Table 6.1 columns “collection” and “large pieces”). Starting with the lowest numbered collection for each neighborhood sample (Table 6.1 column “Neigh”), the largest piece of obsidian was picked from each surface collection until a sample of a target size was reached for each neighborhood. The target size was twenty pieces of grey obsidian. If one pass through the surface collections did not yield the target sample, the procedure was repeated again starting with the lowest numbered surface collection. Each successive pass through a neighborhood collection yielded smaller pieces. The results of this sampling procedure can be seen in in table 6.1 column “sample.” An unfortunate aspect of this sampling procedure is that it had to be carried out before data were available on the technological aspects of the obsidian artifacts. When such data became available (from the analysis of Bradford Andrews), it was clear that the geological sources of the artifacts covaried significantly with the technological tool types, and this required additional analysis to disentangle (described below).

Analysis 6.1 Geochemical Sourcing.

The final sample contains 155 pieces of obsidian. Fifteen were identified via sight sorting as green and 140 were identified as grey pieces. Michael Glascock (2012) and MURR performed the chemical analysis using XRF of the obsidian sample from the Calixtlahuaca survey. The grey obsidian was sourced to Otumba, Malpais, Zacualtipan, Ucareo, Zinapecuaro, and from a source known at the Santa Catarina site. The green obsidian was sourced to Pachuca. Two of the grey obsidian pieces were chemically assigned to the Pachuca source. Upon closer examinations of those pieces, they do have a green cast. Both pieces are among the thickest in the sample. It is probable, given the relatively poor lighting of the field lab where the visual assessment was made, that these pieces were incorrectly sorted due to being more opaque than thinner pieces.

Source	Location	XRF Sample (Grey Only)	Total Assemblage
Ucareo	West Mexico	57.20%	45.73%
Otumba	Central Mexico	39.10%	31.26%
Zacualtipan	Central Mexico	1.40%	1.12%
Malpais	Central Mexico	0.70%	0.56%
Zinapecuaro	West Mexico	0.70%	0.56%
Santa Catarina	Unknown	0.70%	0.56%

Pachuca	Central Mexico		20.04%
Total in Sample		138	2120

Table 6.2 Percentage of each identified obsidiansource in the sample and total assemblage

The total proportion that each obsidian source made up of the total sample and the projected proportion of each source in the total assemblage can be found in Table 6.2. The results from the survey chemical characterization analysis and those from the excavated materials were quite similar. This suggests that both samples were from the same parent population. A detailed comparison between these results and those from the excavation materials can be found in Chapter 7. One interesting feature of these data is the prominence of west Mexican obsidian sources at Calixtlahuaca. At nearly all other Middle and Late Postclassic sites in central Mexico, the green, Pachuca obsidian dominates household assemblages, often at levels as high as 90 to 95% of all obsidian (Braswell 2003).

Analysis 6.2 The sources of obsidian found in each neighborhood.

Next I examined the proportion of each obsidian source present in each neighborhood. The raw proportions based on the XRF sample for each neighborhood are used to calculate an estimate for those neighborhoods using the total lithic assemblage for each neighborhood. These data are present in Table 6.3 and 6.4. Of the obsidian sources found at Calixtlahuaca, Otumba and Sierra de la Navajas (Pachuca) are the dominant Central Mexican sources. Minor Central Mexican sources at Calixtlahuaca are Malpais and Zacualtipan. West Mexican obsidian sources found at Calixtlahuaca are Ucareo and

Zinapecuaro, though the latter is found in trace amounts. One additional source was identified for the city. The exact location of this source is unknown, but matches a compositional group identified at the site of Santa Catarina in the State of Mexico. The data in Table 6.4 show considerable variation among neighborhoods in their obsidian sources. Below I show that this variation has a clear spatial structure (analysis 6.6).

Neighborhood	Ucareo	Otumba	Malpais	Zinapecuaro	Zacualtipan	Santa Catarina	N
1	100.00	0.00	0.00	0.00	0.00	0.00	2
2	70.00	20.00	10.00	0.00	0.00	0.00	10
3	81.25	18.75	0.00	0.00	0.00	0.00	16
4	66.67	33.33	0.00	0.00	0.00	0.00	3
5	83.33	8.33	0.00	0.00	8.33	0.00	12
6	36.84	57.89	0.00	0.05	0.00	0.00	19
7	46.15	53.85	0.00	0.00	0.00	0.00	13
8	33.33	66.67	0.00	0.00	0.00	0.00	6
9	100.00	0.00	0.00	0.00	0.00	0.00	2
10	33.33	60.00	0.00	0.00	6.67	0.00	15
11	62.50	25.00	0.00	0.00	0.00	12.50	8
12	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	50.00	50.00	0.00	0.00	0.00	0.00	2
14	100.00	0.00	0.00	0.00	0.00	0.00	1
15	0.00	100.00	0.00	0.00	0.00	0.00	1
16	33.33	66.67	0.00	0.00	0.00	0.00	3
17	75.00	25.00	0.00	0.00	0.00	0.00	16
18	0.00	0.00	0.00	0.00	0.00	0.00	0
19	42.86	57.14	0.00	0.00	0.00	0.00	7
20	0.00	100.00	0.00	0.00	0.00	0.00	2
Total Sample	57.20	39.10	0.70	0.70	1.40	0.70	138

Table 6. 3   Proportion of geological obsidian sources by neighborhood as reflected in the sample. N is the number of artifacts sourced.

Neig	Ucareo	Otumba	Malpais	Zinapecuaro	Zacualtipan	Santa Catarina	Pachuca	N
1	100.00	0.00	0.00	0.00	0.00	0.00	0.00	12
2	62.22	17.78	8.89	0.00	0.00	0.00	11.11	18
3	65.57	15.13	0.00	0.00	0.00	0.00	18.95	285
4	66.67	33.33	0.00	0.00	0.00	0.00	0.00	5
5	53.42	5.34	0.00	0.00	5.34	0.00	35.90	117
6	32.44	50.98	0.00	0.05	0.00	0.00	11.95	251
7	40.00	46.67	0.00	0.00	0.00	0.00	13.33	15
8	27.08	54.17	0.00	0.00	0.00	0.00	18.75	16
9	40.00	0.00	0.00	0.00	0.00	0.00	60.00	5
10	26.36	47.44	0.00	0.00	5.27	0.00	20.93	43
11	31.25	12.50	0.00	0.00	0.00	6.25	50.00	20
12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	25.00	25.00	0.00	0.00	0.00	0.00	50.00	4
14	50.00	0.00	0.00	0.00	0.00	0.00	50.00	2
15	0.00	50.00	0.00	0.00	0.00	0.00	50.00	2
16	12.50	25.00	0.00	0.00	0.00	0.00	62.50	8
17	48.33	16.11	0.00	0.00	0.00	0.00	35.56	90
18	0.00	0.00	0.00	0.00	0.00	0.00	100.00	1
19	33.33	44.44	0.00	0.00	0.00	0.00	22.22	9
20	0.00	27.78	0.00	0.00	0.00	0.00	72.22	18

Table 6. 4 Proportion of geological obsidian sources by neighborhood adjusted for the total obsidian assemblage from each neighborhood

Analysis 6.3 Obsidian and technology types

Once the data on obsidian technologies became available, I examined the distribution of obsidian sources amongst technology types to determine if there were any preferences for different tool types. Not all of the obsidian sourced with XRF from the survey materials had been examined by Dr. Bradford Andrews to determine the technology type. However, all the obsidian sampled by Dr. Adrian Burke from the excavated materials had technology type information. I examine both samples separately to control for sampling error. The distribution for each technology type is tested against the general distribution for each of the major grey sources. If there is no source preference for technological use then the distribution of sources for the technology should be similar to the overall distribution. Since preference does not impact the obsidian selected, then each obsidian source is used in relation to its general availability which is best represented by the sitewide distribution (as represented by the excavated material). These relationships are found in Table 6.5.

Percantage of Ucareo v Otumba	Survey			Excavation		
Technology	Ucareo	Otumba	N	Ucareo	Otumba	N
Bipolar	68.18	31.82	22	50.00	50.00	4
Biface	0.00	100.00	10	13.95	86.05	25
Core-Blade	90.70	9.30	43	86.42	13.58	81
General	28.57	71.43	7	48.00	52.00	43
Total Source Sample	68.29	31.71	82	58.82	41.18	153

Table 6.5 Distribution of major obsidian sources by technology types for both survey and excavation XRF samples.

Surprisingly, there are stark differences between the sources used for the categories of bifacial technology and general technological categories such as unifacial tools, and those used for core-blade technology. Bipolar technology is present in almost identical percentages as found in the general assemblage. This is not surprising since evidence of bipolar technology is found primarily on reused obsidian pieces. The general category consists of flakes and other fragments produced using unknown techniques. This catch-all category is the only one where the survey and excavation figures differ strongly from each other. Given the strength of some of the differences in sources among technology types, the XRF sample would need to match the assemblage for each neighborhood. Otherwise, the XRF sample would be biased toward the sources found in the technology types that dominate it.

Analysis 6.4. Comparing the XRF and actual technology type distributions

In this analysis, I examine the relationship among the lithic tool technologies sampled and the resulting obsidian sources. As can be seen in Table 6.5, both bipolar technology (an expedient technique of lithic processing) and general lithic debris are derived roughly equally from Central Mexican and West Mexican sources. Core-blade and bifacial technologies have disproportionately more obsidian from one source area than the other. This is true for both the excavated and surface collection samples, suggesting the pattern is not simply an artifact of sample selection. The presence of one source region in such higher quantities in a specific tool technology over another can bias the chemical characterization results. This bias is problematic if the obsidian selected for chemical characterization does not reflect the proportion of each technology type in the total assemblage. The technology types sampled strongly influence the percentage of obsidian from that source area. Due to the size constraints of XRF analysis discussed above, Core-blade technology was evidently oversampled for chemical characterization.

The percentages for obsidian sources based on tool technology are better to for calibration of the neighborhood source percentage values.

Analysis 6.5. Calculating neighborhood source distributions

The lithics characterized by XRF did differ from the total assemblage for the sitewide sample of obsidian. The differences, which can be seen in the last row of Table 6.6, predominantly impact the results derived from the bipolar and general technology types. Both these technology types are relatively equally distributed across the Ucareo and Otumba source areas. This fact mitigates some of the bias since, probabilistically, the two obsidian artifact types contribute similar percentages to the final total. However, the core-blade technology type makes up ten percent less of the total assemblage than found in the XRF sample. West Mexican obsidian, which dominate the core-blade technology, would be slightly over-represented in the distribution of obsidian sources across the settlement. Of more immediate concern is the impact of this bias on the distribution across neighborhoods of obsidian from the different sources.

Neighborhood	Grey Bipolar	Grey Biface	Grey Core-Blade	Grey General	N
2	18.75	6.25	43.75	31.25	16
3	9.80	13.73	26.96	49.51	204
4	0.00	0.00	0.00	100.00	2
5	13.04	11.59	44.93	30.43	69
6	10.05	15.98	27.40	46.58	219
7	37.50	12.50	25.00	25.00	8
8	0.00	38.46	23.08	38.46	13
9	0.00	0.00	100.00	0.00	2
10	15.63	9.38	25.00	50.00	32

11	12.50	0.00	75.00	12.50	8
13	0.00	0.00	100.00	0.00	2
14	0.00	0.00	100.00	0.00	1
15	0.00	0.00	0.00	100.00	1
16	25.00	50.00	0.00	25.00	4
17	9.84	9.84	37.70	42.62	61
19	50.00	16.67	16.67	16.67	6
20	20.00	20.00	60.00	0.00	5
Sitewide	13.06	12.02	41.50	33.41	653
XRF Sample	26.83	12.20	52.44	8.54	82

Table 6.6 The distribution of technology types by neighborhood. This is based all obsidian in each neighborhood sample. The distribution found in the XRF sample is provided for comparison.

Table 6.6 depicts the distribution of obsidian artifacts from different technology types across the seventeen neighborhoods for which obsidian data is available. The percentages from each technology type per neighborhood fluctuate greatly. From some neighborhoods only core-blade technology was recovered. Other neighborhoods have a more equal distribution across types. For many neighborhoods, the actual sources from chemical characterization may not reflect the real distribution within the neighborhood. This requires a calibration of the absolute values for each neighborhood for each tool type by the general distribution for those tool types. Since the source fluctuates with tool type, the neighborhood values for each type were multiplied by the proportion of each sources contribution to that type. This a better estimate of sources present in each neighborhood. This is presented in Table 6.7.

Neigh	Ucareo	Otumba	Pachuca	Cmex	Wmex	N= obsidian
2	59.08	29.81	11.11	40.92	59.08	18
3	44.36	35.33	20.31	55.64	44.36	256
4	19.20	20.80	60.00	80.80	19.20	5

5	42.84	24.15	33.01	57.16	42.84	103
6	49.26	40.12	10.61	50.74	49.26	245
7	48.73	31.27	20.00	51.27	48.73	10
8	35.56	45.69	18.75	64.44	35.56	16
9	43.21	6.79	50.00	56.79	43.21	4
10	47.23	34.82	17.95	52.77	47.23	39
11	35.26	9.18	55.56	64.74	35.26	18
13	43.21	6.79	50.00	56.79	43.21	4
14	43.21	6.79	50.00	56.79	43.21	2
15	24.00	26.00	50.00	76.00	24.00	2
16	16.01	28.43	55.56	83.99	16.01	9
17	38.84	24.70	36.46	61.16	38.84	96
19	44.11	30.89	25.00	55.89	44.11	8
20	24.39	11.33	64.29	75.61	24.39	14
Sitewide	44.26	32.65	23.09	55.74	44.26	849

Table 6.7 The values for the main geological sources by neighborhood once calibrated to account for the differences in source by tool type.

Because a number of obsidian sources are represented by only one or two pieces in my sample, the relationship between these obsidian sources and technology could not be assessed quantitatively. The calibrations rely on the information on obsidian from the Ucareo, Otumba, and Pachuca sources. These are the major sources of obsidian that entered the city.

Analysis 6.6. Spatial distribution of obsidian sources

I used ArcGIS to visualize the spatial distribution of Central Mexican and West Mexican obsidian at Calixtlahuaca's neighborhoods. Figure 6.1 shows the resulting map, using the data from Table 6.7. The city can be divided into two areas based on the similarity in proportion of Central Mexican and West Mexican obsidian sources among neighborhoods. These two areas are separated by the thick black line in figures 6.1-6.3. The neighborhoods in the western half of the city contain roughly equal proportions of

West Mexican obsidian and Central Mexican obsidian. The eastern neighborhoods have little West Mexican obsidian. The neighborhoods that comprise each area and the mean proportion for Central Mexican and West Mexican obsidian for those areas are listed in Table 6.8.

Area	Neighborhoods	Central Mexican	West Mexican
West	1, 2, 3, 4, 8, 5, 6, 7, 9, 10, 11, 13, 14	58.83	42.60
East	15, 16, 17, 18, 19, 29	84.31	15.69

Table 6.8 Proposed market divisions and proportions of West and Central Mexican obsidian in each.

The existence of two areas with distinct proportions from different geographic sources conforms to the above described pattern for the operation of multiple markets at Calixtlahuaca. Obsidian to these markets was likely supplied from different regional distribution networks. Was obsidian marketing at Calixtlahuaca unique? Or do other categories of goods also conform to the model of two separate market systems at the site? A common model for Mesoamerican obsidian exchange is that its distribution was in the hands of itinerant obsidian-knappers, who visited cities and markets to sell their products, independent of the operation of other regional merchants (Hirth 2008, 2009).

If the obsidian was brought into Calixtlahuaca by itinerant merchants, then it is possible that each merchant only visited a portion of the neighborhoods. If each merchant had a different supply of obsidian this could have produced the pattern shown in Figure 6.1. Other household goods, provisioned separately, would show a different distribution, most likely not following the pattern in Figure 6.1. To test the hypothesis that only obsidian distribution produced the observed pattern, I examine the distribution of other types of imported goods at the site. If obsidian and ceramic goods were distributed as part of the same distribution networks, then other imported products would show the same spatial pattern as the obsidian. This finding would support the conclusion that multiple market systems were operating at the city.

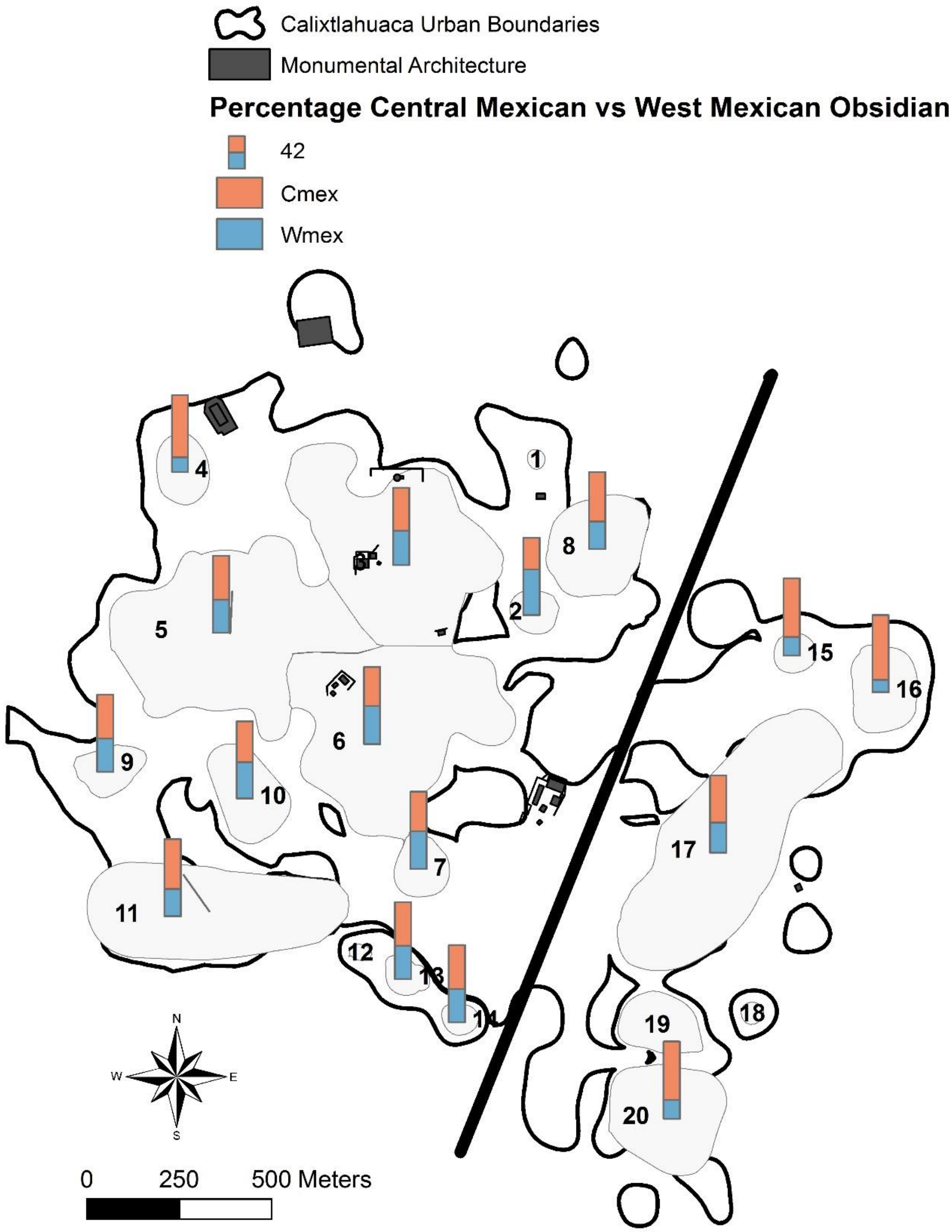


Figure 6.1 Neighborhood porportions of sources obsidian and divisions produced by this distribution.

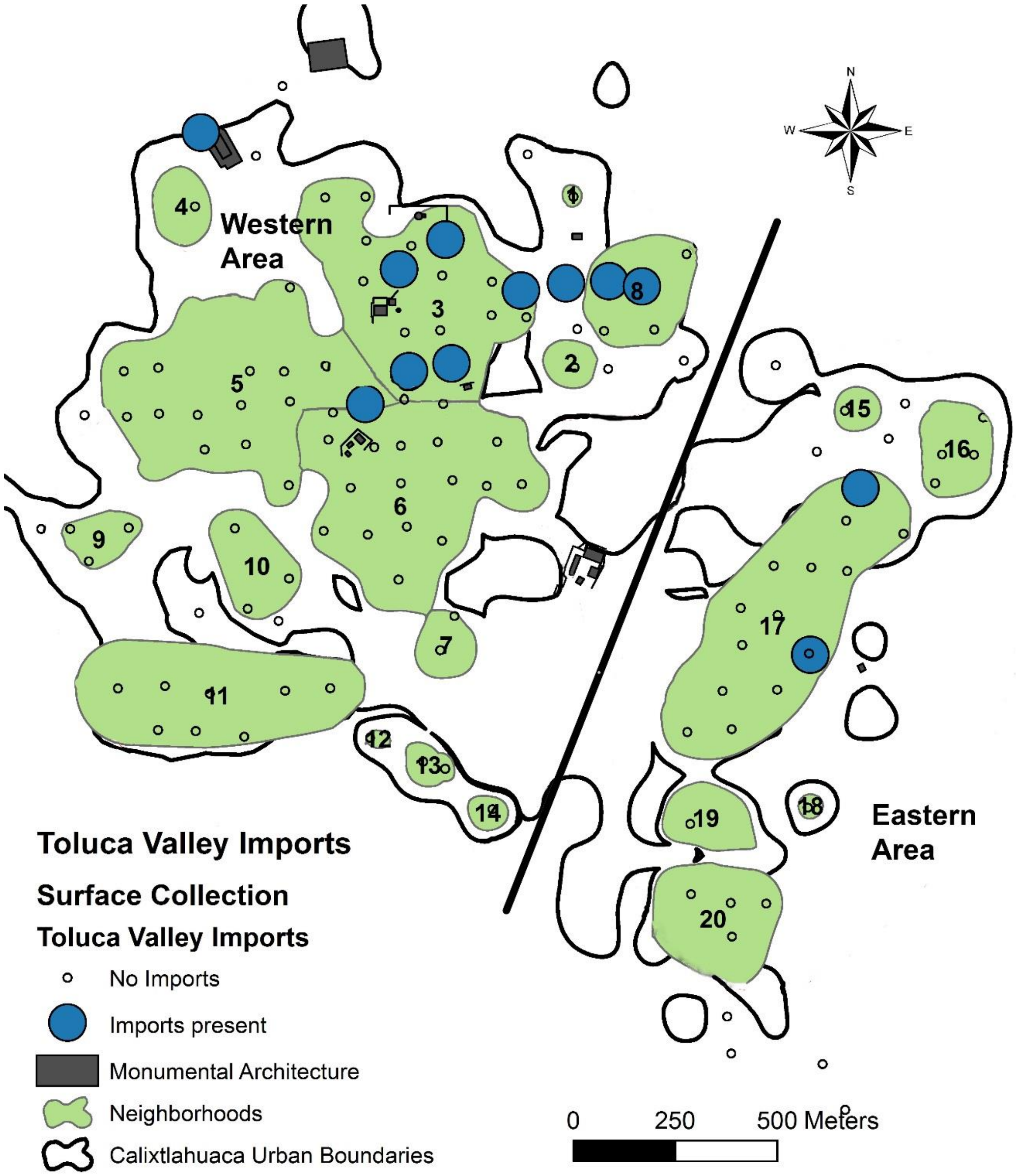


Figure 6.2 Locations where imports from elsewhere in the Toluca Valley were present.

Analysis 6.7 Confirming market areas

I first examine the distribution of imported ceramic objects from elsewhere in the Toluca Valley. The exact source of these ceramic objects is not known, but they were almost certainly imported into Calixtlahuaca. They appear to have been made from non-local clays, and each of the types is far more abundant in another part of the Toluca Valley than at Calixtlahuaca. The ceramic types that make up the Toluca Valley imports category are: B-5 bowls (Valle de Bravo, Red bowls with interior incisions), B-11 bowls (red bowls with exterior incisions), D-6 bowls (bowls with badly executed horizontal bands), G bowls (negative decoration). These types are described in detail in Huster (2015). As can be seen in Figure 6.2, these imported types are found almost exclusively in the hypothesized Western market area. Specifically, these are clustered in the Northwest quadrant of the city. The two surface collections containing Toluca Valley imports outside of the Western market area are located in the neighborhood in the East that has the highest amount of West Mexican obsidian of any neighborhood in that zone.

Similar examination of the distribution of Central Mexican imported ceramic goods (Fig 6.3) shows a different pattern from both the Toluca Valley imports and the obsidian. Central Mexican imports are found in both market areas at Calixtlahuaca. While there are more collections in the Eastern market area with Central Mexican imports, there is no statistically significant difference between this area and the West. While more Central Mexican obsidian finds its way into the Eastern market area, ceramics from the same region do not follow the same pattern. It is possible that this pattern is a result of differences in chronology between the East and West halves of the city. Perhaps one portion of the city is older and thus the spatial pattern is a result of changing distribution networks through time. Before the implications of these analyses can be described, I need to rule out the possibility that the patterns arise more from chronological changes at the site than from the operation of markets.

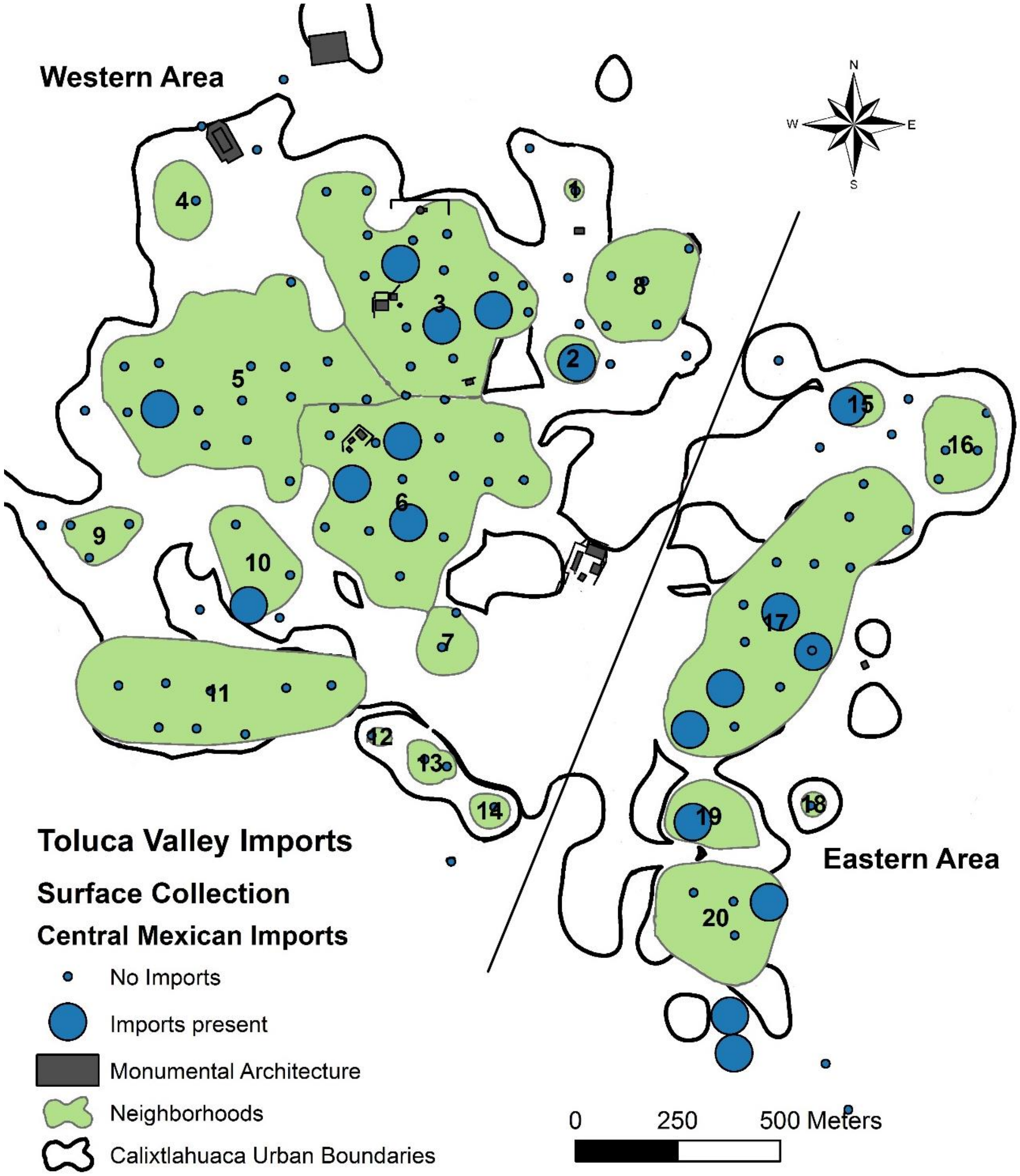


Figure 6. 3 Locations where imports from Central Mexico were present.

Chronological patterns.

Using the chronological assessments for the archaeological phases from the 2007 excavations at the site (Huster and Smith 2013), I examine the degree to which the above spatial patterns correspond to longer periods of occupation. I use excavation locations to determine if a neighborhood was occupied during each phase. Due to issues of accessibility, most excavations at Calixtlahuaca were located in the Northwest quadrant of the settlement. The Northwest quadrant of the city is where artifact densities are the highest and neighborhoods are the largest. In other words, the most populous portion of the city was located in the Northwest. However, because of this preference not all neighborhoods were sampled via excavation. Only 6 of 20 neighborhoods contained excavations with well-phased deposits, and most excavations were located in neighborhoods 3 and 5. Despite this dearth of data, there is evidence that the earliest phase (Dongu) settlements are present in most of the neighborhoods in the Western market area; no Dongu phase settlements were located in the East. The small number of excavations in the Eastern area makes it difficult to say with confidence that occupation in the Eastern areas began in the West. The two excavations located in the east were single phase occupations. They date to different phases, but contain the same obsidian percentage as the surface collections from the area (Chapter 7). This indicates that even if the Eastern half of the city was not occupied early, once it was occupied the distribution network did not change greatly.

Conclusion

The spatial patterns of the various types of imported products support the hypothesis that two separate market systems operated at the same time in Calixtlahuaca. Neighborhood residents in proximity to one another obtained similar proportions of obsidian from the same sources, and these proportions differed between two spatial zones at the site. Imported ceramics from other settlements in the Toluca Valley were only available in the Western area, suggesting a distribution similar to that of the obsidian sources, which were not distributed the same in both areas. This suggests that these produce were passed through the same distribution channels. Products from other parts of Central Mexico were available in varying quantities in all market areas. These include ceramic imports from the imperial core of the Triple Alliance Empire. All but the Toluca Valley ceramic imports were available throughout Calixtlahuaca and consumed in variable quantities. This distribution suggests that while residents provisioned themselves from the closest marketplace to them, these marketplaces were not supplied exclusively by supply chains from specific regions. Nor is there any quality about the social make-up of these socially mixed neighborhoods (Chapter 4 and 5) that would attract vendors with products from one region over another.

Markets and their commercial distribution networks were fundamental to supplying the city and its inhabitants with needed goods. It is possible that demographic and topographic aspects of the settlement may have influenced a vendor's choice to sell their wares at a given marketplace. The eastern area is less intensely populated (Chapter 3) and requires the vendor to carry their product around Cerro Tenismo to the area around Cerro San Marcos. Again, the return on the effort may not have been sufficient for some vendors. The vendors who were most willing to sell at the Eastern marketplace were the vendors with Central Mexican products since this area has much higher amounts of Central Mexican obsidian and does not receive Toluca Valley imports. The presence of residents with social identities focused on Central Mexico in all areas of the city may have given some vendors a set of regular customers who had additional material needs that do not survive into the archaeological record. The presence of residents with social identities focused on Central Mexico would have provided merchants selling Central Mexican goods incentive to sell in more difficult to reach places that would not have been as profitable to other merchants without that built in consumer base. Obsidian, which does not have the same pattern of demand as a differentiated good like a decorated pot, could have been bought by a wider segment of the population further increasing profit for the vendors.

CHAPTER 7

COMPARISON BETWEEN SURVEY AND EXCAVATION DATA

Archaeologists have long valued surface survey for its utility in addressing large-scale regional questions cheaply and non-destructively. The Basin of Mexico surveys in Mesoamerica (Sanders et al. 1979; Parsons et al. 1982; 1983) are an example of this type of survey based research. These types of surveys provide data on a large scale economic and political system and produce new information years after their completion (e.g. Minc 1994; Minc et al. 1994). Scholars in Europe and Asia use survey methods to study smaller regions or sites with certain level of success. Many of these studies focus on how to identify plowzone materials as the remains of important economic settlements or its relation to forms of intensive agriculture (e.g. Bintliff 2000; Francovich et al. 2000). Even with its successes, the usefulness of surface survey to address smaller scale research has often come into question.

Palumbo (2015) cogently describes the main concerns that archaeologists have with using survey based materials. Borrowing from Hope-Simpson (1982), Palumbo writes that there are three main problems with survey data. 1) Surface materials are subject to a wide variety of post-depositional processes that cannot be controlled for. 2) Early periods in the archaeological sequence are underrepresented in surface materials. This is because earlier strata would naturally be located at much deeper depths and less subject to the post-depositional processes that bring the artifacts to the surface. 3) The artifacts found on the surface may not be representative of those located below the surface. The worry here is that interpretations made based on the surface materials are not accurate representations of actual prehistoric conditions. (Pulambo 2015: 78). Research on this issue, of which Pulambo is a part, provide contradictory solutions to these three concerns.

Pulambo's own study at Pitti-Gonzalez in Panama draws three conclusions 1) Surface materials do not underrepresent early components of the settlement, 2) the materials on the surface correlate moderately well with the materials encountered below the surface, 3) the interpretations possible from both samples are comparable. These findings are very promising for using survey to address interasite questions like neighborhood socio-spatial organization. However, a recent study from Yucatan reports less encouraging results.

Johnson's (2014) study of the relationship between what is recovered on the surface and what items lie beneath that exact location suggests that surface materials are imperfect reflections of what is found in excavated contexts. Johnson attributes this to the stochastic effects of how artifacts arrive at the surface. He argues that at larger scales, such as site wide, survey materials reflect an accurate artifact assemblage. Surface collections are not accurate reflections for subsurface finds at the precise locations of their placement. While Johnson's results are not surprising (see chapter 3), it is my expectation that surface collections may accurately reflect intrasite patterns, as they did for Pulambo, for scales above the collection unit. I test this idea by comparing key selected results reported in chapters five and six with parallel studies using the excavated assemblage. I argue that the excavated assemblage will yield the same results from analytical methods similar to those used with the survey materials. The excavations did not sample all neighborhoods identified at Calixtlahuaca. This is due in part to the fact that the neighborhoods were identified after the excavations took place. Excavations occurred in six neighborhoods and two small sections outside the formal neighborhood boundaries (Table 7.1). The Northwest portion of the settlement was sampled heavily. Two excavations are located in Neighborhood 17 in the Eastern section of Calixtlahuaca.

Neighborhood	Excavations
Not in a Neighborhood	4
2	1
3	8
5	1
6	5
10	2
17	2

Table 7.1 Number of excavations present in the seven neighborhoods sampled.

Comparing Excavated and Surface Collected Data Sets

Given the law of superposition, the artifacts on the surface should be mostly from the final occupation of the settlement. Calixtlahuaca Archaeological Project geoarchaeologist Alexander Borejsza has identified the history of terracing at Calixtlahuaca (Smith et al. 2013). Prehispanic terraces were dismantled to produce wider modern terraces. The soil contents of upper terraces were redeposited on top of lower terraces to produce a new, artifact rich surface. This set of depositional events produced a surface that mixes materials from throughout the city's history. While surface collections most definitely cannot be an indication of what is directly below them, they can tell us about the population in the general vicinity of collection unit. The ceramics and obsidian on the surface of the settlement produce a palimpsest of the artifacts produced, used, and discarded at the city throughout its occupation. In order to compare the surface data with the data from the excavations, I must convert the excavated data into a comparable sample.

Chronological analysis of the city from excavated contexts yielded three temporal period or phases (Huster and Smith 2015). These are the Dongu phase (1126-1375 AD), the Ninupi phase (1375-1445 AD), and the Yata phase (1445-1531 AD). The Dongu phase at Calixtlahuaca is almost three times the length of the other phases. As a result, Dongu phase usage and discard should contribute three times the sherds and obsidian to the surface assemblage as the other two phases. Simply using all the materials from each excavated location will not accurately reflect the proportion each temporal phase contributes to the total assemblage of the surface materials. For this reason, I do not use ceramic and obsidian data from contexts that were not phased chronologically. Additionally, because only rim sherds were used to calculate the figures used in the surface analysis, I use only rim sherds from the excavated materials.

Transforming the Data

Ceramics. Angela Huster provided a file with all the rim sherds for each type from each phase for the domestic context sample (DC3) of the excavated data. The domestic context sample contains only well-dated and stratigraphically secure refuse deposits associated with houses. I combined types so the resulting categories match those discussed in chapter five. All phases for each excavated context were added together with Dongu phase contexts being weighted three times that of other phases (Table 7.2).

Unit	plainware bowls	plainware jars	E bowls	B bowls	C bowls	Aztec bowls	thick rim jars	basins	comal	decorate jars	other decorated	Total
303	204	88	121	99	12	3	13	3	3	26	29	601
304	19	3	14	2	0	3	2	0	1	2	1	47
305	366	375	189	117	3	6	15	0	3	39	36	1149
307	1027	659	505	472	98	30	230	18	83	134	299	3555
308	88	49	32	36	12	24	19	0	9	9	30	308
309	31	7	25	68	2	15	37	2	31	8	13	239
310	102	81	402	42	12	42	3	0	0	54	45	783
311	222	206	187	173	12	19	119	4	27	48	41	1058
313	202	151	160	115	13	1	44	1	0	32	35	754
314	0	27	36	0	0	6	3	0	0	3	0	75
315	951	1683	1593	552	165	9	30	0	0	192	207	5382
316	960	1051	572	458	112	53	376	9	55	134	273	4053
317	56	47	101	109	19	54	97	9	79	18	61	650
319	174	252	174	66	3	189	18	0	3	30	18	927
320	294	231	423	375	18	0	99	6	0	63	51	1560
321	7	8	15	7	0	0	0	0	1	2	0	40
322	22	53	23	26	6	8	19	0	1	6	17	181
323	1263	1635	1737	573	84	21	33	18	0	294	192	5850
324	133	135	80	31	0	7	21	0	8	16	49	480
325	3	5	11	12	0	3	8	0	0	1	1	44
326	126	141	114	45	0	0	1	0	0	15	9	451
327	11	11	19	10	1	0	13	0	0	1	3	69

Table 7.2 Ceramic weighted counts for all phased contexts from excavation locations

Lithics. The lithic data came from the Calixtlahuaca project database. I retrieved data on the color, technology, and phase for the domestic sample employed in the ceramic analysis (excavated sample DC3). I combined the phases together in proportion to the temporal lengths, using same procedure used to aggregate the ceramic data.

Excavations within 50 meters of a neighborhood boundary were included as part of the neighborhood for this analysis. The results of combining the data in this way can be seen in Table 7.3.

Unit	Market	Phases	Grey-Biface	Grey-Bipolar	Grey-Core/Blade	Grey-General	Total Grey	Total Green	Total Obsidian
307	NW	2,4,6	129	5	123	105	362	164	526
308	NW	4	7	6	15	10	38	27	65
309	NW	6	4	0	9	6	19	22	41
311	NW	4	66	8	112	65	251	71	322
313	NW	4	3	2	7	4	16	2	18
314	SW	2	3	0	4	6	13	0	13
315	NW	2	8	5	28	20	61	18	79
316	NW	2,4,6	48	7	90	70	215	86	301
317	NW	6	2	0	15	6	23	39	62
319	SW	2	0	2	5	2	9	2	11
320	SW	2	21	11	38	34	104	43	147
321	SW	6	25	8	19	11	63	3	66
322	E	4	1	3	10	4	18	19	37
323	NW	2	39	19	84	34	176	37	213
324	SW	2,6	17	16	50	31	114	29	143
326	SW	2	3	7	5	6	21	4	25
327	E	6	0	1	4	2	7	6	13

Table 7.3 Obsidian weighted counts for all phased contexts from excavation locations

Comparisons of Ceramic Data

Analysis 7.1 Wealth and Class Measures.

This section examines the presence of households from different social classes within individual neighborhoods. The results from the survey indicate that elites did not live separately from commoners, in separate neighborhoods. Using the weighted ceramic data, I calculated the bowl to jar ratio and decorated percentage for the excavated contexts. I used the elite signature of a bowl to jar ratio of three or higher (chapter five) to identify similar collections within the excavated sample. Three households from the DC3 sample have bowl to jar ratio above three (Table 7.4) though the range is not as extreme as found in the survey sample. Only one of the three, Unit 310, has a decorated percent above fifty which suggests that the wealth differences among these households are not extreme. On this basis I interpret units 303, 304, and 310 as likely elite contexts.

Neigh	Unit	Bow: Jar Ratio	% Decorated
N3	307	2.38	43.26
N3	309	2.96	54.81
N3	311	1.75	45.37
N3	313	2.32	47.21
N3	315	1.83	50.50
N3	316	1.56	39.53
N5	308	2.88	46.43
N6	320	2.95	59.62
N6	321	2.90	60.00
N6	324	1.74	38.13
N6	326	1.87	40.58
N10	314	1.27	60.00
N10	319	2.08	51.78
N17	322	1.31	47.51
N17	327	1.76	49.28
Outside	303	3.69	48.25
Outside	304	5.57	46.81
Outside	305	1.67	33.94
Outside	310	4.67	76.25
Outside	317	2.47	55.69
Outside	323	1.97	49.59
Outside	325	2.14	63.64

Table 7.4 The bowl to jar ratio and percent decorated of artifact in the excavated assemblage. Units that correspond to the elite criteria are boxed.

The elite contexts identified in Chapter 5 are located throughout the site in very low concentrations. Half of these elite contexts are outside of neighborhood boundaries (Figure 4.2). All three excavated contexts occur outside of a neighborhood boundary. The locations of two of the excavation units identified as elite here are very close to the monumental palace (Figure 7.1). These units coupled with one of the identified elite surface collections, are located near enough to each other to suggest some clustering near the palace in extra-neighborhood space, or possibly an elite neighborhood.

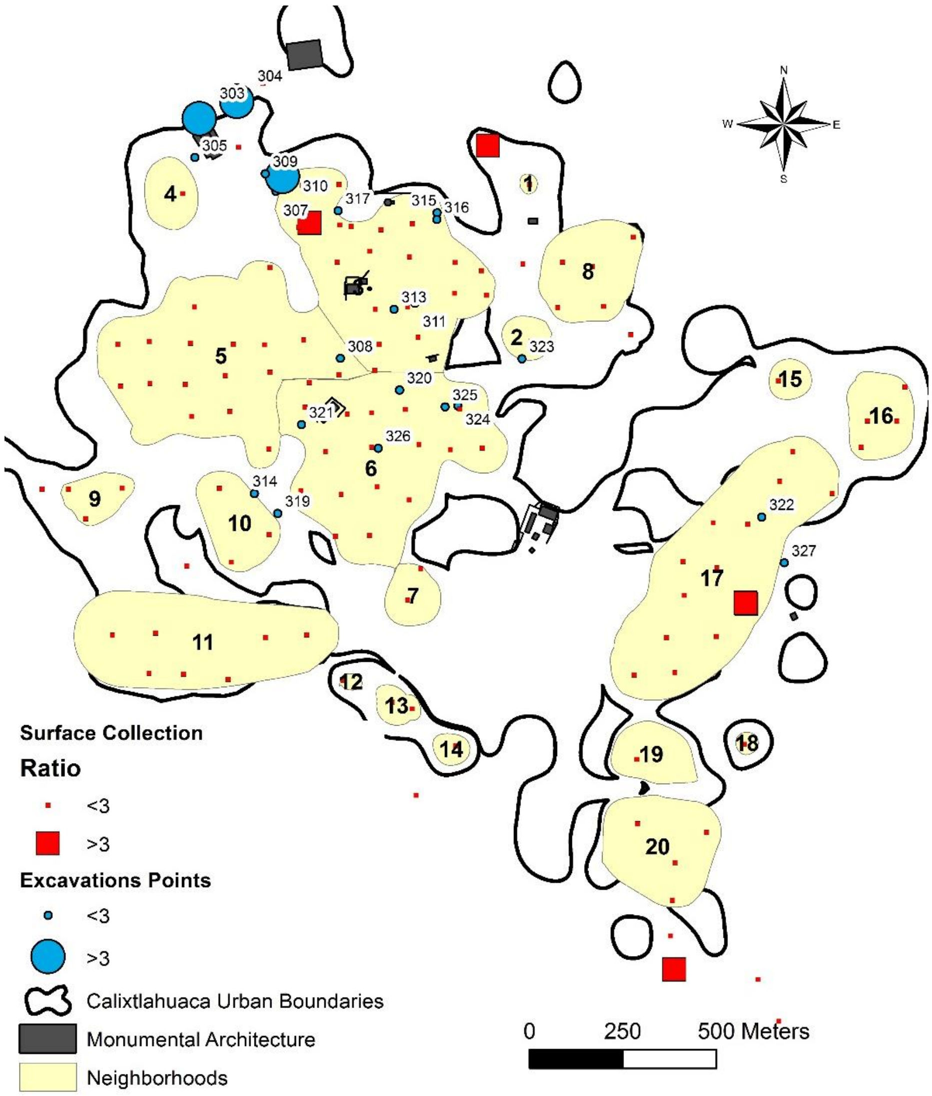


Figure 7.1 Map showing the location of both the excavations and surface collections that meet the requirements for an elite context—a bowl to jar ratio above 3.

Analysis 7.2 Consumer Groups.

I analyzed the excavated materials to see if it was possible to identify consumer groups that match those identified with K-means analysis of the surface collection data (Chapter 5). The excavated materials produce similar patterns in the neighborhoods as those generated with the surface collections. Brainerd-Robinson Similarity Coefficients were used in Chapter 5 to double check the results of the K-means groupings. This method produces a measure of the degree of similarity between samples. I used a Brainerd-Robinson Similarity Coefficient Matrix to compare the excavated units with the mean values for the K-means groups identified in Chapter 5. All excavation units could be matched to a K-means group with coefficients above 150 (200 is the most similar). Since there are eleven attributes or artifact categories whose individual means are used to determine the K-means group, a simple statistical test to determine if both sets of data come from similar populations is not possible. As a check, I compared the mean for each category separately for each excavation unit group with its associated K-means group using a t-test of statistical significance. The results of this analysis can be seen in Table 7.5.

Group	#Categories Statistically Similar	# Categories Statistically Different	Not Enough Data	Total Categories
A/1	8	2	1	11
B/2	7	1	3	11
C/3	8	1	2	11
D/4	0	0	11	11
E/5	7	4	0	11

Table 7.5 Tthe number of categories that are statistically the same or different between the K-Means Groups (numbers) and Excavated Groups (letters).

Both the excavated unit grouping and the K-means groups have eleven different attributes whose individual mean values are compared. No pair of excavated unit group and K-means group had statistically similar attribute means for all eleven attributes. However, the vast majority of cases have a statistically significant result indicating that both samples come from the same parent population (Table 7.5). The temporal phases associated with each excavated unit group (survey consumer group) show no correlation suggesting that there is no relationship between consumer groups and temporal phases in the excavated sample.

Since all the neighborhoods sampled by excavation are identified as socially mixed in terms of consumer groups/social identities in the survey, a mixture of different groups in the neighborhoods among the excavated units would support the survey pattern. In contrast, if all the excavated units from a neighborhood are from the same consumer group, than clustering not identified in the survey might be present. Table 7.6 depicts the distribution of consumer groups identified for excavated contexts among neighborhoods. Neighborhood 3 has the largest amount of excavated units compared with other neighborhoods. Over half of Neighborhood 3's excavations belong to Group A (corresponding to K-means Group 1) consumer group units. However, given that Group A accounts for over half of all excavated units, this concentration is not higher than the expected average. In the survey sample, no single K-means group was present in high enough concentrations within a neighborhood such that the neighborhood could be considered socially clustered. It appears from this analysis that both the excavated and surface materials present a pattern of socially meaningful consumer behavior.

Neighborhood	KM 1	KM 2	KM 3	KM 4	KM 5	Total
Outside Boundary	1	0	2	0	0	3
N2	1	0	0	0	0	1
N3	5	1	0	0	2	8
N5	1	0	0	0	0	1
N6	2	1	0	0	2	5

N10	1	1	0	0	0	2
N17	1	0	0	1	0	2

Table 7.6 The distribution of excavations across neighborhoods in regard to K-Means Group. KM-# indicate to which of the K-means groups from Chapter 5 are these data associated.

Site-wide Obsidian Source Comparisons

Analysis 7.3 Comparing the total assemblage.

I discuss in Chapter 6 the sampling issues for XRF sourcing at Calixtlahuaca that arise from unexpected preferences for specific sources for different technologies. The samples for both the excavation and survey XRF studies are impacted by this issue. While individual excavation units were not sampled consistently across the settlement, the overall and phased samples are consistent in terms of the proportion of technology sampled (Table 7.7). The differences between the survey and excavation XRF sample are noticeable for two technology types. However, this difference does not strongly impact the overall sitewide distribution of obsidian sources calculated from these samples (Table 7.8). That both analyses yielded similar results supports Scott's (2012) contention that survey data are suitable for understanding large spatial scales.

Distribution of Technology Types Across Samples

Sample Name	Bipolar	General	Core-Blade	Biface	N
Survey Sample-MURR	26.83	8.54	52.44	12.20	82
Excavation Sample-Burke	2.61	16.34	52.94	28.10	153
Phase 2 of Excavation	4.62	20.00	50.77	24.62	65
Phase 4 of Excavation	0.00	14.04	54.39	31.58	57
Phase 6 of Excavation	3.23	12.90	54.84	29.03	31

Table 7.7 Lithic technologies sampled by each XRF Sample

Obsidian Source	Total Survey Assemblage	Total DC3 Assemblage
Ucareo	45.73%	45.88%
Otumba	31.26%	26.30%
Minor	2.80%	4.68%
Unknown	0.00%	3.34%
Pachuca	20.04%	20.22%
N	2120	23,793

Table 7.8 Site-wide obsidian source distributions based on survey and excavation assemblages. The same frequencies have been extrapolated from sourced artifacts to the entire samples.

Neighborhood and Market Area Comparisons

Analysis of the surface data suggests the presence of two market areas composed of sets of adjacent neighborhoods whose inhabitants had access to the same obsidian sources in similar proportion. If the excavated units also show the same pattern of obsidian usage, this would support the model described in Chapter 6. To test this, I perform two analyses on the excavation data. The first analysis compares the excavated units with survey data for each neighborhood. The second looks at the pattern for the whole market area. Naturally, since we have few excavations for each neighborhood, the pooling of those data points for the market area as a whole produces the most robust results. In both cases, the survey and excavation data yield the same pattern, suggesting that the survey materials have indeed identified the actual neighborhood and intra-urban market patterns.

As described in Chapter 6, the XRF analysis demonstrating source bias among technology types was used to estimate the percentage of the major obsidian sources for each excavation unit (see Table 7.9). The XRF data for the excavation materials was primarily used to calculate the ratios between the different sources for use in calibrating non-sourced materials. Occasionally, the number of pieces sampled by XRF for a specific tool type less was than four pieces in the sample from the excavation. Because of the low count, the survey XRF sample ratios were used. In each of those cases the distribution was close to equal for both geological sources and did not weight one source more than another. The excavation XRF sample does not reflect the actual technological composition of the excavated assemblage for most excavated units. This procedure for estimation creates a more accurate estimate of source distribution than is possible from the XRF sample alone.

Neighborhood	Unit	Pachuca	Otumba	Ucareo	West Mexico	Central Mexico
2	323	17.37	31.12	50.92	50.92	48.50
	Survey	11.11	29.81	59.08	59.08	40.92
N3	307	31.18	30.40	35.13	30.40	66.31
	309	53.66	24.10	20.07	24.10	73.73
	311	22.05	40.92	34.03	40.92	56.08
	313	11.11	51.14	36.83	51.14	47.94
	315	22.78	49.59	27.38	49.59	50.17
	316	28.57	38.49	31.04	38.49	59.61
	317	62.90	23.34	13.04	23.34	75.94
	Exc Avg	33.18	36.85	28.22	36.85	61.40
	Survey	20.31	35.33	44.36	44.36	55.64
N5	308	41.54	33.20	25.00	33.20	66.54
	Survey	33.01	24.15	42.84	42.84	57.16

N6	320	29.25	40.42	29.91	40.42	59.16
	321	4.55	33.04	56.69	33.04	61.23
	324	20.28	45.54	34.08	45.54	54.36
	326	16.00	50.28	34.72	50.28	50.72
	Exc Avg	17.52	42.32	38.85	42.32	56.37
	Survey	10.61	40.12	49.26	49.26	50.74
N10	314	0.00	50.21	48.35	50.21	48.35
	319	18.18	64.35	18.61	64.35	36.79
	Exc Avg	9.09	57.28	33.48	57.28	42.57
	Survey	17.95	34.82	47.23	47.23	52.77
N17	322	51.35	33.48	16.07	33.48	67.42
	327	46.15	32.93	22.62	32.93	68.78
	Exc Avg	48.75	33.20	19.35	33.20	68.10
	Survey	36.46	24.70	38.84	38.84	61.16

Table 7.9 Neighborhood patterns of obsidian source usage based on the excavated data. Survey results for the same neighborhoods are included for comparison.

Analysis 7.4. Comparing neighborhood obsidian sources.

Once the excavation data are adjusted to account for the differences in geologic sources by tool type, I examined the pattern of obsidian source use across neighborhoods at the city using the excavated data. Table 7.9 shows the data for each excavated unit by neighborhood with the corresponding data from the survey. While there is some variation among excavated units in the percentages of Pachuca, Otumba, and Ucareo obsidian, the pattern for presence of West Mexican verses Central Mexican obsidian is more or less consistent. A statistical analysis comparing this data was not possible because only one data point exists for the survey data on neighborhoods. However, market areas cover several neighborhoods which will allow for more robust statistical comparison.

Analysis 7.5 Reliability of survey data compared to excavation data.

Given the variation among the results from the excavated and surface materials, I decided to test the probability that these results came from the same population. In other words, are the results from the excavated and surface material analysis similar enough given the assumptions about market distribution networks being correct. Using ANOVA a second time, I compared the figures obtained for the East and West site areas from the excavation with the comparable figures from the survey. ANOVA calculates the probability that the two samples come from the same population. This analysis examines whether the surface collection data is as representative of the cities inhabitants as are the data from excavations. I use a p-value of 0.10 or lower to indicate statistically significant differences between the samples. In each case the p-values are nowhere near the 0.10 threshold suggesting that both the survey and excavation data from the same area are in accordance with each other (Table 7.10). Table 7.10 includes all the surface collections used in the Chapter 6 analysis of neighborhoods and all the excavated material used in this analysis. The surface collections, aggregated to the neighborhood unit of analysis, produce the same patterns as excavations in those areas.

Market	Pachuca	Ucareo	Otumba	Other	Wmex	Cmex	N	p-value
East-Exc	48.75	33.20	19.35	0.00	33.20	68.10	2	
East-S	46.26	29.47	24.27	0.00	29.47	70.53	5	0.79
West-Exc	24.87	42.54	31.49	1.10	42.54	56.37	15	
West-S	37.49	38.22	24.29	0.00	57.40	42.60	13	0.88

Table 7.10 Similarity between neighborhoods and excavated units located in the East or West market area.

Analysis 7.5 Comparing market area obsidian sources.

The analysis of the survey data aggregated to the neighborhood level produced a pattern of obsidian across Calixtlahuaca suggesting the presence of two distinct market areas. These market areas are located in the East and the West sections of the city. Excavations occurring in the two market areas should have similar obsidian source percentages as those of the neighborhood survey data for the same area.

Market	Pachuca	Ucareo	Otumba	Other	Wmex	Cmex	N	p-value
East	48.75	33.20	19.35	0.00	33.20	68.10	2	
West	24.87	42.54	31.49	1.10	42.54	56.37	15	0.17

Table 7.11 Obsidian source distribution in the East and West market areas, excavation data..

I used ANOVA to examine the relationship among the excavated units. Table 7.11 presents the summary data for excavated units by market area. In this case, the two populations are two groups who obtain obsidian from the same market. I use the same threshold of a p-value lower than 0.10 to reject the idea that the samples obtain obsidian from the same market. The probability of the two market areas does not meet this requirement, indicating that no statistically significant difference exists between the two groups. This result is contrary to the result for this same test on the survey data. A likely reason for this inconsistency is that only two excavated units are available for the eastern portion of the city. In the survey sample covers a much larger portion of this section and samples four additional neighborhoods to the one neighborhood covered by excavation units. As we saw above, the results of survey and excavation in each market area produce comparable source distributions.

Conclusion

The perspective on survey data as being ineffective for addressing intrasite research questions is assumes all survey conditions are uniform and contrary to the results of this study. As seen in Johnson's (2014) example, the materials on the surface may not reflect the subsurface artifact assemblage. The existence of contradictory cases, such as Palumbo (2015), point to the importance of specific formation processes impacting the parcel of land being examined. Some of the factors that can impact surface materials recovery were discussed in Chapter 3. The practice of terracing at Calixtlahuaca—particularly in recent times—means that most of the subsurface materials were in a disturbed context. However, to the benefit of survey, this mixing, coupled with the actions or plowing, produced surfaces that represented the conditions below the surface. This good fortune was magnified by the residential pattern by through excavation. Many house excavations were single component sites meaning that materials from multiple temporal periods did not mix in the terracing process as terrace fill as often. Given the general plausibility of surface material as indicators of the actual character of the subsurface site, this chapter provides multiple tests of the comparability of the two sets of contexts. Understanding the similarities and differences between surface and excavated deposits is beneficial for archaeological research.

This chapter uses repeated comparative analyses to show that surface collection and archaeological survey produce equivalent results to excavated data for intrasite spatial patterns. Fine distinctions among temporal phases at Calixtlahuaca cannot be addressed using surface materials, but pervasive patterns related to settlement organization and social relationships are visible. The excavated data consists mostly of single component sites from a variety of temporal phases. There was no spatial correlation among single component excavation units or the few multicomponent units. Despite these temporal differences, the subtle social and spatial patterns found in the palimpsest of the survey were confirmed. This insight opens the doors to larger questions about neighborhood, market, or social identity longevity.

Excavation data can provide detailed information on temporal patterns at a settlement or a city for a number of households. Unfortunately, excavation projects encounter many challenges that prevent full coverage of an archaeological site. Limited resources, large settlements, and uncooperative landowners can dictate where and how many excavations can occur. For research questions that examine supra-household social organizations at an intrasite level, intensive surface survey offers an alternative or a supplementary method. In this case, the interpretation I made using the survey data were cross-checked and mostly confirmed using the excavation data.

CHAPTER 8

THE MULTIFACETED NATURE OF NEIGHBORHOOD SOCIO-SPATIAL ORGANIZATION

In chapter 2 I describe the various factors that influence residential patterns in modern and historic cities. At Calixtlahuaca, I chose to focus on three separate types of neighborhood socio-spatial clustering. These three types of clustering--by class, by social identity, and by resource access--can function independently of one another or can work conjointly. The end result is the socio-spatial urban environment that is described in this dissertation. I focus on social clustering, which I have defined as the degree of homogeneity of a population within a defined spatial area. The results of this study show that all neighborhoods within an urban center do not necessarily show the same patterns of social clustering or any social clustering at all. This study shows that heterogeneous mixes of social groups living near each other may share common markets. Settlement patterns are influenced by consumer choices, which are not restricted to the types of choices made in a marketplace. The types of consumer choices that structure the selection of neighborhood have a clear influence on city form. How these various neighborhoods interlink for economic and political purposes determines how the city functions as a political and economic system. This study looks at multiple types of social clustering to better understand how neighborhoods were related to each other at Calixtlahuaca.

Mumford (1954; 257) defines neighborhoods as places where people live in close proximity to one another. The neighborhood is the geographic area within a city where people engage in daily face to face interaction. The neighborhood is distinct either physically or socially (Smith 2010a; Smith and Novic 2012). I use this definition throughout my research. The many types of social ties and interpersonal interactions that occur within neighborhoods are the medium through which neighborhoods develop and change. Daily routine activities, from market purchase to ritual practice, provide a setting for neighborhood development to occur (Rapoport 1980; Sampson 2003; Sullivan 1980). Religion, class, race, place of origin, occupation, and position within the political hierarchy are social aspects that have structured social clustering in neighborhoods throughout history (Rapoport 1980; Sampson 2003; Marcuse 2002; Garrioch and Peel 2006). Throughout history, a variety of drivers, such as simple household preference or housing regulations have generated social and economic clustering in neighborhoods (York et al. 2011).

Urban Boundaries

The archaeological remains of Calixtlahuaca are located on the slopes of Cerro Tenismo and Cerro San Marcos, volcanic hills north of modern Toluca. Cerro Tenismo is the larger of the two hills and has been terraced for agricultural purposes periodically from prehistoric times to today. The earliest terraces held the remains of Aztec Period Calixtlahuaca. These were abandoned and later the hill was re-terraced in historical times, most likely in the nineteenth century (Smith et al. 2013). These recent terraces have been maintained to the present, and they are still actively cultivated. This history of terracing created unique problems for the Calixtlahuaca Archaeological Project (CAP), especially for the survey. Since the remains of houses were either buried under terrace fill or had themselves become terrace fill, identifying the size of city was difficult. Our solution was to focus our efforts on an intensive survey with surface collections coupled with visual assessments (called observations) in a pedestrian survey. I used these data to create an estimate of the urban boundaries of Calixtlahuaca.

My first step (discussed in Chapter 3) was to make sure that the data recovered from both the surface collections and the observations were free of bias. In particular, I focused on three issues that may affect interpretations of the surface data. 1) I examined the impact of observer bias, or the differences in perception and understanding of density categories, on the information from the pedestrian survey. This was done by comparing the visual assessments made before taking surface collections with the actual artifact count recovered. In this case, project members were less consistent with the visual assessments of the more dense categories but accurate in identifying the lower density areas. This suggests that the edges of the urban area, the ones with low artifact densities, would be easy to identify.

2) Using ESRI ArcGIS, I generated a spline interpolation raster of ceramic counts. These counts were then converted into contours. The contour for one sherd per square meter was selected as the urban boundary for Calixtlahuaca. Below this level settlement can be interpreted as dispersed or nonexistent, and therefore areas with surface densities of less than one sherd per square meter were interpreted as areas outside of the ancient urban center.

3) I used the visual assessments on visibility to better understand what parts of the survey area are likely to have a depressed artifact count. I also looked at the impact of land use on the recovery rates. These were modeled in a spline interpolation raster and converted into contours. Both contours are used to create the city boundaries presented in Chapter 3.

Important for the research presented here, neighborhood boundaries were also identified using artifact distributions. The contour selected in this case was three sherds per square meter. That level of density has been used elsewhere (Smith et al. 1994) to identify urban boundaries and is indicative of a more intense occupation as expected in a neighborhood. Through this method I identified twenty neighborhoods at Calixtlahuaca. These neighborhoods cover approximately 50% of the surface area of the ancient city. The percentage increases to 70% if the areas without definite occupation are excluded (thus decreasing the total size of the city). Between these neighborhoods are areas with less dense settlement, possible transitional areas between neighborhoods. These less dense areas may have participated in neighborhood life of multiple neighborhoods though it is difficult to determine which they felt they belonged. Two of the elite house groups were located in these transition zones, which would have afforded them greater access to land for elite gardens and parks (Stark 2014) while maintaining access to nearby neighborhood access and resources. In chapter 7 I also discuss excavations of several probable elite houses that exist in these transition zones but near the palace. Alternately, in the more marginal in terms of land and resource access of these inter-neighborhoods spaces individuals who were outsiders could have settled, though this is speculative. The twenty neighborhoods are the focus of this dissertation.

In the remainder of this chapter I summarize the results of the three research questions discussed in chapter one. The research presented here examines neighborhood socio-spatial organization by asking about 1) The relative wealth differences of neighborhood residents; 2) The shared taste of community members for various decorated ceramics and vessel forms; 3) The potential for neighbors to interact with each other while at markets, as expressed through similar proportions of objects from the same sources.

Social Class

In ancient Mesoamerica there is textual and archaeological evidence for two social classes. Where available, architectural data have been used to separate elite and commoner members of society (Smith et al 2014, Haviland & Moholy-Nagy 1992, Foias et al. 2012.) Unfortunately, Calixtlahuaca does not have surface visible domestic architecture. I devised an alternative method to identify elite and commoner contexts using surface collections. I begin with the assumption that the elites of Mesoamerica societies had greater access to wealth and participated in activities like feasting to gain power and prestige (Chapter 4). I analyze the frequency of bowls as an example of serving vessels, and jars as objects of domestic storage. Using the ratio of bowls to jars, I identified two statistically differentiated populations at Calixtlahuaca. I argued that the group that had three or more times the number of bowls compared to jars, measured as a ratio, were the elite population. This was a small portion of the population and were at the far extreme of the distribution of bowl to jar ratios on a histogram. I next compared the percentage of decorated ceramics as a measure of wealth. The elite group contained twice as many decorated ceramics as the commoner group on average. I tested the statistical significance of these population differences with ANOVA. The low p value indicates that the two groups did indeed differ in their quantities of decorated ceramics While the elites did not have exclusive access to significant numbers of wealth objects, the number of commoners with high amounts of decorated ceramics was minimal compared to entire population. All elite cases had a high frequency of decorated ceramics.

The next component of this analysis examined the distribution of elite and commoner surface collections. Approximately ninety-six percent of the surface collections were from commoner contexts compared to a small number of elites. This means that most neighborhoods did not contain elite residents. While this result technically indicates clustering among commoners, the location of elite surface collections suggests a more complicated residential pattern. Half of the elite surface collections are located outside the boundaries of neighborhoods in sparsely populated parts of the city. The other half are located in heavily populated neighborhoods on both the east and west halves of the city.

In Chapter 7 I explored the presence of these patterns in the excavated data at the level of the house. Elites were identified using the same artifact-focused methods. The three possible elite houses clustered together spatially and were located near the palace . Since the palace is obviously an elite residence, that this small cluster of elite context excavations were located here is not surprising. Contrary to the excavation results---which imply elite clustering-- near the palace, the survey showed a pattern where elites lived dispersed across the city. The results of the excavation analysis somewhat contradict this pattern. A small cluster of elites was identified using the excavation materials. This cluster was located in the vicinity of the palace and exterior to any identified neighborhood. No other elite contexts were identified using the excavation data. A cluster of elites located near the palace area is not unexpected and appears to be unique cluster pattern. The location of this cluster outside of identified neighborhoods does conform with the results from the survey placing some elite groups outside neighborhood boundaries. The presence of one cluster in a unique social context does not invalidate the survey findings on its own, though it does suggest smaller scale (below the level of neighborhood) clustering was present at Calixtlahuaca.

Social Identity

The relationship among social identities, social networks, and consumption practices is the theoretical focus of Chapter 5. I define social identities as all types of social groups where commonalities and connectedness (Brubaker and Cooper 2000) within the group generate consumption similarities that can be used to define categorical attributes. Social identities and social networks inform each other through practice and, together, they both influence consumption behavior (figure 5.1).This perspective is influenced by Bourdieu (1984) and critical researchers influenced by him (Brubaker and Cooper 2000). Empirical research on consumption behaviors from the field of market research (e.g. Gîrboveanu and Puiu 2008) and anthropological theorizing of consumption (e.g. Miller 1995; Douglas and Isherwood 1996) provided the rationale for connecting economic behavior to the display of social group membership. Social identities generate material attributes that can serve as a short-hand for identification of such groups by both others in society and researchers like myself. Past consumption practices can be identified in the archaeological record, allowing archaeologists to reconstruct social identities and networks.

Theoretical work on consumption behaviors and other patterns of behavior, combined with the insights from market research, allow me to identify consumer groups at Calixtlahuaca. The central premise is that the social networks that individuals engage with the most frequently influence the types of consumer choices they make. These choices can be used to reconstruct the social groups that urban residents belonged to. I used K-means cluster analysis to identify five consumer groups whose differences in assemblages suggest the marking of some social identity. K-means cluster analysis is a non-hierarchical method of clustering that attempts to minimize the distance (and error) within the groups formed. This method allows me to identify groups of consumers whose consumption behavior is similar by examining the variables. I can also determine what category is driving the formation of the group, thus learning how each group is unique. I examined the spatial distribution of these groups statistically for clustering within the neighborhoods. Only one small neighborhood containing individuals who consume Basin of Mexican style goods showed a high degree of clustering. The nineteen other neighborhoods were mixed, containing residents from all consumer groups. This result suggests that the residents of Calixtlahuaca interacted with—and were influenced by—people outside the neighborhood setting to a higher degree than intra-neighborhood interactions.

Chapter 7 describes a comparable study using the data from the excavations at Calixtlahuaca. The ceramic types are distributed proportionally with the survey data among the five different consumer groups. The different groups also showed no spatial clustering in neighborhoods using the excavated data. No consumer group showed an association with the temporal divisions of the chronology, suggesting these patterns were present across time and space. This analysis corroborates my finding that the city of Calixtlahuaca was socially mixed with individual social identity with its concomitant networks having the potential to integrate disparate neighborhoods.

Markets

Neighbors who shop at the same marketplace have opportunities to engage with one another, and this can promote the formation of socially integrated neighborhoods. Since neither social class nor social identity appear to have structured Calixtlahuaca's neighborhoods, I asked whether access to markets may have influenced neighborhood composition and socio-spatial organization (Chapter 6). Research on markets in Mesoamerica has mostly been limited to the identification of only a single market location within a settlement, and its associated distribution network. The idea that multiple markets may have coexisted within a large urban area has been hypothesized but not tested at Tikal (Fry 1979). The number of separately supplied markets within the city was a question addressed in Chapter 6. My analysis focuses on the economic concept of a non-differentiated good, which can be defined as a good for which all producers produce products that are so nearly identical as to not have differences that are selected by the buyer (Gordon et al. 1999). Staple goods like grain or mineral resources are common non-differentiated goods. While some of these goods will exhibit no change in demand regardless of other factors, many are elastic and demand fluctuates with price. However, there is no perceived benefit to purchase from one producer over another. As a result, the sources of those items in an assemblage should conform to Hirth's (1998) predictions for domestic assemblages that are heterogeneous (similar mix of artifacts in the assemblages across all households) where markets were operating.

At Calixtlahuaca, I analyzed obsidian as an undifferentiated good. In particular I focused on the distribution of obsidian from Central Mexico and West Mexico because the obsidian sources were controlled by the Triple Alliance and Tarascan empires respectively. While there was no differentiation of source usage by neighborhood, a larger zonal pattern is visible. The larger Western portion of the city received obsidian in roughly equal amounts from both source regions. The only exception was the surface collection in the area of the palace, who represented a house group that had a distinct preference for Central Mexican obsidian. The smaller Eastern part of the city obtained upwards of 70% of their obsidian from Central Mexico. The parallel analysis of excavation data in Chapter 7 supports these conclusions. These patterns are not temporal, as both early and later excavations in the East and West sides of the city show the same pattern.

Synthesis

The analyses described in this dissertation suggest that the only aspect of social life at Calixtlahuaca structured by residential location was access to specific markets. Calixtlahuaca was a city with ethnic and linguistic diversity caught between two Postclassic empires. The Triple Alliance eventually conquered the city in 1478 (Garcia Castro 1999).

The literature on social clustering in Mesoamerican cities is not large and mostly focuses on ethnic enclaves at Teotihuacan (Rattray 1990; 1993). There is even less information available for comparative analysis on multiple distribution networks and marketplaces within one city. There is some evidence on social clustering patterns along social class and social identity. In chapter 2 I discussed the evidence for social clustering in the Mesoamerica. Mixing of social class in Mesoamerica, based on the current sample, is common. Cities within the same culture area do not show a uniform socio-spatial organization. Social identity differences are most pronounced when residences are clustered. Socially mixed social identity groups like we see at Calixtlahuaca are not often identified. This may be a factor of methods for identifying social identity groups or an feature of the types of data available.

Conclusion

This study provides a detailed picture of the urban social organization of an Aztec period capital city. Calixtlahuaca's urban form was relatively stable throughout its occupation, suggesting that deeper structural patterns characterized in this study persisted even as large scale cultural changes occurred. The manner in which survey data was used and combined with excavation data to understand these structural patterns is one of the strengths of this study. Neighborhoods were identified using methods that did not rely on surface-visible architecture, which permitted an analysis of the full extent of the lived spaces in the city. These neighborhoods do not exhibit the types of community structure that are often associated with neighborhood forms. Though socially mixed in composition, these neighborhoods show a larger network of interaction among members of the greater urban community. Fargher et al. (2012) use public architecture and plazas to discuss collectiveness of the political conditions within the neighborhood and the city at large. These public and often monumental features serve to identify neighborhood boundaries (Blanton 1978; Hirth 2000). At Calixtlahuaca, the arrangement of public architecture and plazas do not appear to divide the city into neighborhoods. The lack of surface visible architecture also made it difficult to identify residential settlement patterns

Further research on social clustering patterns in ancient Mesoamerican cities is needed.   There is a dearth of the kinds of data needed for large scale studies of urban form, making comparative analysis of these patterns—and the economic and political processes that produce them—difficult. This study shows the value of understanding how aspects of identity and economic issues beyond of social class relate to urban structure and its development. Understanding the social makeup of a neighborhood can allow researchers to focus on other aspects of equity besides the standard class inequality. Researchers can begin to ask questions about the ways diverse other social categories—what I have been calling social identities—play a role in the distribution of resources. By adding additional types of social categories--like social identity-- that influence decision making and access, the complexities of neighborhood political systems can be explored to better understand urban processes. These questions naturally lead to issues, such as equity, that are prominent in urban studies today. Many of the world's largest and most inequitable urban areas have settlement histories of hundreds or thousands of years. Archaeological research can help scholars of modern conditions to understand the development process of these equity patterns. Archaeologists can answer questions on whether or not these conditions are chronic and if not, at what point did they develop.

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APPENDIX A

MODERN LANDUSE AND VISIBILITY

Modern land use and the associated visibility of the observation or surface collection area has a significant effect on artifact recovery. This appendix contains the categories and codes used during the Calixtlahuaca survey for land use and visibility.

Modern Land Use Code	Description	Visibility Code	Description
FF	Fallow Fields	1	0 to 25% (Poor)
P	Pavement	2	26 to 50% (Fair)
FG	Fill with Grass	3	51 to 75% (Good)
F	Fill	4	76 to 100% (Excellent)
SDG	Surface Disturbance with Grass		
SD	Surface Disturbance		
AF	Active Fields		
RP	Recently Plowed		
CC	Construction Cut		
RC	River Cut		
ID	Irrigation Ditch		
MMO	Man Made Other		
DR	Dirt Road		
ST	Structures		
C	Concha/Ball Field		
AS	Archaeological Structure		
MX	Mixed Use		
ER	Outcrop/Exposed Rock Bedrock		
BD	Bedrock		
FO	Forest		
UC	Uncultivated		
CF	Cliff Face		
EG	Gully Area		
DP	Dirt Path		

APPENDIX B

VESSEL FORM CODES

Vessel form was classified by using two separate components. First the general shape was identified. Second, identifying details like the slope of the walls or types of handles was used to further identify the vessel form. The two components together collectively are the vessel form.

Vessel Form			
Code A	Larger Form	Code B	Form Detail
1	Tripod	1	Plate
2	Molcajete	2	Conical
3	Simple Bowl	3	Hemispherical
4	Bowl (general)	4	Straight
5	Olla	5	Incurved
6	Basin	6	Oval
7	Comal	7	Flaring
8	Copa	8	Aztec
9	Goblet	9	Globular
10	Pitcher	10	No Spout
11	Miniature Vessel	11	Hollow Handle
12	Sahumador	12	Handle Fragment
13	Incensario	13	Spout Fragment
14	Pyriform	14	Tall Neck
15	Globo	15	Short Neck
16	Tlaloc	16	Narrow Neck
17	Spoon	17	Square Shoulder
18	Spinning	18	Mini Jar
19	Misc	19	Mini Bowl
20	Other	20	Mini Sahumador
21	Unknown	21	Mini Pitcher
		22	Mini Tri Bowl
		23	Mini Molc
		24	Mini Tri Plate
		25	Mini Incensario
		26	Mini Other
		27	Toluca Valley Style
		28	Valley of Mexico/Morelos Style
		29	Basin
		30	Brazier
		31	Striated
		32	Hanging
		33	Guinda
		34	Techialoyan
		35	Cholula

36	Jarra
37	Vessel
38	Texcoco Fabrica Marked
39	Strap Handle
40	Asymmetric
41	Misc
42	Other
43	Uncertain
44	Unknown