# GEOARCHAEOLOGY OF CERAMICS OUT OF XALTOCAN

A Thesis by

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The following faculty members have examined the final copy of this thesis for form and content, and recommend that it be accepted in partial fulfillment of the requirement for the degree of Master of Arts with a major in Anthropology.

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DEDICATION

To my parents, LeRoy and Carla. Without your love and support I do not know where I would be today.

To Sheila Hauser, Shannon Reed, and Rowena Butner. Thank you for proof reading my thesis again and again. Your encouragment and support helped keep me sane.

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ABSTRACT

Practicing archaeologists have numerous objectives when investigating a site, the main goal is learning and understanding about those who once lived there and reconstructing their lives through the materials they left behind. What we discover is then interpreted and compared to what we see in other sites. With more advanced technology, we take our studies to greater heights, giving concrete evidence to our work. This research employs multiple geoarchaeological methods to develop geological signatures of ceramics production locales in the Basin of Mexico and determine the provenance of Aztec figurines found in Xaltocan, a site in the northern Basin of Mexico. Geoarchaeological methods have great potential for the determination of provenance, or production locale, of archaeological ceramics and other artifacts, but the success of such methods depends on our understandings of the geological variation present in the geographical region of interest. X-Ray Diffraction (XRD) and petrographic analysis will be combined with previously completed Instrumental Neutron Activation Analysis (INAA) to characterize geological variation resulting from the source of the clay and temper.

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# Chapter One
# Introduction

Archaeologists spend much of their academic careers rebuilding the history of other cultures. The majority of research comes from intense surveys and excavations of archaeological sites. In addition, the artifacts collected such as lithic tools, bones, and ceramics are analyzed and recorded. Specifically, when analyzing ceramics, they are examined for their temper, motif, use, and production (Rice 1987). The artifacts are interpreted and compared to artifacts from additional sites to verify their results. These techniques are the backbone for archaeology and have gone unchanged since the development of the field. As time has gone by there have been major breakthroughs in technology that have brought archaeologists the ability to take their research a step further and contribute more to the archaeological record. This study demonstrates the use of geoarchaeological analysis to extract additional information from ceramic figurines that have already been assessed using traditional archaeological methods.

This thesis focuses on artifacts found in Xaltocan, Mexico (see Figure 1) specifically ceramic figurines are the main emphasis of this research. This study employs two types of geoarchaeological data: the first is petrography analysis and the second is X-ray Diffraction (XRD) analysis. Geoarchaeological methods have demonstrated great promise for the determination of provenance of archaeological ceramics and other artifacts. In turn, this data may help us understand patterns of trade, social relationships, and identities forged through such economic practices (Overholtzer 2013). The success of such methods relies on our understandings of the geological variation present in the geographical region of interest. The internal drainage in the Basin of Mexico, also known as the Valley of Mexico located in central Mexico, is a particularly difficult region for provenance analyses because sediments from all directions wash down into the center so there is slight variation in the geological makeup.

Currently, most research coming out of the Basin of Mexico has used INAA (Neutron activation analysis). INAA is a bulk characterization method and has some disadvantages for identifying the chemical geological makeup of pottery. INAA was completed on 55 of the 57 figurines that I analyzed. Out of the 55 figurines, 44 have provenance determined. A total of 10 locations were identified by Dr. Lisa Overholtzer (see Table 1). This leaves a total of 13 figurines that still require identification.

This research will employ multiple geoarchaeological methods to develop improved geological signatures for ceramic production locales in the Basin of Mexico and determine the provenance of the remaining 13 Aztec figurines found in Xaltocan. X-ray diffraction and petrographic analysis will be combined and compared to the INAA to characterize geological variation resulting from the source of the clay, naturally occurring aplastic inclusions, and temper.  Step one was to examine the figurines that had provenance determined by INAA, each sample was analyzed by petrography and XRD. Step two was to analyze the remaining thirteen samples using petrography and XRD. The last step was to compare the unidentified samples to those with provenance determined.

# Chapter Two
# Background

After Teotihuacán's collapse the Basin of Mexico was politically fragmented and filled with a host of small city-states that over the next several centuries vied for power and political control (Brumfiel 1983). It was around the mid-tenth century that the island of Xaltocan was constructed (see Table 2 for Xaltocan’s chronology). Xaltocan is a Postclassic site that is situated on a low, man-made island in the northern Basin of Mexico (see Figure 1) on Lake Xaltocan (Brumfiel 2005: 38). The Xaltocan people were not originally part of the Aztec empire. Initially this man-made island was inhabited by the Otomí people in the mid-eleventh century (Brumfiel 2005: 119). In 1250 AD warfare broke out between the Otomí and the Tepanec city-state and by 1395 AD the Otomí people were conquered. According to the ethnohistory the island was deserted and remained empty for the next three decades (Overholtzer N.D.: 8-9). The island was then resettled by a multi-ethnic tribute population sent by the Aztec ruler in 1428 (Brumfiel 2005:119). With the formation of the Aztec Triple Alliance consisting of Tenochtitlan, Texcoco, and Tlacopan Xaltocan was incorporated into what is now called the Aztec empire (Chimonas 2005: 169). As the Aztec power grew their conquering created a large amount of hostility between the people of Mexico. When an area had been conquered, the Aztec leader would use fear to control the new population. Becoming a new territory was difficult as the elites forced the conquered groups to provide tribute to the conquering leaders. Tribute could be a variety of objects such as cotton, food, ceramics, and clothing (Smith 2012). The Aztecs aggression ultimately led to their enemies joining forces with the Hispanic invaders.

In 1521 AD, Xaltocan was burned to the ground by Spanish conquistadors on their march to Tenochtitlan, the capital of the Aztec empire. After the fall of the Aztecs, Xaltocan was required to give tribute to the Spanish (Rodríguez-Alegría et al. 2013: 399). Furthermore, many of the small city-states were forced together to give the Spaniards more control over the groups. The first action taken by the Spanish was to cut off communication between the different city-states. An example that Rodríguez-Alegría (2013:399) explores is the disruption of transportation by canoe between Lake Texcoco and Lake Xaltocan. In addition, the lake's water table began to drop due to sediments washing in and blocking waterways caused by deforestation of the surrounding land (see Image 1). Eventually all the lakes in the Basin of Mexico were low enough that the water passages between the lakes were exposed. The complete drainage of the basin took place within the last fifty years (Rodríguez-Alegría et al., 2013: 399). Today, Xaltocan sits on a dry lake bed with roads connecting the towns. There are many archaeologists using Xaltocan's past as their focus of study such as John Millhauser, Elizabeth Brumfiel, Jaime Mata-Míguez, and Lisa Overholter to name a few, their research adds to our knowledge of the area.

# Chapter Three
# Figurines

There is a wide variety of ceramic items found throughout the Basin of Mexico. This section specifically examines 53 figurines that make up this research. Brumfiel and Overholtzer's 2009 article was used as a reference for this section. Figurines from Xaltocan's Postclassic site come in many forms: curated, mud men and women, flat-backed, rattles, animals, and mazapan (Brumfiel and Overholtzer 2009: 297-299). Curated (see Image 2) make up thirteen percent of the figurines found in Xaltocan. This type predates Postclassic occupation; they were produced at various times throughout the Early Formative to the Late Classic (Brumfiel and Overholtzer 2009: 302). Mud men and women (see Image 3) make up approximately eight percent of figurines found in Xaltocan. There is not much known about this type, early theories focus on stages of creation (Brumfiel and Overholtzer 2009:305). Flat-backed (see Image 4) figurines represent people from everyday life. These are the most common type found in Xaltocan. These figurines are free standing, mold made figures. They have a smooth surface, flat back, and extremely detailed features (Brumfiel and Overholtzer 2009:307-309). Next are the hollow ceramics such as rattles. Rattles (see Image 5) tend to depict female figures with conventional hairstyles, skirts, and are bare breast. Penultimate type is the animal figurine (see Image 6); great majorities of these represent dogs. Dogs played an influential role in Aztec society, they were killed and cremated when a death occurred so that the dog can carry the deceased on its back into the afterlife. (Brumfiel and Overholtzer 2009:312-315) The final type is Mazapan (see Image 7); these figurines are similar to the Flat-Backed style. They are made using a single mold; the main difference between the two is that Mazapan has a decorated back. These figurines were most likely located on household altars. (Overholtzer and Stoner N.D.: 24)

The figurines in my sampling fall within seven categories: 7 curated, 7 mud men and women, 29 flat-backed, 2 rattles, 5 animal figurines, 5 Mazapan, and 2 unassigned.

*Paste and Temper*

Ceramics are made of paste and temper. The paste is clay that naturally contains some non-plastic inclusions. Additional non-plastic materials, such as sand, ground up rock or ceramics, and organic materials, are added as temper to the paste to help control shrinkage and breakage during the firing process. The paste and the temper are kneaded together to create a specific texture. When the mixing is completed the compound will be formed into a ceramic item. The style of ceramics being made will depend on how hot the fire is, where the item is placed within the fire, or if it gets a slip or glaze. Paste is made of fine mineral particles, as occasionally is temper. To study the chemical and crystalline structures of fired ceramics to infer the process and location of its production, we need special equipment that allows us to test these small particles. Three techniques that allow us to do this are INAA, XRD, and petrography (D. Tenorio et al. 2005: 471)

# Chapter Four
# Geology

As mentioned before, determining provenance in the Basin of Mexico is challenging due to the sediments that wash down into the valley. It is not surprising therefore that there is little research on this subject. John Millhauser dealt with several issues that stemmed from the lack of published research about this geographical area.  In addition, he did not have access to clay samples to compare his ceramics against. Millhauser resolved this by analyzing Mary Hopkins (1996) dissertation, he used her research to compare against his own samples to provide provenance. Hopkins and associates traveled throughout the valley from 1983 to 1989 collecting clay samples to use as comparisons for her study. The ancient ceramics were compared using aplastic contents and fired color. After the evaluation, Hopkins found that the clays were usable for the comparison to the ancient ceramics (Hopkins 1996: 296).

The Teotihuacan Valley is made up of 600 square kilometers with an altitude of 2240-2300 meters. The area slopes downward northeast to the southwest, where it opens into the larger Basin. The Teotihuacan Valley is surrounded by volcanos and rest on altered marine sediments. Two intersecting faults and the Mexican Volcanic Belt run through the valley creating an abundance of mineral diversity (Hopkins 1996: 72).

The earliest known volcanic activity begins around the mid-Tertiary forming Cerro Malinalco to the north of the valley. The mountains that surround the area and the lava flows that underlie Teotihuacan date to the Quaternary, Hopkins analyzed the differences in the lithology between the mountains surrounding the valley. (Hopkins 1996: 72-73). The soil is made up of weathered volcanic ash, mostly deposited around 4500 BP from the Becerra formation. It is not uncommon to identify white ash within ceramics produced at Teotihuacan (Hopkins 1996: 73).

John Millhauser dissertation focuses mainly on the Xaltocan area. He identifies intermediate extrusive igneous rock made up primarily of andesite to the west of Lake Xaltocan, with mafic extrusive igneous rock, primarily basalt, to the east (See figure 3). Tezontle (tuff or scoria) and volcanic ash is a common occurrence not only in Xaltocan but all over the Basin of Mexico. Pottery from this area tends to have aplastic inclusions, most likely derived from eroded rock formations to the west of Lake Xaltocan. The sample from San Bartolomé was distinctive due to ostracods (small crustaceans that live the bottom of lake beds) found within the clay, Millhauser found that ceramics produced from this area did have ostracod fossil inclusions (Millhauser 2010: 419) Overholtzer refers to this type of clays source as Xaltocan 1b.

# Chapter Five
# Research and Methodology

The initial research revolved around the 53 Aztec figurines found in Xaltocan, focusing on previous work performed by Lisa Overholtzer. She reconstructed the life histories of ceramic figurines used from the Early to Late Postclassic periods. To determine the provenance of 51 of the Aztec figurines, she performed Neutron Activation Analysis (INAA). It measures the concentration of 33 elements in parts per million. These measurements are then compared to a larger database, in the case of Overholtzer's figurines, they were sent to the University of Missouri Research Reactor (MURR) (Stoner et al. 2013: 9). The results led to the understanding of the relationships (trade and exchange, economics, and politics) between people and figurines. Most of the figurines were classified by sub regions: Xaltocan-1a, Xaltocan-1b, Cuauhtitlan, Southern Basin-3, Teotihuacan Valley (Otumba), Southern Basin-1, Tenochtitlan, Teotihuacan Valley (Teo-Core), Xaltocan-2, and Xaltocan-3b, leaving 11 unassigned and 2 with no INAA performed.

*Neutron Activation Analysis*

Between the late 1950's and the early 1960's, the use of physicochemical analyses on ceramics began. Major research institutions began to utilize massive analytical programs, focusing primarily on optical emission spectroscopy. While this was going on Brookhaven National laboratory employed neutron activation analysis. Prudence Rice (1987: 312) states that the growth of chemical analytical research was greatly influenced by the application of INAA. Defining ceramic materials chemical composition is a significant analytical objective. Within the last 30 years there has been an increase in this analysis popularity. This is mainly due to the increase accuracy of INAA. By studying chemical compositions of ceramics archaeologists can identify information on the origin and fabric of the artifact. INAA does not identify the source of the element within the sample or the relation to each other (Rice 1987:390). This process requires a sample size of 50-100 mg, the sample is prepared by powdering the sample and pressing it into a pellet. When the process is completed the powdered sample is destroyed. Once the sample is prepared, it is introduced into the reactor core. The sample is bombarded with neutrons at a controlled rate for brief period to excite the nuclei of the atoms. This changes the elements into unstable radioactive isotopes which emit several kinds of radiation as they decay. Gamma rays are the most important kind of radiation for INAA. The gamma ray wavelengths (energies) are measured by scintillation detectors (high efficiency) or Ge(Li) semiconductor detectors in a gamma spectrometer apparatus. The data is then displayed as a spectrum of numbers instead of energy. The elements in the sample are identified by determining the gamma ray energy levels. The concentration is estimated by the number of gamma photons. There are many advantages of INAA: the samples extracted from the figurines are small and can be taken from discreet locations (Overholtzer took her samples from the bottom or the back of the artifact), preparation time is low, many elements can be determined simultaneously, the analysis is very sensitive (concentration as low as parts per billion), and it can analyze an entire specimen thanks to the penetration of neutrons and gamma rays. There are a few disadvantages: cost to run one sample is approximately $400, only a few labs run this type of analysis, and finally samples are rendered radioactive (Rice 1987: 196-198).

Once the testing is completed they are compared to the University of Missouri Research Reactor (MURR) database (Stoner et al. 2013: 9). In the case of Overholtzer et al.'s work, six types of figurines were selected: flat-backed, mud-men-and-women, animal, curated, rattle, and Mazapan (2013:11). From the tested, seven main groups were identified: Chalco, Otumba, Texcoco, Cerro Portezuelo, Cuauhtitlan, Tenochtitlan, and Otumba. Southern Basin-1, 2, and 3 is a set of macro- or regional-level groups, which cannot be placed in a specific category. Minor groups consist of Xaltocan-1, Xaltocan-2, Xaltocan-3, and Teotihuacan-Core. Out of the 57 tested, 13 remain unassigned.

*X-ray-Diffraction*

Von Laue, a German physicist  first used XRD in 1912 (Rice 1987: 382). This method is used for ceramic characterization based on identifying the crystalline structure of minerals. Minerals crystalline structure is a function of spacing and arrangement of their fundamental atoms they can be thought as planes or layers of atoms. Every mineral has a unique chemical configuration and thus a unique atomic lattice arrangement. X-rays are produced when electrons overwhelm a target made of elements. After filtering, it has sharply defined wavelengths (between 0.5 and 2.5 Å) making it monochromatic. The X-rays then is aimed at the sample, the atomic planes will reflect the X-rays. They are then picked up by a detector; the diffraction pattern is then analyzed. The minerals are identified by their distinctive lattice spacing.

With the assistance of William Parcell, Andrew Swindle and Bill Bischoff, along with the use of the equipment available through the Department of Geology at Wichita State University, I will conduct XRD analysis of fifty-two figurines. First, I will crush a small piece of each figurine into a fine powder. This prepared sample will be analyzed using the Rygaler Minitlex. This equipment will determine the structure, preferred crystal orientation, phases, crystal defects, and strain of the sample. The results will help me identify the mineralogical makeup within the ceramics, which I will compare with the previous INAA results.

Tenorio et al. also uses XRD to study his samples. The equipment he used for recording the spectra is the Siemens D500 diffractometer. To run the sample, it must first be crushed into a fine powder and packed into a glass slide. The machine runs through a cycle of tests, "The diffracted patterns were recorded between 2.5 and 70 °Θ) with a scanning step of 0.02° 2Θ and a measuring time of two seconds per point." (Tenorio et al. 2005: 473). The authors again run samples of local resources to have a comparable sample to test. They found that local clays were high in quartz. They also had the same mineral composition as other baked ceramic items for the local area. With these results, the authors can confidently say that the ceramics tested are from a local source in the San Miguel region. They also can tell from the diffraction pattern of the pottery that the mineral illite appears, meaning the fire did not reach 800°C. If the fire reached that temperature, the mineral illite would have decomposed (Tenorio et al., 2005: 479). Pottery that was determined to be foreign had quantities of albite mixed with quartz and anorthite, which is similar to what we see at Teotihuacán (Tenorio et al. 2005: 479).

*Petrography*

Petrography is a technique that is borrowed from geology used to describe and classify rocks. By applying this study to ceramics (thinking of ceramics as artificial stone), pottery can be compared to metamorphosed sedimentary rocks. Minerals are identified by their optical properties as observed through a microscope as plane-polarizing and cross-polarizing light passes through the sample. Petrography is accomplished by the study of individual grains or by study of thin sections. The ceramic must be sampled and made into a thin section. Some pottery must be impregnated with an epoxy resin using a vacuum (my samples have a blue epoxy added to help identify voids within the ceramic). The samples are then attached to a slide and ground down to 0.03 mm.

Petrography is the last method I will employ in this thesis. To better understand how petrography works, I examined James Stoltman's article on quantitative approach to petrographic analysis. His article introduces a technique for quantitative analysis of petrographic samples. The technique is a version for point counting that is able to estimate both added temper and natural inclusion with precise accuracy (Stoltman 1989: 147). This type of research greatly benefits archaeologists when dealing with an abundance of problems concerning: classification, production, cultural interaction, and technological advances. There are two approaches mentioned in the archaeological literature: point counting and visual comparison. The first involves overlaying a grid over the specimen and counting all mineral inclusion below the grid intersecting points. The latter estimates the density of the inclusions by comparing them visually to a sample (Stoltman 1989: 148). Stoltman's quantitative approach is a form of point counting. His methodology involves explicit interpretive step that interprets raw point counting frequencies into a narrowed set of categories that is significant to past cultural behavior (Stoltman 1989: 158).

*Thin Sections*

By examining the mineralogical composition of ceramics archaeologists can complement the study of chemical analysis. John Millhauser argues that using a single method to understand provenance can be difficult. His argument is based on ceramic composition being the result of many geological and human factors (Millhauser 2012: 145). When using INAA, a chemical analysis, compositional data is used to differentiate between clays. The issue with relying on chemical analysis is it can lump clays and aplastic inclusions together (Millhauser 2012: 415).

"Thin section petrography is a systematic method for identifying, describing, and quantifying the inclusions, voids and pastes of ceramics (Shepard 1956; Stoltman 1989) based on the applications of optical mineralogy developed in the geosciences" (Millhauser 2012: 416). With Millhauser's dissertation being the most up to date and comparable study to my own, I will use his methods as the framework for my own. Millhauser breaks the inclusions into three groups: minerals associated with mafic rocks (amphibole, olivine, and pyroxene), minerals associated with felsic rocks (mica, quartz, and feldspar), and rocks associated with volcanic and pyroclastic deposits (Millhauser 2012: 418). Within a sample, these minerals make up 94% of the inclusions. The use of the Wentworth scale size grade for silts, clay, and sands will be used to assist in the assessment of sedimentary inclusions compared against my samples. He relied mainly on simple comparisons based on averages and raw counts (Millhauser 2012: 418). For the inclusion density, Millhauser divided the point counting into voids, clay fabric, and aplastic inclusion. He used the multi-intercept point counting method; the reason for this is that this provides an estimate of the entire area of the inclusions in each slide (Millhauser 2012: 418). For recording shape, he uses a visual comparison guide that is based on roundness and spheroid, prepared by the Gamma Zeta Chapter of Sigma Gamma Epsilon at Kent State University (Millhauser 2012: 530). Millhauser stopped point counted at 250 clay points or 50 aplastic inclusions, whichever came first. He did this technique so he would not spend too long on one sample (Millhauser 2012: 530). The voids were described by alternating rim, crystals, or carbon inside the petrographic slides. The minerals from the aplastic inclusions were identified based on formal qualities of cleavage, form, and qualities of color, pleochroism, and relief.

The thin sections were prepared by National Petrographic Service. Each sample was impregnated with a blue epoxy resin to help with the identification of voids within the figurine. Once impregnated the samples were glued to a microscope slide, cut with a rock saw, and then ground to 30µm thickness. Next, I will examine each slide under a Leica DM750P Petrographic Polarizing Microscope. I identified and counted the minerals at 1 mm intervals. I recorded each mineral inclusion and voids in a Microsoft Excel spreadsheet noting the size, shape, and roundness. Petrographic studies can help in identify specific crystalline structures that can then be compared to the known geology of the Basin of Mexico, which will help in identifying where craft production took place.

*Methodology*

With INAA leaving several of the figurines unassigned, X-ray Diffraction (XRD) and petrography were used to identify the remaining 13 figurines. Both methods will be performed on the 44 samples that have been identified using INAA, so they could be used to compare to the 13 unassigned figurines.

While studying the petrographic slides, several types of minerals were identified. Those minerals that could be identified by their specific name were recorded into a table using that classification (example: plagioclastis a type of feldspar). If a mineral could not be identified by a specific name then it was recorded by field (example, not all types of feldspars can be identified using petrography alone, in these cases they were put in the category of feldspars).

# Chapter Six
# Results

*Petrography*

The 44 figurines assigned provenience through INAA were cut into thin sections to be compared to the remaining 13 samples left unassigned after INAA. As seen in table 3, the minerals have been split into categories: quartz/feldspar, feldspar, pyroxene, lithic, amphibole, mica, and uncommon igneous, organics, clay/soil, calcite, ostracods, grog, opaque, clay, voids, and hematite clay nodules. Each classification has specific criteria the mineral or particle must meet before it can be designated to that group. The classifications were based on Millhouser's dissertation. He identifies igneous inclusions, sedimentary inclusions, biogenic/anthropogenic inclusions, and other inclusions.

*Igneous Inclusions*

<u>Quartz/Feldspar</u> is the category that is utilized for inclusions that are too small to be distinguished between feldspar and quartz. These inclusions lack color in plane polarizing light (PPL), have low relief, and low first-order interference color in crossed polarizing light (XPL).

<u>Feldspar</u> has first order interference colors when observed through crossed polarized light, the color can range from white to gray. When under plane polarized light it remains, clear and has low relief. Feldspar can be distinguished from quartz by the inclusions shape, rectangular and euhedral.

Plagioclase feldspar was identified due to the presence of zoned twinning and polysynthetic.

<u>Quartz</u> appears clear when viewed under plane polarized light which closely resembles feldspar. Unlike feldspar, quartz can be distinguished by its first order colors of gray to pale yellow to tan.

Pyroxene has an octagon shape that can be identified when found in euhedral crystal structure. There are two types of pyroxene that were identified within my samples: clinopyroxene and othopyroxene.

Clinopyroxene appears pale green in plane polarized light and has first order interference colors in cross polarized light. This type of inclusion has little to no pleochroism (when the inclusion gives the appearance of being different colors when seen from different angles).

Othopyroxene tends to be clear in plane polarized light and can range up to second order interference colors.

Amphibole is recognizable by its intense coloration of green to brown in plane polarized light, its euhedral shape, pleochroism, and cleavage of 60°-120°. There were no amphiboles identified in these samples.

Mica is made up of a plate structure, high order interference colors in cross polarized light, and in plane polarized light there is strong pleochroism.

Biotite is dark brown to green for the most part, can be confused with hornblend.

Muscovite tends to be a lighter color than biotite.

Fluorite was not an inclusion identified in these samples. If it was, in plane polarized light fluorite appears as a distinct purple color with a quadrilateral shape.

Olivine in plane polarized light appears clear with irregular fracture and high relief. In cross polarized light, olivine has high order interference colors.

Lithics in plane polarized light have a wide variety of colors: tan, brown, black, and pink. In cross polarized light, the lithics have a glassy appearance and is opaque.

Igneous clast is rocks with igneous minerals such as pyroxene, feldspar, and amphibole.

Volcanic glass can either be clear or colored in plane polarized light and is isotrophic in cross polarized light, it can have black specs or air bubbles within it.

*Sedimentary Inclusions*

Clay/Soil has a different texture, color, and density than the rest of the clay that makes the body of the sample.

Calcite is made up of fine crystal structure that creates a scintillating pattern in crossed and plane polarized light. When observed through cross polarized light, calcite appears with high third-order interference.

*Biogenic/Anthropogenic Inclusions*

Ostracods are small crustacean that live in brackish freshwater environment, with bivalve shells.

Organics include a wide variety of inclusions such as: phytoliths, carbon, roots, and other plant material.

Carbon can be seen within the voids of some of the samples, most likely is the remains of burned plant material.

Grog is crushed ceramics that is used as temper when making new pottery.

*Other Inclusions*

Opaques are inclusions that do not transmit light in both plane and crossed polarized light.

Other is the category that includes all inclusions that lack a consistent texture, color, and interference colors.

*Voids*

Voids are all empty space within the sample. Any voids that had anything within them were not included in the count.

After studying the 44 samples I split them into the 10 groups. I then averaged each mineral count to assist in the assigning provenience. Once calculating the average was complete, I then lined up each of the unassigned samples and compared them to each site. Several of the sites had no matches, such as Cuauhtitlan, Southern Basin-3, Teotihuacan Valley (Otumba), Southern Basin-1, and Xaltocan-3B. As seen in Table 5, the 13 samples provenance was assigned to a designated area.

As expected, there are many similarities between the minerology of each location. Only one of the locations had a specific inclusion that distinguished the figurines, identifying them as Xaltocan 1b. Even though the mineralogy is nearly the same from each site, it is the combination and amount of each mineral that clarifies the major differences between them.

Cauahtitlan had high levels of plagioclase, biotite, muscovite, quartz, and opaque inclusions. There are medium levels of quartz-feldspar, clinopyroxene, feldspar, and igneous clast. The figurines from the Cauahtitlan also have low levels of volcanic glass, lithic, and hematite clay nodule.

Southern Basin-1 has high averages of feldspar, plagioclase, muscovite, quartz, and opaque inclusions. With medium levels of clinopyroxene, quartz/feldspar, lithic, igneous clast, and biotite. There were only a few minerals with low averages: volcanic glass, carbon, and grog.

Southern Basin-3 was the only location that had a high average of lithics within the figurines from this area. Other than the lithics, there are also high levels of muscovite, quartz, and opaque. The figurines have medium levels of quart-feldspar, plagioclase, clinopyroxene, and feldspar. With low levels of volcanic glass, igneous clast, carbon, and hematite clay nodule.

Tenochtitlan figurines have high levels of muscovite, plagioclase, and opaque inclusions. The rest of the minerals are split between medium and low. The medium levels were quartz/feldspar, biotite, quartz, and feldspars. With low averages of volcanic glass, clinopyroxene, grog, lithic and hematite clay nodules.

Teotihuacan Valley (Otumba) artifacts have a large variety of minerals with low levels: quartz/feldspar, clinopyroxene, volcanic glass, lithic, igneous clast, and calcite, opaque, and hematite clay nodules. The medium level minerals are feldspar, plagioclase, and biotite. The two minerals with highest levels were muscovite and quartz.

Teotihuacan Valley (Teo-Core) has high levels of plagioclase, clinopyroxene, quartz, opaque, and muscovite. There were only a few minerals that ranked with medium levels such as quartz feldspar and feldspar. With many low-ranking minerals, othopyroxene, igneous clast, carbon, grog, hematite clay nodule, lithics, and biotite.

Xaltocan-1a has a few inclusions with high averages of plagioclase and quartz. While most the minerals fell in the middle range, such as; quartz-feldspar, clinopyroxene, lithic, feldspar, opaque, biotite, and muscovite. These figures have low averages of volcanic glass, othopyroxene, igneous clast, and hematite clay nodule.

Xaltocan-1b is the only locations that have ostracod fossils within them. Overall there are a wide variety of inclusions that make up the paste of the figurine. Xaltocan-1b has low averages of volcanic glass, quartz-feldspar, othopyroxene, lithic, igneous clast, carbon, ostracods, opaque, biotite, and hematite clay nodules. Medium averages of muscovite, feldspar, plagioclase, and clinopyroxene. Only one mineral had a high average in Xaltocan-1b figurines, which is quartz.

Xaltocan-2 was the only site that produced figurines with high levels of hematite clay nodules. Other than hematite, quartz had high levels as well. With medium levels of plagioclase, lithics, muscovite, and opaque. Xaltocan-2 also had low levels of clinopyroxene, feldspar, biotite, and quartz-feldspar

Xaltocan-3b has low levels of lithics, igneous glass, and muscovite. The medium averages of biotite and opaque inclusions. With the highest being quartz/feldspar, plagioclase, clinopyroxene, feldspar, and quartz.

*X-ray Diffraction*

Forty archaeological samples from Mexico were analyzed by XRD to create samples I could compare the remaining 13 unassigned figurines. Unfortunately, the results varied greatly in most figurines, in a few cases the mineral composition was too close to pinpoint one location. Some of this is due to not having a large enough sample from each location.

# Chapter Seven
# Discussion

As discussed in chapter one, the Basin of Mexico is extremely complicated due to its location. All the erosional debris washes down into the valley making the differences in the mineralogy slight. As expected the petrographic material shows that many the minerals were the same in each sample. A problem I ran into was that there have only been a handful of petrographic studies performed in the Basin of Mexico. By using Mary Hopkins and John Millhauser's dissertation I could clearly identify ceramics coming from Xaltocan and Teotihuacan Valley. To make up for the lack of information, I tested the 44 INAA samples that had the provenance clarified to compare against the 13 unassigned samples. With this information, I could assign provenance to the remaining 13 samples.

With XRD the small sample size caused some issues when determining provenance. Without many samples to compare them to I was unable to identify consistent patterns that would clarify the types of minerals coming out of each site. To utilize XRD to its greatest potential I would need a larger comparison collection and a greater understanding of the XRD process. With the materials available to me currently I was unable to identify provenance using only XRD. It is my suggestion that samples be retested in the future with someone who has the time and funds to apply this method correctly. Therefore, I will leave the powdered samples for future research.

Nearly all types of analysis have some form of disadvantages, whether it is the cost to it being destructive process. For petrography, a disadvantage is when the inclusion count is performed, I counted to 50 inclusions or 250 clay points. It is not surprising that if a count were to be done again the numbers would not be the same. The numbers would be near my count but it is not possible to get the exact same count as before. By using multiple methods of analysis, the results can then be compared to each other to ensure that the results are accurate.

# Chapter Eight
# Conclusion

## Implications

Archaeologists have been studying the evidence for the Aztecs elaborate trade system since the early days of archaeology. I used this research to determine where the artifacts from Xaltocan originated. To do this, many archaeologists rely heavily on using INAA. Unfortunately, INAA does have some disadvantages for identifying the chemical geological makeup of ceramics. To offset this issue, I have utilized petrography and XRD. Petrography is an excellent technique for determining provenance. The process not only identified the provenance for the remaining 13 samples from Xaltocan, Mexico, but it also gave us a better understanding of the complexity the trade system. Xaltocan had goods arriving from throughout the Basin of Mexico, in this study figurines were brought in from the Southern Basin, Tenochtitlan, and Teotihuacan. Several of the figurines from this study were produced from within Xaltocan as well.

Unfortunately, I was unable to identify provenance using XRD. There are many reasons why XRD did not work well for this study. First the comparative samples for many of the sites were not large enough to identify consistent patterns of the mineral crystalline structure of the samples. Second, to accurately determine which mineral structures are present you must add different chemicals to remove the suspected mineral, I did not have the time or the funding to pursue this line of inquire. With the materials and resources made available to me I was unable to determine provenance using XRD alone.

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APPENDIX

APPENDIX

Table 1. Figurines analyzed by INAA (Overholtzer and Stoner, N.D.)

| ANID | Alt_ID | Context | Period | Description | Final Group |
|---|---|---|---|---|---|
| AZX068 | 611 | C, 4 | Phase 4 | Flat-Backed | Xaltocan-1a |
| AZX069 | 616 | C, 8 Feat. 201 | Phase 4 | Rattle | Xaltocan-1a |
| AZX071 | 617 | D, 19 | Phase 2 | Mud-men-and-women | Xaltocan-3b |
| AZX072 | 615 | G, 10 | Phase 2 | Animal (dog) | Xaltocan-2 |
| AZX073 | 619 | G, 20 | Phase 1 | Mud-men-and-women | Xaltocan-1b |
| AZX074 | 610 | G4, 5 | Phase 3 | Flat-Backed | Xaltocan-1a |
| AZX076 | 612 | K, 10 | Phase 3 | Flat-Backed | Xaltocan-1a |
| AZX108 | 83 | Structure 92 | Phase 3 | Rattle | Xaltocan-1a |
| AZX109 | 721 | Zoc B, 4B | Mixed | Flat-Backed | Xaltocan-1b |
| AZX111 | 26 | G7, 8M | Phase 1 | Flat-Backed | Unassigned |
| AZX112 | 43 | X2, 19Q | Phase 3 | Flat-Backed | Unassigned |
| AZX113 | 76 | X2, 14Q | Phase 3 | Flat-Backed | Cuauhtitlan |
| AZX114 | 88 | Structure 114 | Phase 4 | Flat-Backed | Xaltocan-1a |
| AZX115 | 98 | Surface Location 20 | Phase 3 | Flat-Backed | Southern Basin-3 |
| AZX116 | 123 | R, 6 | Phase 4 | Flat-Backed | Teotihuacan Valley (Otumba) |
| AZX117 | 139 | Z2, 23W | Phase 1 | Flat-Backed | Xaltocan-1b |
| AZX118 | 144 | PC5, 22O | Phase 3 | Flat-Backed | Cuauhtitlan |
| AZX119 | 165 | Y5, 16 Feat. 3 | Phase 1 | Flat-Backed | Southern Basin-1 |
| AZX121 | 501 | PC4C, 10 | Phase 3 | Flat-Backed | Southern Basin-1 |
| AZX122 | 504 | PC5, 20Q | Phase 3 | Flat-Backed | Unassigned |

Table 1. (continued)

| ANID | Alt_ID | Context | Period | Description | Final Group |
|---|---|---|---|---|---|
| AZX123 | 514 | PC5, 23 | Phase 3 | Flat-Backed | Xaltocan-1a |
| AZX124 | 516 | PC5, 18L | Phase 3 | Flat-Backed | Tenochtitlan |
| AZX125 | 520 | PC4A, 5B | Phase 3 | Flat-Backed | Teotihuacan Valley (Otumba) |
| AZX126 | 541 | Y5, 17 Feat. 3 | Phase 1 | Flat-Backed | Xaltocan-1b |
| AZX127 | 583 | X2, 10L | Phase 3 | Flat-Backed | Xaltocan-1a |
| AZX128 | 584 | X2, 24Q | Phase 2 | Flat-Backed | Southern basin-3 |
| AZX129 | 587 | Survey N126W94 | Phase 2 | Flat-Backed | Cuauhtitlan |
| AZX130 | 589 | R, 2 | Phase 4 | Flat-Backed | Xaltocan-1a |
| AZX131 | 556 | PC5, 23S | Phase 3 | Flat-Backed | Southern Basin-3 |
| AZX132 | 126 | X2, 23AB | Phase 3 | Flat-Backed | Tenochtitlan |
| AZX133 | 115 | PC2A, 5I | Colonial | Flat-Backed | Unassigned |
| AZX134 | 760 | Z1, 19X locus 2 | Phase 1 | Flat-Backed | Xaltocan-1b |
| AZX135 | 94 | X2, 19AA | Phase 3 | Flat-Backed | Xaltocan-1a |
| AZX138 | 77 | T, 8A | Phase 4 | Flat-Backed | Teotihuacan Valley (Otumba) |
| AZX139 | 15 | Survey, N210W357 | Phase 2 | Mazapan | Xaltocan-1b |
| AZX140 | 16 | X2, 1.1-1.3 Feat. 2 | Phase 3 | Mazapan | Xaltocan-1b |
| AZX141 | 78 | G, 16 | Phase 1 | Mazapan | Xaltocan-1b |
| AZX144 | 578 | Z1, 8H | Mixed | Mazapan | Unassigned |
| AZX145 | 751 | Zoc C, 11K | Phase 1 | Mazapan | Unassigned |
| AZX147 | 544 | PC4A, 12F | Phase 3 | Mud men-and-women | Xaltocan-1b |
| AZX148 | 507 | Z1, 17U Loc. 4 | Phase 1 | Mud men-and-women | Unassigned |

Table 1. (continued)

| ANID | Alt_ID | Context | Period | Description | Final Group |
|---|---|---|---|---|---|
| AZX149 | 510 | Y5, 18 Feat. 3 | Phase 1 | Mud men-and-women | Xaltocan-1b |
| AZX150 | 548 | Z2, 23W | Phase 1 | Mud men-and-women | Xaltocan-1b |
| AZX151 | 625 | Y3, 9A | Phase 2 | Mud men-and-women | Xaltocan-1b |
| AZX152 | 192 | C, 3 | Phase 4 | Curated; Tzacualli | Teotihuacan Valley (Teo-Core) |
| AZX153 | 205 | G6, 21D | Phase 1 | Curated; Miccaotli | Unassigned |
| AZX154 | 208 | G6, 5 | Phase 3 | Curated; Tzacualli | Teotihuacan Valley (Teo-Core) |
| AZX157 | 554 | Z1, 9J | Phase 1 | Curated; Metepec | Teotihuacan Valley (Teo-Core) |
| AZX158 | 577 | PC4B, 7B | Phase 3 | Curated; Miccaotli | Teotihuacan Valley (Teo-Core) |
| AZX160 | 741 | Zoc C, 7H | Phase 1 | Curated; Tzacualli | Unassigned |
| AZX161 | 289 | Y2, 8ZZ | Phase 1 | Curated; Metepec | Teotihuacan Valley (Teo-Core) |
| AZX162 | 312 | X1, 7A | Phase 3 | Animal (dog) | Unassigned |
| AZX163 | 759 | Zoc C, 6E | Phase 1 | Animal (dog) | Unassigned |
| AZX164 | 322 | G7, 15Z | Phase 1 | Animal (dog) | Xaltocan-1a |
| AZX165 | 735 | Zoc B, 10V | Phase 2 | Animal (dog) | Xaltocan-1a |

Table 2: Xaltocan Chronology (Overholtzer and Stoner, N.D.)

| Phase | Dates | Period | Ceramics |
|---|---|---|---|
| 1 | 900-1000 C.E. | Early Postclassic | Aztec I |
| 2 | 1100-1300 C.E. | Early to Middle Postclassic | Aztec I and II |
| 3 | 1300-1430 C.E. | Middle Postclassic | Aztec II |
| 4 | 1430-1521 C.E. | Late Postclassic | Aztec III and IV |

Table 3: Summary of points counted in thin section samples that provenance was determined by INAA (Neutron Activation Analysis). Numbers in this table represent each mineral counted during analysis and size is in mm.

| Artifact | Location | Quartz/ Feldspar | FELDSPAR Feldspar | Plagioclase | PYROXENE Clino-pyroxene | Ortho-pyroxene | LITHIC Volcanic glass | Lithic | Igneous clast |
|---|---|---|---|---|---|---|---|---|---|
| AZX113 | Cuauhtitlan | 3 | 3 | 6 | 3 | 0 | 0 | 1 | 3 |
| AZX118 | Cuauhtitlan | 3 | 4 | 7 | 2 | 0 | 1 | 1 | 2 |
| AZX129 | Cuauhtitlan | 4 | 1 | 10 | 1 | 0 | 0 | 2 | 1 |
| AZX119 | Southern Basin-1 | 3 | 4 | 6 | 3 | 0 | 0 | 2 | 3 |
| AZX121 | Southern Basin-1 | 2 | 7 | 4 | 3 | 0 | 1 | 4 | 3 |
| AZX115 | Southern Basin-3 | 4 | 2 | 5 | 4 | 0 | 1 | 7 | 1 |
| AZX128 | Southern Basin-3 | 2 | 5 | 3 | 5 | 0 | 2 | 6 | 0 |
| AZX131 | Southern Basin-3 | 3 | 3 | 4 | 5 | 0 | 1 | 6 | 0 |
| AZX124 | Tenochtitlan | 4 | 3 | 7 | 1 | 0 | 0 | 2 | 0 |
| AZX132 | Tenochtitlan | 3 | 3 | 8 | 1 | 0 | 1 | 1 | 0 |
| AZX116 | Teotihuacan Valley (Otumba) | 3 | 5 | 3 | 2 | 0 | 2 | 2 | 3 |
| AZX125 | Teotihuacan Valley (Otumba) | 3 | 5 | 5 | 3 | 0 | 1 | 3 | 2 |
| AZX138 | Teotihuacan Valley (Otumba) | 2 | 4 | 4 | 2 | 0 | 2 | 3 | 3 |
| AZX152 | Teotihuacan Valley (Teo-Core) | 3 | 3 | 5 | 5 | 0 | 0 | 1 | 0 |
| AZX154 | Teotihuacan Valley (Teo-Core) | 2 | 3 | 5 | 6 | 1 | 0 | 3 | 0 |
| AZX157 | Teotihuacan Valley (Teo-Core) | 2 | 3 | 4 | 4 | 1 | 0 | 2 | 1 |

Table 3. (continued)

| Artifact | Location | Quartz/ Feldspar | FELDSPAR | | PYROXENE | | LITHIC | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Feldspar | Plagioclase | Clino- pyroxene | Ortho- pyroxene | Volcanic glass | Lithic | Igneous clast |
| AZX158 | Teotihuacan Valley (Teo-Core) | 3 | 3 | 8 | 5 | 0 | 0 | 2 | 0 |
| AZX161 | Teotihuacan Valley (Teo-Core) | 3 | 4 | 5 | 7 | 0 | 0 | 2 | 1 |
| AZX068 | Xaltocan-1a | 1 | 4 | 6 | 3 | 0 | 1 | 2 | 1 |
| AZX074 | Xaltocan-1a | 4 | 5 | 6 | 4 | 0 | 1 | 3 | 0 |
| AZX076 | Xaltocan-1a | 3 | 6 | 7 | 2 | 0 | 0 | 2 | 1 |
| AZX114 | Xaltocan-1a | 2 | 4 | 5 | 2 | 0 | 0 | 1 | 1 |
| AZX123 | Xaltocan-1a | 5 | 6 | 7 | 4 | 0 | 0 | 0 | 0 |
| AZX127 | Xaltocan-1a | 4 | 5 | 8 | 2 | 0 | 0 | 2 | 1 |
| AZX130 | Xaltocan-1a | 4 | 4 | 8 | 3 | 0 | 0 | 4 | 1 |
| AZX135 | Xaltocan-1a | 3 | 3 | 7 | 2 | 0 | 0 | 3 | 1 |
| AZX164 | Xaltocan-1a | 5 | 3 | 7 | 2 | 0 | 1 | 3 | 0 |
| AZX165 | Xaltocan-1a | 2 | 2 | 8 | 2 | 0 | 0 | 2 | 0 |
| AZX069 | Xaltocan-1a | 3 | 3 | 6 | 4 | 1 | 0 | 2 | 0 |
| AZX108 | Xaltocan-1a | 4 | 5 | 8 | 4 | 0 | 0 | 2 | 0 |
| AZX109 | Xaltocan-1b | 6 | 4 | 5 | 5 | 1 | 0 | 1 | 0 |
| AZX117 | Xaltocan-1b | 6 | 5 | 6 | 3 | 1 | 0 | 2 | 1 |

Table 3. (continued)

| Artifact | Location | Quartz/ Feldspar | FELDSPAR Feldspar | Plagioclase | PYROXENE Clino-pyroxene | Ortho-pyroxene | LITHIC Volcanic glass | Lithic | Igneous clast |
|---|---|---|---|---|---|---|---|---|---|
| AZX126 | Xaltocan-1b | 5 | 6 | 5 | 3 | 1 | 0 | 2 | 1 |
| AZX134 | Xaltocan-1b | 4 | 7 | 7 | 3 | 1 | 0 | 4 | 1 |
| AZX073 | Xaltocan-1b | 3 | 5 | 7 | 3 | 0 | 0 | 2 | 1 |
| AZX147 | Xaltocan-1b | 5 | 6 | 6 | 7 | 1 | 0 | 3 | 0 |
| AZX149 | Xaltocan-1b | 1 | 5 | 7 | 1 | 0 | 2 | 4 | 0 |
| AZX150 | Xaltocan-1b | 3 | 2 | 5 | 3 | 1 | 0 | 3 | 1 |
| AZX151 | Xaltocan-1b | 6 | 4 | 5 | 5 | 1 | 0 | 3 | 2 |
| AZX139 | Xaltocan-1b | 3 | 4 | 2 | 5 | 1 | 0 | 1 | 0 |
| AZX140 | Xaltocan-1b | 3 | 6 | 4 | 5 | 1 | 0 | 0 | 0 |
| AZX141 | Xaltocan-1b | 3 | 6 | 6 | 3 | 2 | 0 | 3 | 0 |
| AZX072 | Xaltocan-2 | 2 | 2 | 6 | 1 | 0 | 0 | 4 | 0 |
| AZX071 | Xaltocan-3b | 5 | 7 | 6 | 5 | 0 | 0 | 1 | 2 |

Table 3. (continued)

| Artifact | Location | **AMPHIBOLE** Actinolite | Hornblende | Tremolite | **MICA** Biotite | Muscovite | **UNCOMMON IGNEOUS** Quartz | Fluorite | Olivine |
|---|---|---|---|---|---|---|---|---|---|
| AZX113 | Cuauhtitlan | 0 | 0 | 0 | 7 | 8 | 6 | 0 | 0 |
| AZX118 | Cuauhtitlan | 0 | 0 | 0 | 5 | 8 | 5 | 0 | 0 |
| AZX129 | Cuauhtitlan | 0 | 0 | 0 | 5 | 7 | 6 | 0 | 0 |
| AZX119 | Southern Basin-1 | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 0 |
| AZX121 | Southern Basin-1 | 0 | 0 | 0 | 3 | 7 | 7 | 0 | 0 |
| AZX115 | Southern Basin-3 | 0 | 0 | 0 | 2 | 6 | 4 | 0 | 0 |
| AZX128 | Southern Basin-3 | 0 | 0 | 0 | 3 | 5 | 6 | 0 | 0 |
| AZX131 | Southern Basin-3 | 0 | 0 | 0 | 2 | 5 | 5 | 0 | 0 |
| AZX124 | Tenochtitlan | 0 | 0 | 0 | 5 | 11 | 4 | 0 | 0 |
| AZX132 | Tenochtitlan | 0 | 0 | 0 | 4 | 9 | 4 | 0 | 0 |
| AZX116 | Teotihuacan Valley (Otumba) | 0 | 0 | 0 | 5 | 6 | 9 | 0 | 0 |
| AZX125 | Teotihuacan Valley (Otumba) | 0 | 0 | 0 | 4 | 5 | 8 | 0 | 0 |
| AZX138 | Teotihuacan Valley (Otumba) | 0 | 0 | 0 | 5 | 6 | 7 | 0 | 0 |
| AZX152 | Teotihuacan Valley (Teo-Core) | 0 | 0 | 0 | 4 | 3 | 8 | 0 | 0 |
| AZX154 | Teotihuacan Valley (Teo-Core) | 0 | 0 | 0 | 2 | 4 | 8 | 0 | 0 |
| AZX157 | Teotihuacan Valley (Teo-Core) | 0 | 0 | 0 | 3 | 5 | 8 | 0 | 0 |

Table 3. (continued)

| Artifact | Location | AMPHIBOLE | | | MICA | | UNCOMMON IGNEOUS | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Actinolite | Hornblende | Tremolite | Biotite | Muscovite | Quartz | Fluorite | Olivine |
| AZX158 | Teotihuacan Valley (Teo-Core) | 0 | 0 | 0 | 2 | 6 | 11 | 0 | 0 |
| AZX161 | Teotihuacan Valley (Teo-Core) | 0 | 0 | 0 | 3 | 7 | 8 | 0 | 0 |
| AZX068 | Xaltocan-1a | 0 | 0 | 0 | 4 | 4 | 14 | 0 | 0 |
| AZX074 | Xaltocan-1a | 0 | 0 | 0 | 6 | 5 | 7 | 0 | 0 |
| AZX076 | Xaltocan-1a | 0 | 0 | 0 | 5 | 5 | 12 | 0 | 0 |
| AZX114 | Xaltocan-1a | 0 | 0 | 0 | 5 | 9 | 9 | 0 | 0 |
| AZX123 | Xaltocan-1a | 0 | 0 | 0 | 6 | 8 | 7 | 0 | 0 |
| AZX127 | Xaltocan-1a | 0 | 0 | 0 | 4 | 5 | 9 | 0 | 0 |
| AZX130 | Xaltocan-1a | 0 | 0 | 0 | 5 | 7 | 9 | 0 | 0 |
| AZX135 | Xaltocan-1a | 0 | 0 | 0 | 6 | 6 | 9 | 0 | 0 |
| AZX164 | Xaltocan-1a | 0 | 0 | 0 | 4 | 6 | 11 | 0 | 0 |
| AZX165 | Xaltocan-1a | 0 | 0 | 0 | 3 | 9 | 9 | 0 | 0 |
| AZX069 | Xaltocan-1a | 0 | 0 | 0 | 5 | 7 | 9 | 0 | 0 |
| AZX108 | Xaltocan-1a | 0 | 0 | 0 | 5 | 7 | 7 | 0 | 0 |
| AZX109 | Xaltocan-1b | 0 | 0 | 0 | 6 | 1 | 10 | 0 | 0 |
| AZX117 | Xaltocan-1b | 0 | 0 | 0 | 3 | 2 | 9 | 0 | 0 |

Table 3. (continued)

| Artifact | Location | AMPHIBOLE | | | MICA | | UNCOMMON IGNEOUS | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Actinolite | Hornblende | Tremolite | Biotite | Muscovite | Quartz | Fluorite | Olivine |
| AZX126 | Xaltocan-1b | 0 | 0 | 0 | 4 | 2 | 14 | 0 | 0 |
| AZX134 | Xaltocan-1b | 0 | 0 | 0 | 3 | 1 | 10 | 0 | 0 |
| AZX073 | Xaltocan-1b | 0 | 0 | 0 | 4 | 1 | 14 | 0 | 0 |
| AZX147 | Xaltocan-1b | 0 | 0 | 0 | 0 | 3 | 9 | 0 | 0 |
| AZX149 | Xaltocan-1b | 0 | 0 | 0 | 3 | 5 | 8 | 0 | 0 |
| AZX150 | Xaltocan-1b | 0 | 0 | 0 | 2 | 5 | 8 | 0 | 0 |
| AZX151 | Xaltocan-1b | 0 | 0 | 0 | 3 | 1 | 9 | 0 | 0 |
| AZX139 | Xaltocan-1b | 0 | 0 | 0 | 4 | 4 | 13 | 0 | 0 |
| AZX140 | Xaltocan-1b | 0 | 0 | 0 | 1 | 1 | 15 | 0 | 0 |
| AZX141 | Xaltocan-1b | 0 | 0 | 0 | 2 | 2 | 8 | 0 | 0 |
| AZX072 | Xaltocan-2 | 0 | 0 | 0 | 2 | 2 | 9 | 0 | 0 |
| AZX071 | Xaltocan-3b | 0 | 0 | 0 | 3 | 2 | 8 | 0 | 0 |

Table 3. (continued)

| Artifact | Location | ORGANICS Carbon | Roots | Phytolith | Clay/Soil | Calcite | Ostracod | Grog |
|---|---|---|---|---|---|---|---|---|
| AZX113 | Cuauhtitlan | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX118 | Cuauhtitlan | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX129 | Cuauhtitlan | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX119 | Southern Basin-1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX121 | Southern Basin-1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| AZX115 | Southern Basin-3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX128 | Southern Basin-3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX131 | Southern Basin-3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX124 | Tenochtitlan | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX132 | Tenochtitlan | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| AZX116 | Teotihuacan Valley (Otumba) | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| AZX125 | Teotihuacan Valley (Otumba) | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| AZX138 | Teotihuacan Valley (Otumba) | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| AZX152 | Teotihuacan Valley (Teo-Core) | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX154 | Teotihuacan Valley (Teo-Core) | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX157 | Teotihuacan Valley (Teo-Core) | 1 | 0 | 0 | 0 | 0 | 0 | 1 |

Table 3 (continued)

| Artifact | Location | ORGANICS Carbon | Roots | Phytolith | Clay/Soil | Calcite | Ostracod | Grog |
|---|---|---|---|---|---|---|---|---|
| AZX158 | Teotihuacan Valley (Teo-Core) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX161 | Teotihuacan Valley (Teo-Core) | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX068 | Xaltocan-1a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX074 | Xaltocan-1a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX076 | Xaltocan-1a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX114 | Xaltocan-1a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX123 | Xaltocan-1a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX127 | Xaltocan-1a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX130 | Xaltocan-1a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX135 | Xaltocan-1a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX164 | Xaltocan-1a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX165 | Xaltocan-1a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX069 | Xaltocan-1a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX108 | Xaltocan-1a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX109 | Xaltocan-1b | 2 | 0 | 0 | 0 | 0 | 1 | 0 |
| AZX117 | Xaltocan-1b | 2 | 0 | 0 | 0 | 0 | 2 | 0 |

Table 3. (continued)

| Artifact | Location | ORGANICS Carbon | Roots | Phytolith | Clay/Soil | Calcite | Ostracod | Grog |
|---|---|---|---|---|---|---|---|---|
| AZX126 | Xaltocan-1b | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| AZX134 | Xaltocan-1b | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| AZX073 | Xaltocan-1b | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| AZX147 | Xaltocan-1b | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| AZX149 | Xaltocan-1b | 1 | 0 | 0 | 0 | 0 | 2 | 0 |
| AZX150 | Xaltocan-1b | 2 | 0 | 0 | 0 | 0 | 2 | 0 |
| AZX151 | Xaltocan-1b | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| AZX139 | Xaltocan-1b | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| AZX140 | Xaltocan-1b | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| AZX141 | Xaltocan-1b | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| AZX072 | Xaltocan-2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX071 | Xaltocan-3b | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 3. (continued)

| Artifact | Location | Opaque | Other | Clay | Voids | Hematite Clay Nodule |
|---|---|---|---|---|---|---|
| AZX113 | Cuauhtitlan | 4 | 0 | 161 | 6 | 0 |
| AZX118 | Cuauhtitlan | 5 | 0 | 154 | 7 | 0 |
| AZX129 | Cuauhtitlan | 6 | 0 | 157 | 6 | 1 |
| AZX119 | Southern Basin-1 | 6 | 0 | 152 | 15 | 0 |
| AZX121 | Southern Basin-1 | 7 | 0 | 158 | 1 | 0 |
| AZX115 | Southern Basin-3 | 7 | 0 | 151 | 4 | 1 |
| AZX128 | Southern Basin-3 | 6 | 0 | 159 | 6 | 0 |
| AZX131 | Southern Basin-3 | 9 | 0 | 154 | 5 | 0 |
| AZX124 | Tenochtitlan | 6 | 0 | 148 | 3 | 1 |
| AZX132 | Tenochtitlan | 8 | 0 | 158 | 5 | 2 |
| AZX116 | Teotihuacan Valley (Otumba) | 3 | 0 | 153 | 4 | 2 |
| AZX125 | Teotihuacan Valley (Otumba) | 2 | 0 | 149 | 5 | 2 |
| AZX138 | Teotihuacan Valley (Otumba) | 3 | 0 | 148 | 3 | 3 |
| AZX152 | Teotihuacan Valley (Teo-Core) | 5 | 0 | 151 | 11 | 1 |
| AZX154 | Teotihuacan Valley (Teo-Core) | 6 | 0 | 156 | 7 | 1 |
| AZX157 | Teotihuacan Valley (Teo-Core) | 4 | 0 | 162 | 10 | 1 |

Table 3. (continued)

| Artifact | Location | Opaque | Other | Clay | Voids | Hematite Clay Nodule |
|---|---|---|---|---|---|---|
| AZX158 | Teotihuacan Valley (Teo-Core) | 6 | 0 | 169 | 4 | 0 |
| AZX161 | Teotihuacan Valley (Teo-Core) | 2 | 0 | 162 | 6 | 1 |
| AZX068 | Xaltocan-1a | 3 | 0 | 142 | 7 | 1 |
| AZX074 | Xaltocan-1a | 4 | 0 | 142 | 8 | 1 |
| AZX076 | Xaltocan-1a | 4 | 0 | 148 | 5 | 1 |
| AZX114 | Xaltocan-1a | 6 | 0 | 151 | 5 | 3 |
| AZX123 | Xaltocan-1a | 4 | 0 | 167 | 7 | 1 |
| AZX127 | Xaltocan-1a | 5 | 0 | 157 | 6 | 3 |
| AZX130 | Xaltocan-1a | 2 | 0 | 156 | 6 | 1 |
| AZX135 | Xaltocan-1a | 5 | 0 | 161 | 7 | 1 |
| AZX164 | Xaltocan-1a | 4 | 0 | 151 | 7 | 2 |
| AZX165 | Xaltocan-1a | 6 | 0 | 154 | 9 | 0 |
| AZX069 | Xaltocan-1a | 3 | 0 | 155 | 7 | 3 |
| AZX108 | Xaltocan-1a | 5 | 0 | 161 | 6 | 1 |
| AZX109 | Xaltocan-1b | 1 | 0 | 151 | 7 | 0 |
| AZX117 | Xaltocan-1b | 4 | 0 | 152 | 4 | 0 |

Table 3. (continued)

| Artifact | Location | Opaque | Other | Clay | Voids | Hematite Clay Nodule |
|---|---|---|---|---|---|---|
| AZX126 | Xaltocan-1b | 1 | 0 | 154 | 4 | 0 |
| AZX134 | Xaltocan-1b | 1 | 0 | 161 | 6 | 0 |
| AZX073 | Xaltocan-1b | 3 | 0 | 149 | 5 | 0 |
| AZX147 | Xaltocan-1b | 0 | 0 | 167 | 7 | 1 |
| AZX149 | Xaltocan-1b | 2 | 0 | 154 | 9 | 0 |
| AZX150 | Xaltocan-1b | 2 | 0 | 151 | 9 | 2 |
| AZX151 | Xaltocan-1b | 1 | 0 | 159 | 8 | 0 |
| AZX139 | Xaltocan-1b | 2 | 0 | 161 | 7 | 2 |
| AZX140 | Xaltocan-1b | 2 | 0 | 149 | 10 | 0 |
| AZX141 | Xaltocan-1b | 3 | 0 | 161 | 11 | 0 |
| AZX072 | Xaltocan-2 | 6 | 0 | 153 | 8 | 5 |
| AZX071 | Xaltocan-3b | 4 | 0 | 153 | 7 | 0 |

Table 4: Petrography averages for each site, the range for each type of inclusion is within parenthesis.

| Location | Quartz/ Feldspar | FELDSPAR Feldspar | Plagioclase | PYROXENE Clino-pyroxene | Ortho-pyroxene | LITHIC Volcanic glass | Lithic | Igneous clast |
|---|---|---|---|---|---|---|---|---|
| Cuauhtitlan | 3.33 (3-4) | 2.65 (1-4) | 7.67 (6-10) | 2.00 (1-3) | 0 (0) | 0.33 (0-1) | 1.33 (1-2) | 2.00 (1-3) |
| Southern Basin-1 | 2.50 (2-3) | 5.50 (4-7) | 5.00 (4-6) | 3.00 (3) | 0 (0) | 0.50 (0-1) | 3.00 (2-4) | 3.00 (3) |
| Southern Basin-3 | 3,00 (2-4) | 3.33 (2-5) | 4.33 (3-6) | 4.67 (4-5) | 0 (0) | 1.33 (1-2) | 6.33 (6-7) | 0.33 (0-1) |
| Tenochtitlan | 3.50 (3-4) | 3.00 (3) | 7.50 (7-8) | 1.00 (1) | 0 (0) | 0.50 (0-1) | 1.50 (1-2) | 0 (0) |
| Teotihuacan Valley (Otumba) | 2.67 (2-3) | 4.67 (4-5) | 4.00 (3-5) | 2.33 (2-3) | 0 (0) | 1.67 (1-2) | 2.67 (2-3) | 2.67 (2-3) |
| Teotihuacan Valley (Teo-Core) | 2.60 (2-3) | 3.20 (3-4) | 5.40 (4-8) | 5.40 (4-7) | 0.40 (0-1) | 0 (0) | 2.00 (1-3) | 0.40 (0-1) |
| Xaltocan-1a | 3.33 (1-5) | 4.17 (2-6) | 6.92 (5-8) | 2.83 (2-4) | 0.08 (0-1) | 0.25 (0-1) | 2.17 (0-4) | 0.50 (0-1) |
| Xaltocan-1b | 4.00 (1-6) | 5.00 (2-7) | 5.42 (2-7) | 3.83 (1-7) | 0.92 (0-1) | 0.17 (0-2) | 2.33 (0-4) | 0.58 (0-2) |
| Xaltocan-2 | 2.00 (2) | 2.00 (2) | 6.00 (6) | 1.00 (1) | 0 (0) | 0 (0) | 4.00 (4) | 0 (0) |
| Xaltocan-3b | 5.00 (5) | 7.00 (7) | 6.00 (6) | 5.00 (5) | 0 (0) | 0 (0) | 1.00 (1) | 2.00 (2) |

Table 4. (continued)

| Location | AMPHIBOLE | | | MICA | | UNCOMMON IGNEOUS | | |
|---|---|---|---|---|---|---|---|---|
| | Actinolite | Hornblende | Tremolite | Biotite | Muscovite | Quartz | Fluorite | Olivine |
| Cuauhtitlan | 0 (0) | 0 (0) | 0 (0) | 5.60 (5-7) | 7.67 (7-8) | 5.67 (5-6) | 0 (0) | 0 (0) |
| Southern Basin-1 | 0 (0) | 0 (0) | 0 (0) | 2.50 (2-3) | 4.50 (2-7) | 4.50 (2-7) | 0 (0) | 0 (0) |
| Southern Basin-3 | 0 (0) | 0 (0) | 0 (0) | 2.33 (2-3) | 5.33 (5-6) | 5.00 (4-6) | 0 (0) | 0 (0) |
| Tenochtitlan | 0 (0) | 0 (0) | 0 (0) | 4.50 (4-5) | 10.00 (9-11) | 4.00 (4) | 0 (0) | 0 (0) |
| Teotihuacan Valley (Otumba) | 0 (0) | 0 (0) | 0 (0) | 4.67 (4-5) | 5.67 (5-6) | 8.00 (7-9) | 0 (0) | 0 (0) |
| Teotihuacan Valley (Teo-Core) | 0 (0) | 0 (0) | 0 (0) | 2.80 (2-4) | 5.00 (3-7) | 8.6 (8-11) | 0 (0) | 0 (0) |
| Xaltocan-1a | 0 (0) | 0 (0) | 0 (0) | 4.83 (3-6) | 6.50 (4-9) | 9.33 (7-14) | 0 (0) | 0 (0) |
| Xaltocan-1b | 0 (0) | 0 (0) | 0 (0) | 2.92 (0-6) | 2.33 (1-5) | 10.58 (8-14) | 0 (0) | 0 (0) |
| Xaltocan-2 | 0 (0) | 0 (0) | 0 (0) | 2.00 (2) | 5.00 (5) | 9.00 (9) | 0 (0) | 0 (0) |
| Xaltocan-3b | 0 (0) | 0 (0) | 0 (0) | 3.00 (3) | 2,00 (2) | 8.00 (8) | 0 (0) | 0 (0) |

Table 4. (continued)

| Location | ORGANICS Carbon | Roots | Phytolith | Clay/Soil | Calcite | Ostracod | Grog |
|---|---|---|---|---|---|---|---|
| Cuauhtitlan | 0(0) | 0(0) | 0(0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Southern Basin-1 | 1.00 (1-2) | 0(0) | 0(0) | 0 (0) | 0 (0) | 0 (0) | 0.50 (0-1) |
| Southern Basin-3 | 1.33 (1-2) | 0(0) | 0(0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Tenochtitlan | 0(0) | 0(0) | 0(0) | 0 (0) | 0 (0) | 0 (0) | 0.50 (0-1) |
| Teotihuacan Valley (Otumba) | 0(0) | 0(0) | 0(0) | 0 (0) | 1.67 (1-2) | 0 (0) | 0 (0) |
| Teotihuacan Valley (Teo-Core) | 0.80 (0-1) | 0(0) | 0(0) | 0 (0) | 0 (0) | 0 (0) | 0.20 (0-1) |
| Xaltocan-1a | 0 (0) | 0(0) | 0(0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Xaltocan-1b | 1.17 (0-2) | 0(0) | 0(0) | 0 (0) | 0 (0) | 1.25 (1-2) | 0 (0) |
| Xaltocan-2 | 0(0) | 0(0) | 0(0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| Xaltocan-3b | 0(0) | 0(0) | 0(0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |

Table 4. (continued)

| Location | Opaque | Other | Clay | Voids | Hematite Clay Nodule |
|---|---|---|---|---|---|
| Cuauhtitlan | 5.00 (4-6) | 0 (0) | 157.33 (154-161) | 6.33 (6-7) | 0.33 (0-1) |
| Southern Basin-1 | 6.50 (6-7) | 0 (0) | 155.00 (152-158) | 8.00 (1-15) | 0 (0) |
| Southern Basin-3 | 7.33(6-9) | 0 (0) | 154.67 (151-159) | 5.00 (4-6) | 0.33 (0-1) |
| Tenochtitlan | 7.00 (6-8) | 0 (0) | 153.00 (148-158) | 4.00 (3-5) | 1.50 (1-2) |
| Teotihuacan Valley (Otumba) | 2.67 (2-3) | 0 (0) | 150.00 (148-153) | 4.00 (3-5) | 2.33 (2-3) |
| Teotihuacan Valley (Teo-Core) | 4.60 (2-6) | 0 (0) | 160.00 (151-169) | 7.60 (4-11) | 0.80 (0-1) |
| Xaltocan-1a | 4.25 (2-6) | 0 (0) | 153.75 (142-167) | 6.67 (5-9) | 1.50 (0-3) |
| Xaltocan-1b | 1.83 (0-3) | 0 (0) | 155.75 (149-167) | 7.25 (4-11) | 0.42 (0-2) |
| Xaltocan-2 | 6.00 (6) | 0 (0) | 153.00 (153) | 8.00 (8) | 5.00 (5) |
| Xaltocan-3b | 4.00 (4) | 0 (0) | 153.00 (153) | 7.00 (7) | 0 (0) |

Table 5. Petrography results of unassigned figurines.

| Artifact | Location | Quartz/ Feldspar | FELDSPAR Feldspar | Plagioclase | PYROXENE Clino-pyroxene | Ortho-pyroxene | LITHIC Volcanic glass | Lithic | Igneous clast |
|---|---|---|---|---|---|---|---|---|---|
| AZX111 | Tenochtitlan | 3 | 3 | 8 | 2 | 0 | 0 | 3 | 0 |
| AZX153 | Teotihuacan Valley (Teo-Core) | 3 | 4 | 6 | 6 | 1 | 0 | 2 | 0 |
| AZX160 | Teotihuacan Valley (Teo-Core) | 4 | 3 | 5 | 5 | 0 | 0 | 2 | 0 |
| AZX122 | Xaltocan-1a | 2 | 4 | 7 | 2 | 1 | 0 | 3 | 1 |
| AZX112 | Xaltocan-1b | 2 | 3 | 6 | 3 | 0 | 0 | 1 | 0 |
| AZX148 | Xaltocan-1b | 5 | 3 | 6 | 4 | 1 | 0 | 1 | 1 |
| AZX162 | Xaltocan-1b | 4 | 4 | 6 | 5 | 1 | 0 | 2 | 1 |
| AZX163 | Xaltocan-1b | 2 | 4 | 4 | 3 | 1 | 0 | 3 | 1 |
| AZX144 | Xaltocan-1b | 2 | 5 | 5 | 4 | 0 | 0 | 2 | 1 |
| AZX145 | Xaltocan-1b | 3 | 3 | 5 | 2 | 1 | 0 | 2 | 2 |
| NO NO. 1 | Xaltocan-1b | 2 | 3 | 4 | 5 | 1 | 0 | 2 | 1 |
| NO NO. 2 | Xaltocan-1b | 2 | 3 | 5 | 3 | 2 | 0 | 2 | 0 |
| AZX133 | Xaltocan-2 | 3 | 3 | 6 | 1 | 0 | 0 | 4 | 0 |

Table 5. (continued)

| Artifact | Location | AMPHIBOLE | | | MICA | | UNCOMMON IGNEOUS | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Actinolite | Hornblende | Tremolite | Biotite | Muscovite | Quartz | Fluorite | Olivine |
| AZX111 | Tenochtitlan | 0 | 0 | 0 | 4 | 9 | 4 | 0 | 0 |
| AZX153 | Teotihuacan Valley (Teo-Core) | 0 | 0 | 0 | 0 | 6 | 10 | 0 | 0 |
| AZX160 | Teotihuacan Valley (Teo-Core) | 0 | 0 | 0 | 2 | 6 | 9 | 0 | 0 |
| AZX122 | Xaltocan-1a | 0 | 0 | 0 | 5 | 5 | 7 | 0 | 0 |
| AZX112 | Xaltocan-1b | 0 | 0 | 0 | 3 | 4 | 8 | 0 | 0 |
| AZX148 | Xaltocan-1b | 0 | 0 | 0 | 2 | 4 | 12 | 0 | 0 |
| AZX162 | Xaltocan-1b | 0 | 0 | 0 | 3 | 4 | 9 | 0 | 0 |
| AZX163 | Xaltocan-1b | 0 | 0 | 0 | 4 | 5 | 8 | 0 | 0 |
| AZX144 | Xaltocan-1b | 0 | 0 | 0 | 2 | 4 | 11 | 0 | 0 |
| AZX145 | Xaltocan-1b | 0 | 0 | 0 | 2 | 1 | 9 | 0 | 0 |
| NO NO. 1 | Xaltocan-1b | 0 | 0 | 0 | 4 | 5 | 9 | 0 | 0 |
| NO NO. 2 | Xaltocan-1b | 0 | 0 | 0 | 3 | 4 | 12 | 0 | 0 |
| AZX133 | Xaltocan-2 | 0 | 0 | 0 | 2 | 5 | 8 | 0 | 0 |

Table 5. (continued)

| Artifact | Location | ORGANICS | | | Clay/Soil | Calcite | Ostracod | Grog |
|---|---|---|---|---|---|---|---|---|
| | | Carbon | Roots | Phytolith | | | | |
| AZX111 | Tenochtitlan | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| AZX153 | Teotihuacan Valley (Teo-Core) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX160 | Teotihuacan Valley (Teo-Core) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX122 | Xaltocan-1a | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX112 | Xaltocan-1b | 1 | 0 | 0 | 0 | 0 | 2 | 0 |
| AZX148 | Xaltocan-1b | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX162 | Xaltocan-1b | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| AZX163 | Xaltocan-1b | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX144 | Xaltocan-1b | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| AZX145 | Xaltocan-1b | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| NO NO. 1 | Xaltocan-1b | 2 | 0 | 0 | 0 | 0 | 2 | 0 |
| NO NO. 2 | Xaltocan-1b | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| AZX133 | Xaltocan-2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 5. (continued)

| Artifact | Location | Opaque | Other | Clay | Voids | Hematite Clay Nodule |
|---|---|---|---|---|---|---|
| AZX111 | Tenochtitlan | 7 | 0 | 153 | 3 | 3 |
| AZX153 | Teotihuacan Valley (Teo-Core) | 6 | 0 | 164 | 6 | 0 |
| AZX160 | Teotihuacan Valley (Teo-Core) | 5 | 0 | 158 | 8 | 1 |
| AZX122 | Xaltocan-1a | 4 | 0 | 152 | 8 | 1 |
| AZX112 | Xaltocan-1b | 3 | 0 | 157 | 14 | 0 |
| AZX148 | Xaltocan-1b | 2 | 1 | 150 | 8 | 0 |
| AZX162 | Xaltocan-1b | 2 | 0 | 153 | 6 | 1 |
| AZX163 | Xaltocan-1b | 4 | 1 | 157 | 8 | 1 |
| AZX144 | Xaltocan-1b | 3 | 0 | 164 | 10 | 0 |
| AZX145 | Xaltocan-1b | 3 | 0 | 162 | 15 | 1 |
| NO NO. 1 | Xaltocan-1b | 3 | 0 | 151 | 6 | 1 |
| NO NO. 2 | Xaltocan-1b | 3 | 0 | 135 | 9 | 0 |
| AZX133 | Xaltocan-2 | 5 | 0 | 156 | 7 | 6 |

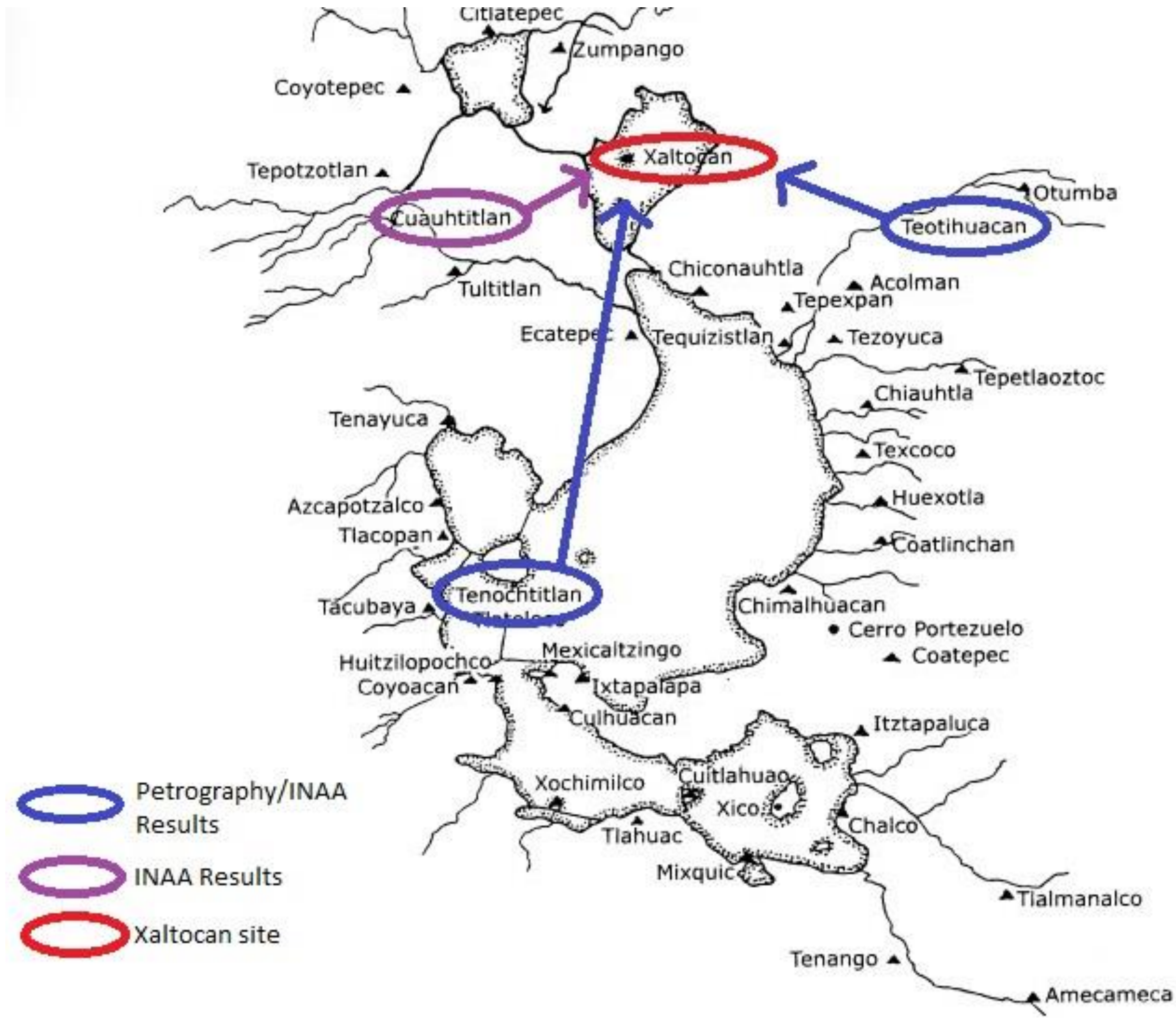


Figure 1: Map of the Basin of Mexico with Xaltocan circled in red. The sites circled in blue are the locations that were identified using both petrography and INAA. The one circled in purple was identified using INAA. Other locations are the southern basin in general and from within Xaltocan. Base map from Nichols (2002) article.

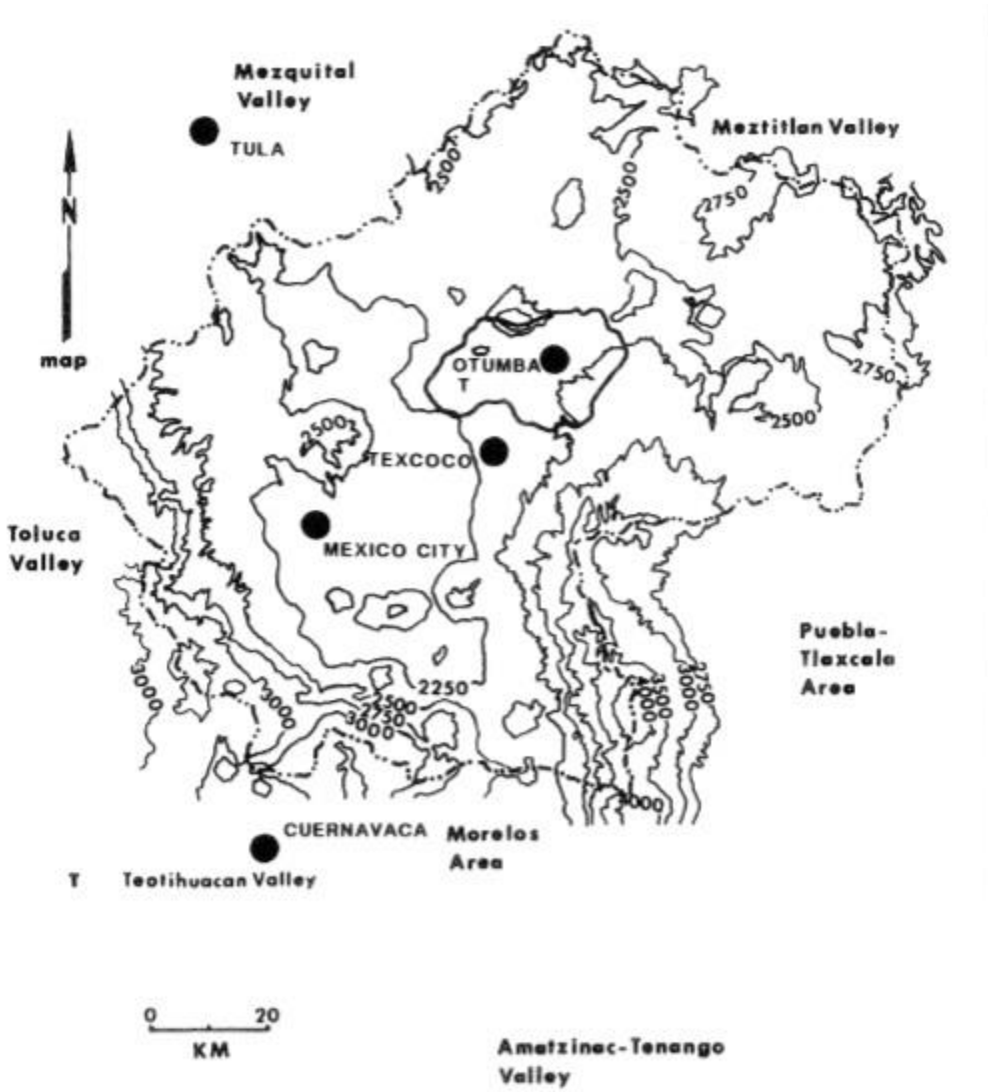


Figure 2: Central Highland map (Charlton et al., 1991)

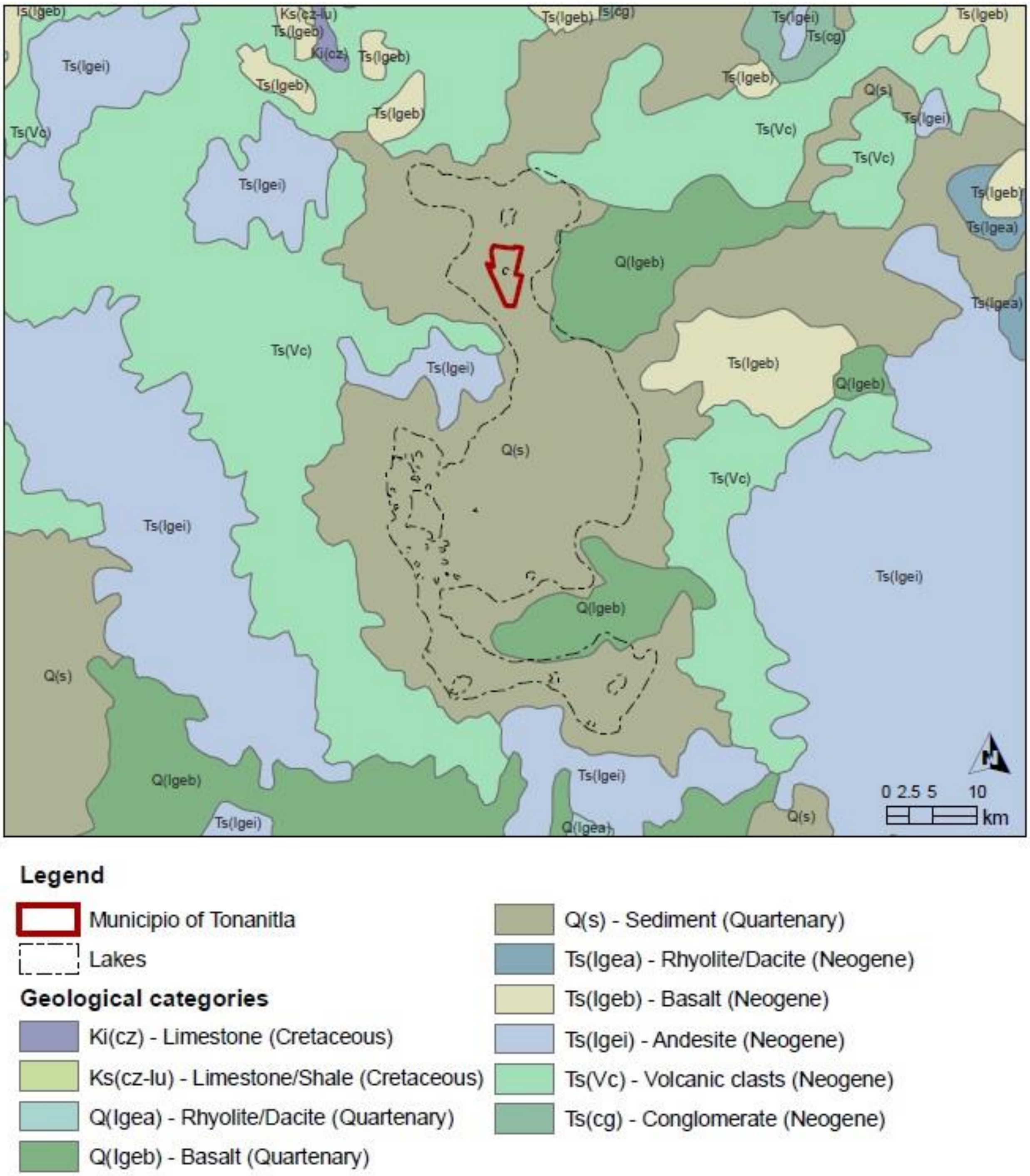


Figure 3: Geological map of the Basin of Mexico. Map from Millhauser's 2012 dissertation.

Image 1: View towards the Mountains from Xaltocan, Mexico, this area was filled with water during ancient times.


Image 2: Curated Figurine AZX152


Image 3: Mud Men and Women Figurine AZX071


Image 4: Flat-Backed Figurine AZX134


Image 5: Rattle Figurine AZX108


Image 6: Animal Figurine AZX072


Image 7: Mazapan Figurine AZX139