The Oaxaca Valley, located in the state of Oaxaca in Southern Mexico, was the site of the Zapotec civilization and its now famous capital, Monte Albán. This site, with political, military, and economic influence and control, helped to consolidate the three arms of the Oaxaca Valley, resulting in a state-level polity which lasted for over 1,000 years, from ca. 500 B.C. all the way to ca. 850 A.D. At the close of the Late Classic period, however, the state seemingly dissolved and the main site shrank from a peak population of 24,000-25,000, down to just a few thousand people.

The reasons for this dissolution remain unknown, but it has been hypothesized by researchers that the growth of regional centers of elite power caused the state to fracture and lose authority. This study evaluates the possible economic independence of one regional center, Jalieza, Oaxaca. Sitting 20 km to the southeast of the central seat of Monte Albán, Jalieza had grown into a community of 16,000 people by the Late Classic period, and was the second largest community in the valley. Using a combination of trace element analysis of pottery and the geographic science of GIS, I examine the question of whether the Jaliezans were becoming economically independent from the capital of Monte Albán.
In order to evaluate this hypothesis, I first developed a GIS model to identify the most likely trade partners for Jalieza. I began by modeling the landscape in terms of effort expended (travel time), and then compared a number of trade routes from Jalieza to other important Late Classic sites, showing which of these routes would be most cost efficient. Lastly, I discuss the possibility of a specific trade route, called the Camino Antiguo, that may have allowed the Late Classic Jaliezans to avoid trade with Monte Albán while connecting them to important Late Classic sites in the Tlacolula sub-valley. Using a gravity model, I then addressed which sites and routes would be preferred. The results of this model set a baseline, by predicting economic interaction along least cost paths.

This predictive model was then compared to the perspective of ceramic exchange. In order to do this, a total of 245 ceramic objects were sampled from three contexts dating to Late Classic Jalieza. These contexts include two houses, situated along the Camino Antiguo, as well as more generalized surface sample. All of these ceramics were analyzed for their trace-element composition via INAA and matched with known clay signatures for various parts of the valley showing with whom Jalieza was trading during the Late Classic.

The results of the least cost path analysis and the gravity model analysis predict that the Late Classic Jaliezans would have traded with places that are 1) large population centers, 2) relatively close to Jalieza, and/or 3) along energy efficient travel routes. Specifically, the model indicate that Jalieza should have been trading with the main site of Monte Albán. However, the results of the INAA study show this to be not true. Jalieza had little in the way of ceramic exchange interactions with Monte Albán, and in contrast was trading with areas that would appear to be costlier in terms of travel time and energy expenditure.
By combining these analytical techniques, the study suggests that Jalieza was indeed moving away from the control and administration of Monte Albán by this Late Classic period. This study thus provides new data on the Late Classic economy and political environment of the Valley of Oaxaca, and new insights into the conditions surrounding the decline of the Zapotec state.
Pottery, Politics, and Trade Routes: Evaluating Independence of Late Classic Jalieza, Oaxaca

by
Sarah T. Walker

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Arts

Presented March 15, 2016
Commencement June 2016

APPROVED:

Major Professor, representing Applied Anthropology

Director of the School of Language, Culture, and Society

Dean of the Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Sarah T. Walker, Author
ACKNOWLEDGEMENTS

The author expresses sincere appreciation to the people of Mexico and INAH, as well as the city of Oaxaca who were so gracious in helping me to learn about this amazing culture. Thank you particularly to Cira Martinez Lopez, Dr. Marcus Winter, Dr. Robert Markens, and all the people at Cuilapan, as well as Ted and Edvard Acres of Oaxaca, Mexico. I also wish to thank Dr. Christina Elson and Dr. Luca Casparis for allowing me to use their work in my thesis. Lastly, I want to thank Dr. Leah Minc without whose tireless effort and patience helped me to understand the complex ideas behind these cultures and without whom this Master’s thesis would not have been possible. With her kindness and constant support, I have become part of a larger study which holds great importance for me and for the study of archaeology as a whole. Next I want to thank Dr. David Brauner, S. Marc Meyers, Dr. Rosenberger, and Dr. Knowles for being on my committee and supporting my research. Additionally, the anthropology department at Oregon State University, the OSU Radiation Center, and the OSU Geography department have been places of great learning and help in the years I was there researching this thesis. Without all of you and the support of my family and friends, especially Barbara Walker, James Sherman Jr., Deward Walker, Jeremias Pink, and Kaitlin Yanchar, I would not have completed this. Thank you as well to the National Science Foundation (NSF) for supporting the discovery and study of ancient civilizations as without your financial support, this project would not have come to fruition. Like all science, this thesis is a result of all of the work of multiple people, not just my work, and I sincerely thank everyone for their help and support in this project.

Funding for this Project was provided in part by an NSF award 1005945 (“Support of Coordinated Regional Trace-Element Studies at the OSU-RC”) to PI Leah Minc.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter 1. The Valley of Oaxaca and the Zapotec</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>1.2 A Brief Geography and History of the Valley of Oaxaca</td>
<td>2</td>
</tr>
<tr>
<td>1.3 Mesoamerican Chronology</td>
<td>6</td>
</tr>
<tr>
<td>1.4 Beginnings of the Zapotec State</td>
<td>7</td>
</tr>
<tr>
<td>1.5 Surrounding Settlements of the Zapotec</td>
<td>15</td>
</tr>
<tr>
<td>1.6 Goals of Present Study</td>
<td>18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 2. Developing a Predictive Trade Model</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Introduction</td>
<td>21</td>
</tr>
<tr>
<td>2.2 Geographic Information Sciences/Systems</td>
<td>24</td>
</tr>
<tr>
<td>2.3 GIS Goals</td>
<td>25</td>
</tr>
<tr>
<td>2.4 GIS Methodology: Developing a Predictive Model</td>
<td>27</td>
</tr>
<tr>
<td>2.5 Tobler’s Analysis Results</td>
<td>37</td>
</tr>
<tr>
<td>2.6 Gravity Model</td>
<td>39</td>
</tr>
<tr>
<td>Chapter 3. Xoo Phase (Late Classic) Jalieza</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>3.1 History of Investigations</td>
<td>45</td>
</tr>
<tr>
<td>3.2 Size and Significance of Jalieza</td>
<td>45</td>
</tr>
<tr>
<td>3.3 The Sample Site Context</td>
<td>47</td>
</tr>
<tr>
<td>3.4 Structure 7</td>
<td>49</td>
</tr>
<tr>
<td>3.5 Structure 2</td>
<td>55</td>
</tr>
<tr>
<td>3.6 The Surface Sample: Context and Sample</td>
<td>60</td>
</tr>
<tr>
<td>3.7 Interpretations for Structures 2 and 7</td>
<td>62</td>
</tr>
<tr>
<td>3.8 Pottery Types and Forms in Late Classic Jalieza</td>
<td>67</td>
</tr>
<tr>
<td>3.9 Statistical Evaluation of Ceramic Frequencies</td>
<td>71</td>
</tr>
<tr>
<td>3.10 Figurines</td>
<td>77</td>
</tr>
<tr>
<td>3.11 Summary</td>
<td>78</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 4. INAA Processing of Artifacts and Geochemical Groups of the Valley of Oaxaca</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Introduction: Selection of Ceramic Samples</td>
<td>79</td>
</tr>
<tr>
<td>4.2 Documentation and Sampling</td>
<td>80</td>
</tr>
<tr>
<td>4.3 Preparation of Samples for Trace Element Analysis</td>
<td>80</td>
</tr>
<tr>
<td>4.4 Sample Preparation for INAA</td>
<td>81</td>
</tr>
<tr>
<td>4.5 Irradiation Protocols</td>
<td>81</td>
</tr>
<tr>
<td>4.6 Establishing Ceramic Provenance</td>
<td>82</td>
</tr>
<tr>
<td>4.7 Statistical Analysis of the Trace-element Data</td>
<td>84</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>4.8 Geochemical Groups pf the Oaxaca Valley</td>
<td>85</td>
</tr>
<tr>
<td>4.9 Geochemical Groups represented at Late Classic Jalieza</td>
<td>90</td>
</tr>
<tr>
<td>Chapter 5. Conclusions</td>
<td>93</td>
</tr>
<tr>
<td>5.1 Conclusion and Discussions</td>
<td>93</td>
</tr>
<tr>
<td>5.2 Summary and Evidence of Pottery Exchange</td>
<td>93</td>
</tr>
<tr>
<td>5.3 Pottery Imports Relative to Least Cost Predictions</td>
<td>97</td>
</tr>
<tr>
<td>5.4 BR Coefficient by Travel Time to Sites</td>
<td>99</td>
</tr>
<tr>
<td>5.5 Jaliezan Exports</td>
<td>100</td>
</tr>
<tr>
<td>5.6 Summary</td>
<td>101</td>
</tr>
<tr>
<td>5.7 Further Research</td>
<td>102</td>
</tr>
<tr>
<td>Bibliography</td>
<td>103</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Locator Map of Oaxaca Valley</td>
<td>2</td>
</tr>
<tr>
<td>1.2 Modern Oaxaca Valley Map</td>
<td>4</td>
</tr>
<tr>
<td>1.3 Late Classic Sites of the Oaxaca Valley</td>
<td>18</td>
</tr>
<tr>
<td>2.1 Photo of Camino Antiguo Hypothetical Path</td>
<td>26</td>
</tr>
<tr>
<td>2.2 Elevation Map of Oaxaca Valley</td>
<td>29</td>
</tr>
<tr>
<td>2.3 Tobler’s Hiking Function Equation</td>
<td>33</td>
</tr>
<tr>
<td>2.4 Slope Map</td>
<td>34</td>
</tr>
<tr>
<td>2.5 Least Cost Path Map: Isochronic Map of Anisotropic Surface</td>
<td>38</td>
</tr>
<tr>
<td>2.6 Gravity Model Equation</td>
<td>41</td>
</tr>
<tr>
<td>2.7 Gravity Model Prediction Graph</td>
<td>43</td>
</tr>
<tr>
<td>3.1 Location of Structure 2 and 7</td>
<td>50</td>
</tr>
<tr>
<td>3.2 Plan of Structure 7</td>
<td>51</td>
</tr>
<tr>
<td>3.3 Plan of Structure 2</td>
<td>57</td>
</tr>
<tr>
<td>3.4 Surface Survey Map</td>
<td>61</td>
</tr>
<tr>
<td>3.5 Paste by Provenience</td>
<td>72</td>
</tr>
<tr>
<td>3.6 Relative frequency of Type by Structure</td>
<td>75</td>
</tr>
<tr>
<td>4.1 Figure of Provenance Results</td>
<td>91</td>
</tr>
<tr>
<td>5.1 BR Coefficient equation</td>
<td>9</td>
</tr>
<tr>
<td>Figure</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>5.2 B-R Coefficient for Each Site showing Similarity to Jalieza</td>
<td>98</td>
</tr>
<tr>
<td>5.3 Bivariate of BR Coefficient by Travel Time in Hours</td>
<td>100</td>
</tr>
<tr>
<td>5.4 BR Coefficient by ‘Pull’ or Gravitational Effect</td>
<td>101</td>
</tr>
</tbody>
</table>
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Mesoamerican Chronology</td>
<td>6</td>
</tr>
<tr>
<td>2.1 Tobler’s Analysis Results</td>
<td>39</td>
</tr>
<tr>
<td>2.2 Gravity Model Results</td>
<td>42</td>
</tr>
<tr>
<td>3.1 Structure 7: Vessel Type and Paste Type</td>
<td>54</td>
</tr>
<tr>
<td>3.2 Structure 2 Assemblage Sampled for INAA</td>
<td>60</td>
</tr>
<tr>
<td>3.3 Rank of Trade Partners</td>
<td>63</td>
</tr>
<tr>
<td>3.4 Paste by Provenience Chi Square</td>
<td>73</td>
</tr>
<tr>
<td>3.5 Provenience by Form Chi Square</td>
<td>77</td>
</tr>
<tr>
<td>5.1 Provenance Results with ‘Pull’ and Travel Times</td>
<td>95</td>
</tr>
</tbody>
</table>
Chapter 1. The Valley of Oaxaca and the Zapotec

1.1 Introduction

In 1931, the excavation began on one of the largest and most important Mesoamerican sites of Monte Albán. The excavation, overseen by Alfonso Caso, Jorge Acosta, and Ignacio Bernal, was one in which no one could have predicted that their work would help place Oaxaca squarely upon the map of Mexican, and indeed worldwide, archaeology. With its rich artifact assemblage including elaborate gold jewelry, evidence of kilns for pottery production, stone elite tombs and immense pyramidal structures that served both civic and ceremonial functions, this site offered insight into the development and decline of the Zapotec state which had built it.

As more study was done, the site of Monte Albán was affirmed to be the central locale for the government of the “Zapotec”, or in Nahuatl the “Tzapotēcah”. However, these people called themselves the “Be’ena’a” which in Zapotec means simply “The People” (Marcus and Flannery 1996; Gary and Linda Feinman 2002; Sherman and Balkansky 2009: Whitecotton 1977). For this paper, however, I will use the more current and commonly used name of “The Zapotec” to refer to these people who developed one of the first sedentary state-level societies in the Americas. Monte Albán, the central seat for the Oaxaca state, like other large settlements of the Zapotec elite was described as “primarily (a) center(s) of political and religious authority that produced relations of dominance and dependence among the people of the urban center and their hinterlands” (Joyce 2011: 119). However, before I discuss the Zapotec state, it is necessary to discuss where this site is and the geography in which this society grew.
1.2 A Brief Geography and History of the Valley of Oaxaca

The site of Monte Albán is described by Mesoamerican scholars as “the largest archaeological site of the Classic period in the southern Mesoamerican highlands” (Winter 1974: 981). This site is located in the central valleys or *Valles Centrales* of the state of Oaxaca, which sit at an average elevation of 1500 meters above sea level at the Valley Floor, with Monte Albán sitting well above (Kowaleski 2003; Blanton *et al.* 1982). This makes this site both beautiful and geologically rugose with mountains.

**Figure 1.1 Locator Map for Oaxaca Valley**

*Base map courtesy of ESRI*
surrounding an alluvial valley. If one stands at the top where much of the pyramidal architecture still stands at Monte Albán, it is possible to see the whole of the Valley of Oaxaca.
Oaxaca stretched below, making it a very advantageous spot to keep an eye on the valley. Additionally, the southern border of the state of Oaxaca is placed along the Pacific Ocean, fortunate geographically as this locale was a rich location for shell, a product desired by elites during the Zapotec state and later (Barber and White 2011). To the North is the state of Puebla, while the modern state of Guerrero sits to the northwest, Vera Cruz lies to the east, with Chiapas sitting to the south of the state.

This mountainous region of Oaxaca has the Sierra Madre mountains running along the length of the entire state, north to south. This main mountain ridge is then divided into the Sierra de Juarez and the Sierra de Oaxaca. The geological diversity is clearly visible to anyone who visits Oaxaca. With dark, rich, and rocky soil sprinkled across the rugged landscape one can see clearly the geologically diverse pattern with the alternating light tan soils which fade into a reddish soil and then alternate back again within a short 200 feet area to the original dark loams and sometimes other soil types. This geology has been described as being comprised of “three major geological complexes (Precambrian metamorphic rocks, Cretaceous limestones, and Miocene volcanic tuffs or ignimbrites)” with distinctive mineral associations (Minc and Sherman 2011: 286).

The mountainous area frames an alluvial valley often described as having a Y shaped form. This Y-shape is divided into three regions or sub-valleys, with the Etla Valley in the Northwest, the Tlacolula in the Eastern part of the Y, and with the Valle Grande/Zimatlán sitting to the south (Marcus and Flannery 1996: 11). This Y shape was
carved out over time by the erosive action of the aforementioned Atoyac River which flows to the south as well as the actions of the Río Salado River (Mine and Sherman 2011; Marcus and Flannery 1996).

**Table 1.1 Mesoamerican Chronology**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1300 B.C. 1100 B.C.</td>
<td>Early Formative</td>
<td>Tierras Largas</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1100 B.C.</td>
<td>Early Formative</td>
<td>San José</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>900 B.C.</td>
<td>Middle Formative</td>
<td>Guadalupe</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>700 B.C.</td>
<td></td>
<td>Rosario</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>500 B.C.</td>
<td></td>
<td>Daniban</td>
<td><strong>Monte Albán Ia</strong></td>
<td>Early Monte Albán I</td>
<td></td>
</tr>
<tr>
<td>300 -100 B.C.</td>
<td>Late Formative</td>
<td>Pe</td>
<td><strong>Monte Albán Ic</strong></td>
<td>Late MA I</td>
<td>X</td>
</tr>
<tr>
<td>100 B.C. – 200 A.D.</td>
<td>Terminal Formative</td>
<td>Nisa</td>
<td><strong>Monte Albán II</strong></td>
<td>Monte Albán II</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tani</td>
<td><strong>Transición from II to IIIA</strong></td>
<td>Monte Albán II</td>
<td></td>
</tr>
<tr>
<td>200 A.D.</td>
<td>Early Classic</td>
<td>Pitao</td>
<td><strong>MA IIIA</strong></td>
<td>Monte Albán IIIA</td>
<td>Monte Albán IIIA</td>
</tr>
<tr>
<td>500 A.D.</td>
<td><strong>Late Classic</strong></td>
<td>Peche</td>
<td><strong>MA IIIA-MA IIIB Transición MA IIIB/IV</strong></td>
<td><strong>Monte Albán IIIB Cont.</strong></td>
<td>Early MA IIIB-IV</td>
</tr>
<tr>
<td>800 A.D.</td>
<td></td>
<td>Xoo(500-800A.D.)</td>
<td></td>
<td></td>
<td>Late MA IIIB-IV</td>
</tr>
<tr>
<td>1000 A.D.</td>
<td>Early Post Classic (starts at 850 A.D.)</td>
<td>Early Liobaa</td>
<td><strong>MA V</strong></td>
<td>Monte Albán V</td>
<td>Early MA V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Late Liobaa</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Valley of Oaxaca is then divided into three geomorphologic zones which are comprised of the alluvial zone, made up of the flattest part of the valley that includes the river and the eroded alluvial areas, a piedmont zone, which is the transitory zone which slopes from the lower valley floor and then segues into the highland mountain zone which surrounds the valley like a wall. This third zone, the mountain zone, has some elevations reaching 3000 meters above sea level. The alluvial and piedmont zones are where much of the Zapotec habitation eventually occurred, with terraces cut into the slopes to create residential areas.

1.3 Mesoamerican Chronology

The long and complex history of occupation in the valley is divided into the phases outlined in Table 1.1. To help clarify the various phases, I have tabulated all the various names each time period can go by. The ceramic phases defined by Caso et al. (1967) for Monte Albán start with Monte Albán I (hereafter MA I) corresponding to the Middle Formative period of Mesoamerica. MA I is based upon distinctive pottery types which were then used as archaeological markers of specific time periods within the valley. Subsequently, ceramic phases pre-dating the founding of Monte Albán were encountered, and the applicability of the Monte Albán sequence for the valley as a whole was challenged, leading to the adoption of a new series of phase names. For instance, the Late Classic period is now called the Xoo Phase (Lind 1994) but is also the same as Caso et al.’s (1967) Monte Albán IIIB/IV.

The periods shown above help to quantify the changes within the Zapotec state from their early chiefdoms at locations such as San José Mogote (Marcus and Flannery 1996), to the later state level society dominated by elites at the site of Monte Albán.
1.4 The Beginning of the Zapotec State

In the 1970s, a settlement survey of the Valley of Oaxaca was initiated by Blanton, Kowalewski, Feinman, and Appel (1982). This survey was undertaken to “better understand the nature of human adaptation and cultural evaluation in pre-Hispanic Valley of Oaxaca (Balkansky et al. 1989:1). In this study, the settlement distribution of the ancient Zapotec society was shown by using pottery distributions combined with the evaluation of remaining mounds or structures, which resulted in a fairly good estimation of the Oaxaca Valley’s population through time.

The evolution of the Zapotec state was also shown through the study of such early settlements like San José Mogote which was the largest settlement during the Early Formative period prior to the Zapotec state. This site, which lasted from approximately 1400 B.C, until approximately 500 B.C. (Coe 1996), started as a small settlement of wattle and daub structures, and slowly emerged as a chiefdom with power over as many as 40 satellite settlements under its influence (Marcus and Flannery 1996:103). With the substantial number of structures and the chiefdom level society, it is thought to have been the precursor to the Zapotec state and San José Mogote is also the locale where the first signs of both hereditary inequality and an apparent elite class first show in the archaeological record for Oaxaca, seen as an important moment of change for the development of the later state.

Along with the site of San José Mogote, two other settlements grew up at the end of the Middle Formative Rosario Phase (Marcus and Flannery 1996) with similar populations and social structure. These two settlements, one of which is located in the
Tlacolula sub-valley to the east at Yegüih, while the other is located down in the south in the Valle Grande area at Tilcajete (Marcus and Flannery 1996; Finsten 1995; Spencer and Redmond 2004b) are hypothesized to have been competing chiefdoms with each other and San José Mogote in the north. These three chiefdoms may have been in a contentious relationship that had resulted in a sort of buffer zone between each of them, approximately 20 km in extent which served as a “no man’s land” (Blanton 1982; Marcus and Flannery 1996; Finsten 1995).

After a long growth period at the northern site of San José Mogote, things began to alter during the Middle Formative, in the very early MA I, 500-250 B.C. The reasons behind the changes are still poorly understood but it appears that the Zapotec people of San José Mogote moved from their original site to the new site of Monte Albán about 20 km to the southeast in the period, “sometime after 500 B.C., [which is] the accepted date for the founding of Monte Albán” (O’Brien and Lewarch 1992: 264). Here, the people of San José Mogote founded the capital of the Zapotec state which was marked by “a) the emergence of a four-tier regional settlement-size hierarchy; b) the appearance of royal palaces and specialized temples; and c) the conquest/subjugation of distant territories” (Spencer and Redmond 2004c: 176).

The move to Monte Albán appears to have been politically motivated, as well as motivated by a possible need for protection from incursions from these other chiefdoms within the other arms of the Oaxaca Valley which were ruled over by the elites of each locale (Balkansky 2002: Spencer and Redmond 2008a). However, the reasons for the move are still not fully known.
By Late MA I, ca. 300 - 100 B.C., Monte Albán had grown from approximately 5,000 people all the way to 17,000 people (Blanton et al. 1992:75). Although the site of Monte Albán was slowly amassing a large population and power as well, the other two chiefly sites in the other arms of the valley, Tilcajete, and Yegüih, had not yet joined the fold.

Instead, during this early period Monte Albán’s elites focused on more distant territories such as Cuicatlán Cañada. This area, located to the north of the valley, was surveyed and then excavated by Charles Spencer and Elsa Redmond (1997d) who argued that the evidence for early military conquest by the Zapotec elite of Monte Albán was clearly shown by the alterations in how the region was settled. This interpretation was supported by multiple discoveries such as the placement of a military presence along a pass which had originally connected the two cultures, as well as evidence for physical violence and construction of a skull rack. The work of Spencer and Redmond helps to show that during late MA I and into the early MA II period, the elites were attempting to expand their influence through “ambitious strategies of territorial expansion, including the conquest and long-term holding of distant territories” (Spencer and Redmond 2004c: 174).

Further, there appears to be a physical reminder of this site’s apparent takeover along with others in the conquest slabs called Los Danzantes, or “The Dancers”, which originally made up a wall that recorded the subjugation of outer settlements by Monte Albán (Winter 2011). These have been dated to early MA I, although they were probably in use after that (Spencer and Redmond 2004c). Once deciphered by Marcus (1976), these stone slabs were shown to depict and record great violence such as in the conquest of the Cuicatlán Cañada area of Tehuacán. This site is one among many that are thought
to have fallen under Monte Albán’s rule during the late MA I phase; other locales with evidence of Monte Albán’s expansionism include “Ejutla (Feinman and Nicholas 1990), Peñoles (Finsten 1996), Miahuatlán, and perhaps the San Francisco Arriba area (Marcus and Flannery 1996: 201–2)” (Spencer and Redmond 2004b: 184).

By MA II, approximately 100 B.C. to A.D. 200, the site of Monte Albán finally succeeded in consolidating the whole valley after three centuries of trying to bring all the settlements under its influence. With this consolidation, we see a move by the valley’s population from the piedmont zones back to the floor of the valley (Marcus and Flannery 1996: 165). This may indicate a cessation of the earlier warfare (Spencer and Redmond 1997; Spencer and Redmond 2004b; Blanton et al. 1979). Lastly, MA II is seen as period of relative peace and growth for the Zapotec people of Oaxaca when compared to MA I.

The Early Classic, or MA IIIA period, is considered the Golden Age of Zapotec civilization. During this period “we see much more evidence of regional integration on all levels” (Balkansky 1983: 232). This is reflected in such material records as indications of greater involvement in the economy in this period by the elite of Monte Albán. This MA IIIA period also marks the point when Caso and Bernal’s ceramic assemblage “diverged from other Mesoamerican styles to become a ceramic isolate” (Blanton et al. 1982: 213). This change in pottery has been interpreted as either a reaction to Teotihuacan’s expansion in the north or perhaps that the Zapotec had finally created a solid state-level society with standardized pottery production.

The size of the population in the valley also grew in this period by thousands of people; “The Monte Alban IIIa system was much larger than that of any previous phase. Between Period MA II and MA IIIa, it grew by some 75,000 people, over 550 sites”
All of these changes show that this period was a rich and thriving period with a standardized type of pottery common in the valley, that of the Gris (gray) ware pottery, as well as increasing population.

Changes in possible elite control may have been occurring as indicated by a change in MA IIIA in the sorts of topics being represented in stone slabs (Marcus 1983). In contrast to the earlier MA I Danzantes in which military themes dominate, by MA IIIA, there appears to be a focus instead on local elite marriage (Marcus 1983: 143). In addition, the local elite lineages in smaller settlements may have been increasing their attempts at independence from Monte Albán by establishing their own elite lineages, reinforced by stone depictions, although there is a need for greater study into this possibility. If local elites were attempting to become more legitimate through this behavior, it could strengthen the idea that the beginning of small lines of fracture in the rock that had been the Zapotec state were spreading, soon to dismantle the whole.

The stage was set for the start of the Late Classic Period, also called the Xoo Phase (Lind 1994) and Caso et al.’s (1967) Monte Albán IIIB/IV. However, there has been some controversy about these periods as originally MA IIIB/IV were thought to have occurred sequentially, one after the other, with MA IIIB representing the Late Classic and MA IV representing the early Post Classic phase.

This pottery chronology, which defined MA IIIB and MA IV pottery types as from different periods by Caso et al. (1967), was based on pottery types which are infamously difficult to tell apart and have made distinguishing the difference between the phases at a site using this typology somewhat difficult to do unless one is extremely knowledgeable
of the pottery types of this area. Because of this difficulty, the phase became known as MA IIIB/IV by archaeologists and researchers studying Oaxaca.

In contrast, with the settlement surveys of the Settlement Pattern Project (Blanton et al. 1977), the researchers who took part felt there was a clear need for greater precision in the phase assignments and therefore MA IIIB and MA IV were identified more clearly as separate phases by incorporating specific types of phase markers based on pottery from the site of Lambityeco. This was because pottery from Lambityeco was initially believed to have been in existence after the end of the Zapotec state, as delineated by the abandonment of Monte Albán, thus allowing the pottery to be labeled as either MA IIIB or MA IV, further clarifying the muddy situation.

In a paper by Winter (1989) this subject is addressed again and along with research by Martinez-Lopez and colleagues (2000), Dr. Winter was able to show that the ceramic markers used to divide the two pottery categories of MA IIIB and MA IV into separate phases were in fact based upon pottery which is coterminous. The use of radiocarbon dating techniques revealed that the Lambityeco pottery had been made before Monte Albán fell thus, solidly defeating the notion that MA IIIB and MA IV were separate and sequential phases of pottery typology. Hence, the phases MA IIIB and IV are now considered coterminous, and called MA IIIB/IV. With the combining of the two phases, which are both pre Post-Classic, it was proposed by Markens (2008) that the use of the term Xoo Phase should become more commonly used. This phase was originally suggested by Lind (1991) and applies to a ceramic phase which occurred from 500 to 800 A.D. (Hanson 2002). This has helped to clarify these confusing and closely similar pottery phases.
The Xoo phase displays “the last time of major building before the abandonment of Monte Albán” (Winter 1974: 981). According to Blanton et al. (1982:262), “Monument building at Monte Albán may show that the elites were attempting to retain their hold and their power over the region as the apparent dissolution increased with populations moving away from the central seat site Monte Alban's primacy in public architecture”; thus the building of monuments stands out in IIIB more than in any other phase. Hence with the building of this monumental architecture in IIIB, the large structures built at Monte Albán by the elite would have had great visibility to the surrounding communities. This may have helped the elite to reinforce their dwindling power, showing their site’s grandeur to the straggling people who may have been leaning towards their own community’s elite lineages as leaders.

In the MA IIIB phase, “the trend toward rural abandonment, coupled with population concentration at Monte Albán, was reversed” indicated by the fact that “roughly one third of the IIIb population in areas intensely surveyed did not live at the Monte Albán site” (Flannery and Marcus 1983a:188). Finsten describes this change as “decentralization (which) is apparent in the decline of Monte Albán, the regional capital for 1200 years prior to A.D. 700, which was followed by the emergence of a settlement hierarchy lacking a well-defined pyramidal structure or central focus” (Finsten 1995: 2).

Balkansky (1998) has argued that three important changes mark this period of dissolution and show that the elites were losing control over the territory by MA IIIB. These changes include 1) little population in areas which surround these smaller settlements, a sort of ‘no man’s land’ area perhaps indicative of a growing turmoil between the polities. As noted above, in the Middle Formative prior to the advent of
Monte Albán, people in the valley had avoided settling in this area as indicated by population surveys using sherds and mound volume. The possibility that by MA IIIB, the Late Classic period people were again choosing to not settle in this ‘no man’s land’ could indicate an increasing atmosphere of tension and could be related to the Zapotec state dissolving.

Additionally, Balkansky notes other changes like 2) the rise of Jalieza in population, as well the increase in population in the Tlacolula arm of the valley in the Dainzú-Macuilxóchitl-Tlacochahuaya-Guadalupe (DMTG) area; and 3) the number of people living in the piedmont areas off of the valley floor increased at this time showing that a possible threat to these settlements had returned and there was a need to move off of the less easily defensible valley floor.

Other changes which reflect the coming dissolution and the increase in attempts to control the faltering state include the apparent ‘meddling’ or ‘tampering’ with of the ceramics of the period. Scholars such as Feinman (1980, 1984) have argued that the rise of rough, easily breakable ceramics shows the attempt by the elite to standardize a market for which they were losing control and in fact, we see just this with the ceramic markers for this period being the least complex or labor intensive for any period, and showing the rough and simplistic style which was overwhelmingly most common in this MA IIIB/MA IV transition (Blanton et al. 1982:111).

By MA IV, the changes which had begun in MA IIIB/IV had somewhat solidified. Monte Albán’s population declined to a few thousand. Other sites located by the settlement survey are away from the main site of Monte Albán, further indicating the dissolution of the Zapotec state and graphically indicating the dispersal in population
resulting from the dissolution of the state. Lastly, these sites are thought to have been dominated by a series of large sites separated by excessive tracts of unused land (Blanton et al. 1982:117).

By the final phase of the Monte Albán ceramic sequence, MA V, we see the end of the Zapotec state and the eventual start of the Post-Classic period. The changes which had accumulated had now become solidified with a drastically reduced population at Monte Albán whose leaders had lost their populations to increases in rural centers, and the possible independent rise of some of these sites. The Spanish explorers who finally came upon the valley late in this MA V period, described it as a rich alluvial plain surrounded by what they considered to be “inaccessible mountains” (Blanton et al. 1983:6). The once state-level society had now become a series of independent *caziques* which were essentially a series of villages run by their own elite families. The changes which had begun in the Late Classic had now resulted in a very different landscape with even ritual behavior having altered, “by Period V there is archaeological and historical evidence that some important sacred activities had shifted to the uplands” (Blanton et al. 1983:383). This final period marks the end of a Mesoamerica free from European influence with the arrival and overall conquest that the Spanish initiated on the Oaxacan populations.

1.5 Surrounding Settlements of the Zapotec and the Decline of the Zapotec State

As noted above, in the earlier periods of Monte Albán’s growth, there were a number of smaller settlements that grew up along with and around this main site. These sites grew as the population of the valley grew and some of these sites were quite populous and important to the economy of the Zapotec during the Early Classic period and into the
Late Classic. For example, the site of Lambityeco located in the eastern arm of the valley, is an important example that shows how some of these smaller satellite settlements developed their own elite systems in this period (Lind and Urcid 2011). By the end of MA IIIb/IV, Lambityeco’s monumental architecture and administrative core appear to be similar to Monte Albán, and the site was surrounded by smaller sites which had grown up around this regional “capital” and participated in a trade network with each other.

Another important urban center during the Late Classic was the combined settlements of Dainzú, Macuilxóchitl, Tlacochuhuaya, and Guadalupe with a large population for this period in this area estimated to be 12,000 people or more (Finsten 1995); for simplicity this settlement is referred to as “DMTG” rather than using the full names of the sites as the sites were interrelated and close geographically.

Jalieza was another important Late Classic locale. By the MA IIIB/IV, around 800 A.D., Jalieza had reached population levels similar to Monte Albán’s MA II and MA IIIA population of 24,000 people with an estimated population of 16,000 (Blanton et al. 1989). Thus, although Monte Albán was still the main seat of the state, other settlements had arisen since its construction, and with its dissolution, these smaller sites appear to have been both gaining power as well as population.
Figure 1.3- Late Classic Settlement Areas of the Oaxaca Valley

Base Map courtesy of Esri. Settlement Survey border courtesy of Jeremias Pink.
In Figure 1.3, the three arms of the valley are shown as well as the locations of some of the important Late Classic settlements. Many settlements during this period were small: the majority had less than 1000 people and the sites with more than 2000 represented less than 2% of the total number of settlements (Flannery and Marcus 1983a). It is also important to mention that population estimates must be considered carefully as when the original Oaxaca Valley Surveys were done, the population of Monte Albán included not just the hilltop capital but surrounding settlements such as Atzompa, with this larger area referred to as “Greater Monte Albán” (Blanton et al. 1982:75).

1.6 Goals of the Present Study

In this thesis, I focus on the Late Classic and the changes which occurred within the valley. In particular, this study evaluates whether the Late Classic settlement of Jalieza was becoming economically independent from the capital of Monte Albán, using a combination of trace-element analysis of pottery and the geographic science of GIS.

Jalieza is an excellent archaeological opportunity to see what the Late Classic dissolution of the state meant to the many Zapotec people living outside of the closest circle of the control of Monte Albán and its powerful elites. The site of Jalieza had originally been a smaller polity of Monte Albán when it first was established in the Early Classic, but in time grew into one of the largest sites in the valley (Finsten 1995). Sitting at approximately 24 km to the southeast of Monte Albán, Jalieza also sat along an important trade route known as the ‘Camino Antiguo’ (Elson and Casparis 2010). This ancient road leads south to the Pacific Coast, while to the northeast the route leads over the pass into the Tlacolula Sub valley (Barber and White 2011). This suggests that
Jalieza could have played a role as an important and strategic trade center for the ancient Zapotecs and that this route might have influenced the Jaliezans Late Classic economy.

Hence, Jalieza offers a rare chance to observe the effects of the Monte Albán state’s dissolution on the satellite communities within the Oaxacan Valley complex, and to evaluate whether this community was trying to exert its own strength and become its own independent political and economic entity separate from the elite controlled Monte Albán. I argue that a breaking away from the economy of Monte Albán and the strengthening of Jalieza as an independent settlement would show in the production and exchange of pottery. For example, if a large proportion of Jalieza’s pottery is from Monte Albán, this would indicate that Jalieza was still in direct economic contact with Monte Albán, and perhaps economically dependent on that site. Conversely, Jalieza’s attempt at independence would be credible if none of the pottery sample from Jalieza is shown to be from Monte Albán.

This study consists of two main parts. First, I create a predictive model as to who Jalieza would be most likely to trade with depending upon distance and roughness of the terrain for a pedestrian trader who had no beasts of burden. This model considers the energetics required to move to goods to different trade locales, based upon the topography. Next, I evaluate various important Late Classic sites for their ‘gravity’, that is how much attraction or “pull” they would exert based on their population size, as larger population centers with more economic diversification and opportunity offer greater pull on potential market participants wishing to trade. By using Geographic Information Systems (GIS), I developed a series of Least Cost paths that lead from Jalieza to various settlements in the valley, and rank the destinations according to their proximity and pull.
Finally, I discuss the possibility of a specific trade route, the *Camino Antiguo* introduced above, as a possible main route to the Tlacolula sub valley. If Jalieza was trading with other locales in the eastern arm using this route as a least cost path, this would show that energy expenditure was more important to the economics of the Late Classic Jaliezans, for instance, than the political pull of Monte Albán.

Once these predictive models were developed, I next evaluate household pottery from two domestic structures from Late Classic Jalieza (Elson and Casparis 2010), along with pottery samples from surface surveys by Elson and Casparis (2010), in order to determine its geographic origin or provenance. By matching the geochemical signatures of the sherds from Jalieza with known clay signatures for various parts of the valley, it is possible to show with whom Jalieza was trading during the Late Classic and whether the people of Jalieza were manufacturing pottery within Jalieza itself.

By combining these analytical methods, the results will either provide support for Jalieza as an independent entity of the Zapotec or show that Jalieza was simply trading with whom they traded dependent upon the amount of energy necessary to travel to and from the trade site. With the final provenance information, Late Classic Jalieza’s economic activity and possible trade partners can be shown as well as the validity of the hypothesis that Jalieza was becoming economically independent, separate from Monte Albán.
Chapter 2. Developing a Predictive Trade Model for Late Classic Jalieza

2.1 Introduction

The Late Classic phase in Jalieza has been hypothesized to be a period of growing independence, breaking away from the control and/or administration of the powerful elite at Monte Albán (Blanton 1989; Finsten 1995). With this possible independence from the control of Monte Albán, trade may also reflect higher exchange or greater interaction with other areas of the valley, such as the Tlacolula sub valley to the east, thus indicating possible economic independence from Monte Albán, as well.

In order to evaluate the independence of Jalieza, and to predict effectively the trade partners of this site, the exchange systems dependent upon the ancient trade routes leading to other Late Classic sites must be shown to be possible in both time expended and energy used. Economically this means that the trade routes used must be advantageous to the people using them. This raises the question: if Jaliezans were trading with more distant locations, was this choice due to a purely economic reason? Or if it was not purely economic, were there other factors like political rivalry impacting the choice of trade partners chosen?

For instance, Human Behavioral Ecology, the theoretical premise of Optimal Forging Theory, argues that people will always try to maximize their profit from an action and at the same time minimize their loss in the form of energy expended (Moore and Keene 2014). Thus, if the result from a particular action is smaller than the gain, people are less likely to partake in that action, preferring instead to conserve energy for a situation in which they are sure to make a gain.
This theory is very pertinent to economic situations, since it suggests that people will minimize their energy expenditures in deciding where to conduct their economic transactions. Additionally, in Cultural Ecology, the theoretical premise is that cultural environments are cybernetic in nature. This theory takes into account energy expended, like optimal foraging, and this hypothesis indicates that economic behavior will adapt according to specific environmental concerns and stresses in order to maximize economic gain. This is similar to a biological organism adapting to an environment in order to maximize gene propagation, for example (Schiffer 2014).

Applying this theoretical premise to the analysis of archaeological trade routes, the theoretical trade routes associated with Jalieza must be viewed as cost effective to the participants. This means that the energy expended in traveling to other locales must be worth the trade participant’s efforts, both in actual time as well as the effort necessary to travel the trade route by foot in order to move and trade goods such as pottery. In other words, the financial gain must outweigh the effort expended to obtain or trade/sell items. If it is found, however, that trade appears to have followed routes considered more energy intensive rather than less through the results of other research methodologies such as in a trace-element analysis study or in ethno-archaeology, it becomes clear other factors must be in play to cause this behavioral compromise.

In this particular instance, if the people of Jalieza wanted to gain independence from the elite of Monte Albán, a trade route might be chosen despite its being a less cost-effective choice when compared to other possible least-cost paths. This could be the case if the most efficient routes to a desired destination went by Monte Albán which the people of Jalieza wished to avoid. Thus, the Jaliezans may have chosen an alternative
path, in order to surreptitiously trade with other parts of the Oaxaca Valley without the economic control and/or influence of the Monte Albán elites. Hence, in order to evaluate the routes that could have been used by the Jaliezans to go to various destinations within the Valley most cost effectively, an analysis must be completed whereby the travel times to potential Late Classic trade partners of Jalieza can be assessed showing the necessary effort required and time spent to complete these economic exchanges in relation to trade route use.

One possible route which could elucidate the political realities of Late Classic Jaliezan trade is that of the Camino Antiguo path. This route was discussed and mapped by Elson and Casparis (2010) in their early 2000s survey for INAH. This route runs through the Late Classic portion of Jalieza and provides an alternative route for the possible economic exchanges with both the Tlacolula sub valley and Ocotlán, and would allow the people of Jalieza the option of travel to the Tlacolula or eastern arm of the Valley and completely avoid the scrutiny of the elite leaders of Monte Albán. This could possibly free the Jaliezan economic system from the Monte Albán elites, allowing them to trade without the oversight of the economic elite of the Zapotec. This Camino Antiguo route has the additional advantage that is a perfect route for providing access to the Pacific Coast of Oaxaca where the Zapotec would collect shell for economic transactions both among the Zapotec as well as with other groups such as the Mixtec and the Maya.

In a recent GIS study of the southern highlands, Barber and White (2012) identified this path as a major interregional route for foot travel for the people of Oaxaca. Their study looked specifically at pedestrian traffic, and attempted to identify a series of least cost routes through the Oaxaca Valley with no prior reference to known archaeological
trade routes. Instead of the normal method to find least cost paths, which involved using a specific origin and end point, their methodology used no starting or ending point; rather, they wanted to identify all possible routes and see which would be quickest and easiest to travel through the Oaxaca Valley area. Intriguingly, the Camino Antiguo appeared at the center of this network of least-cost paths, indicating that the Camino Antiguo trade route was possibly chosen, at least in part, based on an economic basis as a least cost path for the Late Classic Jaliezans to reach both the Tlacolula Sub valley to the northeast and to Ocotlán to the south which eventually would lead to the Pacific coast.

### 2.2 Geographic Information Science/Systems

In the past, prior to the late 1990s and early 2000s, in order to analyze the cost effectiveness of possible trade routes such as in the Barber and White (2012) study, a ground survey would have been necessary along with complex mapping of the area. This would take quite a lot of time and effort by the researchers looking at this issue. However, with the advent of Geographic Information Science/Systems (GIS), it is now possible to look at these travel routes using satellite imagery. Below in Figure 2.1 is a satellite photo of the possible trajectory of the Camino Antiguo through the Late Classic ceremonial site as this route now has a modern highway upon it. However, the beginnings of the Camino Antiguo were surveyed by Elson and her team and therefore I was able to estimate the paths direction where the highway is now present. I did this by using a satellite image of the route and then projecting a possible trajectory by utilizing the original start of the path at Jalieza’s Late Classic central area. Lastly, notice the ruggedness of the surrounding territory showing that energy cost would play an important part in travel for the Late Classic Jaliezans.
Figure 2.1 Photo of Camino Antiguo

Accessed April 2015 using Google Earth

GIS uses computer programming in concert with satellite imagery to study, store, and capture geographical and spatial knowledge in order to visualize digitally a landscape for study (Foote et al. 2015). Prior to the invention of GIS, utilizing satellite imagery to record geographic features of spaces including their elevation, or slope, or spatially analyzing those locales, was not possible without a physical presence at the sites evaluated. Now with the availability of GIS programs as GRASS GIS and JUMP GIS (both of which are open source) or commercially available programs like ArcGIS, the study of spatial relationships on land or sea has become much easier. In this study, I
applied the GIS process to the Jaliezan and Oaxacan landscape to ascertain the paths potentially used by the Late Classic Jaliezans, taking into account time and effort.

2.3 GIS Goals

As the metadata for the Oaxaca valley was already available in the United States Geological Survey (USGS) open source data site, a spatial analysis using GIS could be performed relatively simply. This is because this open source data made a trip to the Valley of Oaxaca unnecessary and its availability allowed for the analysis to be done remotely, making the study feasible both cost and data wise. Once this research was determined to be feasible, two goals were established for this study. First, I wanted to determine whether the Camino Antiguo was as cost efficient as theorized. Second, I sought to answer a series of questions to help evaluate the trade route behaviors of the Late Classic Jaliezans and also to identify the most likely trading partners of Jalieza using GIS that could then be tested with the trace-element analysis.

This process involved various steps. The first step involved the analysis of the Camino Antiguo path as the most cost effective route from Jalieza to Tlacolula, as well as to Ocotlán, in terms of energy expended and time consumed for the people of Jalieza to travel using GIS as noted above. Upon visual inspection of the topography of the Oaxaca Valley, it appears that the quicker and less mountainous route would not go through the mountains like the Camino Antiguo does, but instead head directly north through the flat alluvial zone of the valley.

The second step in order to understand with whom the Jaliezans were trading involved evaluation of the trace element results. This data, when combined with the GIS results,
could either support Jalieza trading with the Tlacolula area or refute this hypothesis as the trace-element study would show the provenance of the sampled pottery from Late Classic Jalieza. Finally, if the results from the INAA study and the GIS analyses indicated Jalieza was indeed trading with the Tlacolula arm of the Oaxaca Valley using the *Camino Antiguo* route, was this due a political reason (i.e. an attempt to avoid the elites of Monte Albán), or was this due to simple least cost effectiveness?

As many archaeologists have argued “the evolutionary tendency linking decentralization and commercialization, apparent in many ancient states, occurs when market institutions assume greater importance in times of weakened political institutions” (Finsten 1995:2; Blanton 1993). This suggests that when the head of a state dissolves in a state level society such as the Zapotec, increased self-reliance and trade occurs within secondary settlements like Jalieza. This self-reliance and trade outside of the elite scope would support the theory that Jalieza was indeed becoming its own economic force independent of Monte Albán.

**2.4 GIS Methodology: Creating a Predictive Model**

To evaluate this site, it was first necessary to develop a computerized map of the Oaxaca Valley which included the archaeological extent of settlement during the Late Classic. This was done by obtaining settlement survey boundary maps (digitized by Jeremias Pink [2015]) based on the survey data from Blanton *et al.* (1978; Blanton *et al.* 1989) This provided a basic outline of the study area to be assessed as well showed the extent of elevation that Late Classic Zapotecs would have had to contend with.
Figure 2.2- Elevation Map of the Oaxaca Valley

*Topographic Map of the Valley of Oaxaca Using a base DEM layer, from ASTER GDEM which is a product of METI and NASA. Survey boundary base map courtesy of Jeremias Pink.*
The Oaxaca Valley is a mountainous area and the people of Jalieza would be forced to deal with this when going to market to trade. This landscape is illustrated in Figure 2.2 in which the lighter colored areas are at a lower elevation while the darker brown area is at a higher elevation.

It is clear from this topographic map that directly east of the Jaliezian settlement rises the steep mountainous terrain surrounding the Oaxaca Valley; it is this route that is crossed by the *Camino Antiguo*. In comparison, a theoretical path from Jalieza to Monte Albán appears to be less rough and therefore much less strenuous.

In addition to these topographical features, notice that there are a substantial number of Late Classic sites which are located in the eastern arm of the Valley; from Lambityeco to Dainzú these sites offered the people of Jalieza a larger number of potential trade partners than if they traveled to the north to Monte Albán. This shows that there may have been potentially more economic opportunities to those Jaliezans who made the trek via the *Camino Antiguo* through the rougher terrain.

The base map which I obtained from the open source USGS is a 30-meter Digital Elevation Model (DEM). DEMs are made up of imaginary points which are draped along the landscape in a grid pattern which record the surface elevations. Digital Elevation Models differ in resolution, from a 90 meter DEM which is much not as precise, a 30 meter DEM which has greater resolution, all the way to a 15 meter DEM, which is very fine (Li *et al.* 2005). As this analysis required evaluating the whole of the Oaxaca Valley, which is a large area to compute, the medium resolution 30 meter DEM provided the best solution in order to avoid excessive computing time.
As the DEM records the elevation of the landscape, it is relatively easy to calculate the slope, or the angle from 0 degrees to 90 degrees, of the terrain. Knowing the slope of an area enables various analyses of a landscape which require the evaluation of how this slope or steepness would affect travel.

To analyze the surface effect on travel, a series of steps are required whereby the researcher uses the GIS map maker and spatial analyst program to add in the data layer by layer. I first over-laid the computerized grid of the 30 Meter DEM on the archaeological extent of Late Classic sites using rasters. Rasters represent a group of cells within the hypothetical grid of points which lie upon the landscape, helping to divide the area and enable measurement of particular qualities. In the ERSI website, the main GIS website devoted to academic research of the earth’s surface, a raster is defined as “a matrix of cells (or pixels) organized into a grid where each cell contains a value representing information such as temperature or elevation. These rasters are made from digital aerial photographs, images from satellites, digital photographs, or even scanned maps” (ESRI Accessed 2015-10-04).

Rasters enable one to look at the landscape and include important data on the terrains complexity. Different kinds of data can be stored within these raster cells, including both thematic data and continuous data. Thematic data includes such information as land-use data or soil data, while continuous data includes such information as the actual elevation of the site evaluated, the temperature of the area, or even spectral data, such as in the case of remote sensing whereby spectral data can help show the chemical components of a particular soil being evaluated depending upon what colors of light are reflected back from a laser sensor aimed at the earth’s surface such as with LIDAR. In this particular
instance, I am interested in the slope of the landscape as it affects speed of travel and energy expended.

Slope is calculated from the elevation, but must be computed separately as a new layer in ArcGIS. I created this slope layer by utilizing the 30 meter DEM data, indicating the settlement survey boundary to obtain the slopes parameters so that the program only calculated the slope of the potential travel areas within the known Late Classic settlements, rather than for the whole state of Oaxaca.

Slope calculations takes into account the elevation degrees of a site when calculating specific spatial relationships, Hence, slope is defined in GIS as “the incline or steepness of a surface” (http://support.esri.com/ from the Esri GIS dictionary Accessed September 2015), and is calculated as “the steepest slope of a plane defined by the cell (being analyzed) and its eight neighboring cells” (http://support.esri.com Accessed Oct 1st, 2015). Input consists of the raster cells whereby each raster has a value dependent upon the elevation. Slope can be measured in degrees from 0 degrees (a flat surface), to a 90-degree vertical plane, and can be measured using a percentage incline defined as the rise over the run multiplied by 100. However, in this analysis we used the simple degree measurement rather than percentage. Figure 2.4 is a map of what the slope raster looks like once one has converted the 30 meter DEM into slope in ArcGIS.

Tobler’s Distance Function (1993) takes into account the surface of a terrain and its effect upon pedestrian travel. As slope increases, the effort which it takes to traverse the area clearly increases which in turn affects the time it takes to cross the area. Simply put, as the grade becomes steeper, the traveler must expend more energy to cross the landscape and travel time is increased. This grade effect upon the speed of travel also comes into play when considering a downhill grade where steepness can slow down travel. Tobler’s equation factors in this incongruity by utilizing negative degrees, meaning that as a person walks down a hill at a certain degree of slope, their speed will pick up until the slope becomes too great and then they are slowed down by the great angle of descent.

\[
W = 6e^{-3.5 \left( \frac{dh}{dx} + 0.05 \right)}
\]

\[
\frac{dh}{dx} = S = \tan \Theta
\]

where
- \( dh \) = elevation difference,
- \( dx \) = distance,
- \( S \) = slope,
- \( \Theta \) = angle of slope (inclination).

**Figure 2.3 Tobler’s Hiking Function Equation**


Tobler’s equation shown above, also known as Tobler’s Hiking Function, is available for ArcGIS through the efforts of Tripcevich ([http://mapaaspects.org/node/3744](http://mapaaspects.org/node/3744)) who developed a methodology by which one could apply Tobler’s equation to a rasterized altitude map. This equation allows for slope to be
Figure 2.4 Map of Oaxacan Valley Once Raster is Converted to Slope

Base map DEM from ASTER GDEM which is a product of METI and NASA
assessed all the way from -90 degrees to 90 degrees and is written as Time (Hours) to Cross 1 Meter =0.000166666*(EXP(3.5*(ABS(TAN(RADIANS(slope_deg)) +0.05)))) (Tripcevich 2009; Yanchar 2012).

Figure 2.4 above shows the increased slope as the darker green areas, that is the areas with highest altitude, while the light green areas are lower slope values. This is computed by ArcGIS by attributing varying values to raster cells which correlate to the elevation, or slope, of the area. These areas are then colored to help show these changes in the topography and these colors can be picked to best accentuate the landscape changes in topography.

Once the slope and travel time are determined, the settlements or locational points that are being evaluated must be entered. These points are in longitudinal and latitudinal format in an X, Y format and then saved as a text file. This is because ArcGIS sees all point data as being on a geometric plane with X, Y, representing Longitude and Latitude, and Z, representing elevation. Note that it is not necessary to account for the Z factor in this routine as slope is automatically inserted by default. However, one could evaluate height as the Z factor along with the X and Y data if necessary or if the height and the X, Y variables are in different measurements such as meters versus feet in order to get a correct slope value (http://blogs.esri.com/esri/arcgis/2007/06/12/setting-the-z-factor-parameter-correctly/ Accessed December 5th, 2015).

Once the layers of slope and the survey extent were complete, I then added in each of the lat-long coordinates for the Late Classic sites as the destination points from which to
calculate the amount of time it would take to and from Jalieza as the origin in each case. I included 15 Late Classic sites that were known to be important economically and whose pottery we can distinguish in the trace-element analysis study. These include Jalieza, Monte Albán, Lambityeco, Dainzú-Macuilxóchitl, Guadalupe, Tlacolula (the Tlacolula arm of the Valley), Mitla, Yagul, Tanivet, Cuilapan, Zaachila, Ocotlán, Yaasuchi, Tlacochahuaya, Ejutla, and also El Pamillo.

Finally, I assessed the least cost paths using “Path Distance” in ArcGIS. This final step allows for the creation of the anisotropic surface of isochrones, or areas of equal travel time from the destination. These isochrones show the time horizons of travel time in relation to the value of slope degrees.

Lastly, we compared the results of the Least Cost paths and evaluated whether the Camino Antiguo route followed the placement of these paths. If this was true and this ancient roadway did match the most cost effective route, then the possibility that the Camino Antiguo represented an attempt by Jalieza to become more politically and economically independent form Monte Albán is lessened considerably. However, if this path is not a good choice as far as energy expenditure and does not match the predicted routes of the ArcGIS analysis, then the hypothesis that Jalieza was attempting to avoid Monte Albán becomes more likely.

Figure 2.5 is the final time horizon map for the Oaxaca Valley. The least cost paths are marked in black with the settlements marked in light green. Jalieza is the origin of the paths at the center of the map.
Figure 2.5 Isochronic Map of the Oaxaca Valley of the Anisotropic surface.

*Base map DEM from ASTER GDEM which is a product of METI and NASA.*
This map also shows the hypothetical route that the *Camino Antiguo* might follow once it had passed through the mountains north of Jalieza. This route is marked in white while the least cost paths are marked in black, showing this route matches up along the least cost route closely.

As travel time is indicated in two hour increments, it is now possible with these data to know with whom Jalieza could have traded reasonably based on energy expended. Unfortunately, the Tobler’s analysis does not allow one to take into consideration weight carried, but it does give a solid predictive ability as to choice of trading partners. Interestingly, all of the Late Classic sites examined here are within a day’s walking distance from Jalieza, although in some cases, it would be a reasonably long journey requiring a nine-hour walk. This shows that the Jaliezans could have traded with almost any of these settlements of the Late Classic by walking. Further, despite the rocky surface many of the settlements are within four hours, a travel distance which could be completed within a day.

### 2.5 Tobler’s Analysis Results

Based on the actual analysis of travel time, the furthest sites from Jalieza are Lambityeco and El Pamillo with the closest site being Yaasuchi. I have tabulated the results below in Table 2.1 with time estimates based on the GIS analysis using Tobler’s exponential equation, assuming a base rate of 5.0 km/hour at a 0-degree incline. Additionally, the Euclidean (straight line) travel times are included measured at the same rate of 5.0 km/hour. This time does not take into account topographical features such as hills or slopes.
Table 2.1 Tobler’s Analysis Results

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Distance from Jalieza in Km. along least-cost path</th>
<th>Distance from Jalieza in Miles along least-cost path.</th>
<th>Time travel on foot 5.0 km/hour equation.</th>
<th>Euclidean Straight line time at 5.0 km per hour (not accounting for slope or least cost paths)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monte Albán</td>
<td>24.00 km</td>
<td>14.91 miles</td>
<td>4.93 Hours</td>
<td>4.08 hours</td>
</tr>
<tr>
<td>Minas de Atzompa</td>
<td>31.75 km</td>
<td>19.72 miles</td>
<td>6.29 Hours</td>
<td>6.35 hours</td>
</tr>
<tr>
<td>Lambityeco</td>
<td>28.32 km</td>
<td>14.27 miles</td>
<td>5.66 hours</td>
<td>5.44 hours</td>
</tr>
<tr>
<td>Yaasuchi</td>
<td>16 km</td>
<td>9 miles</td>
<td>3.2 hours</td>
<td>3.17 hours</td>
</tr>
<tr>
<td>Dainzu-Macuilxóchitl</td>
<td>23.1 km</td>
<td>14 miles</td>
<td>5 hours</td>
<td>4.57 hours</td>
</tr>
<tr>
<td>Tlacochahuaya</td>
<td>20.99 km</td>
<td>13 miles</td>
<td>5 hours</td>
<td>4.17 hours</td>
</tr>
<tr>
<td>Guadalupe</td>
<td>21.5 km</td>
<td>13 miles</td>
<td>5 hours</td>
<td>4.27 hours</td>
</tr>
<tr>
<td>Tlacolula arm</td>
<td>23.03 km</td>
<td>14 miles</td>
<td>5.25 hours</td>
<td>4.57 hours</td>
</tr>
<tr>
<td>Mitla</td>
<td>29.36 km</td>
<td>18.24 miles</td>
<td>7.9 hours</td>
<td>8.2 hours</td>
</tr>
<tr>
<td>Yagul</td>
<td>26.3 km</td>
<td>16 miles</td>
<td>6.15 hours</td>
<td>5.22 hours</td>
</tr>
<tr>
<td>Tanivet</td>
<td>26.71 km</td>
<td>16 miles</td>
<td>6.25 hours</td>
<td>5.30 hours</td>
</tr>
<tr>
<td>Cuilapan</td>
<td>20.4 km</td>
<td>12 miles</td>
<td>4.75 hours</td>
<td>4.05 hours</td>
</tr>
<tr>
<td>Zaachila</td>
<td>14.19 km</td>
<td>8 miles</td>
<td>2.83 hours</td>
<td>2.82 hours</td>
</tr>
<tr>
<td>Ocotlán</td>
<td>16.31 km</td>
<td>10.13 miles</td>
<td>4.75 hours</td>
<td>3.23 hours</td>
</tr>
<tr>
<td>Ejutla</td>
<td>32.1 km</td>
<td>19.94 miles</td>
<td>6.42 hours</td>
<td>6.53 hours</td>
</tr>
<tr>
<td>Coyotepec</td>
<td>14.19 km</td>
<td>8 miles</td>
<td>4 hours</td>
<td>2.81 hours</td>
</tr>
<tr>
<td>El Pamillo</td>
<td>30.25 km</td>
<td>18.15 miles</td>
<td>6.05 hours</td>
<td>7.03 hours</td>
</tr>
</tbody>
</table>

When comparing these times to each other, several important factors become clear.

First, the closest and most likely trading partners for Jalieza based on travel time include Ocotlán, Yaasuchi, Monte Albán, and Zaachila, all within a half-day travel. Second, a number of large sites lie within a six-hour travel, including Cuilapan and the DMTG – a bit longer, but still reasonable within a day. Third, it becomes clear that despite the apparently difficult surface of the pass over which the Camino Antiguo travels, the route
to the Tlacolula area would have involved almost the same amount of travel time as that needed to arrive at Monte Albán, just slightly more, 4.93 hours’ travel time for Monte Albán versus 5.25 hours for the Tlacolula arm. This shows that going to Monte Albán would be slightly more energy efficient than going to the Tlacolula arm. Thus, this shows that there is not a great difference in energy expended. In summary, trade with the eastern arm of the valley emerges as an economically and efficient alternative to trade with the capital at Monte Albán.

2.6 Gravity Model

After completing the analysis of least cost paths, I next analyzed the various trading partners using a gravity model. Gravity models allow one to predict the attraction or pull of a location based on its population and distance. The underlying assumption here is that communities with larger populations will have more buyers and sellers, and thus the potential for more economic interaction than would a smaller community. Given two communities the same distance away, the larger community will exert more pull, for example.

In this analysis, I compared the sites based on population and distance from Jalieza in kilometers to determine to pull a site would have for the Jaliezans. I analyzed the sites which existed in the Late Classic. For instance, Tlacolula and Ocotlán were not occupied during the Late Classic although other small sites were; hence by using Lind and Urcid’s (2010) population estimates for the various arms of the valley, I was able to obtain a sense of what sites would have had the greatest pull. The gravity model is fairly simple to calculate. The populations of the two locations (origin and destination) are multiplied,
then divided by the distance between sites (or travel time) squared (http://geography.com/library/weekly/aa031601a.htm; Accessed January 18th, 2016).

\[ \frac{\text{population}_1 \times \text{population}_2}{\text{distance}^2} \]

**Figure 2.6 Gravity Model Equation**


The equation used in this thesis is shown above in Figure 2.5. The results are then ordered in ‘pull’ by the larger the number. The results of this analysis are listed in Table 2.2 below, assuming a Late Classic population of 16,000 for Jalieza (Finsten 1995; Lind and Urcid 2010; Feinman and Nicholas 2012d).
Table 2.2 Gravity Model Results: Distance and Population Effect on Gravity

<table>
<thead>
<tr>
<th>Site</th>
<th>Population est.</th>
<th>Time to travel to from Jalieza (in hours)</th>
<th>Distance (km)</th>
<th>Final results: population divided by distance squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jalieza</td>
<td>16,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Monte Albán</td>
<td>24,000</td>
<td>5.75</td>
<td>24</td>
<td>666,667</td>
</tr>
<tr>
<td>Dainzú-Macuilxóchitl</td>
<td>6,222</td>
<td>5</td>
<td>21 km</td>
<td>225,742</td>
</tr>
<tr>
<td>Lambityeco</td>
<td>2702</td>
<td>5.66</td>
<td>28.32 km</td>
<td>81,724</td>
</tr>
<tr>
<td>Yaasuchi</td>
<td>112</td>
<td>3.2</td>
<td>16 km</td>
<td>7000</td>
</tr>
<tr>
<td>Yagul</td>
<td>1197</td>
<td>6.15 hours</td>
<td>26 km</td>
<td>28,331</td>
</tr>
<tr>
<td>Ejutla</td>
<td>3029</td>
<td>7.25 hours</td>
<td>32 km</td>
<td>47,328</td>
</tr>
<tr>
<td>Cuilapan</td>
<td>839</td>
<td>4.75 hours</td>
<td>20 km</td>
<td>33,560</td>
</tr>
<tr>
<td>Tlacochahuaya</td>
<td>5352</td>
<td>5 hours</td>
<td>20 km</td>
<td>214,080</td>
</tr>
<tr>
<td>Guadalupe</td>
<td>257</td>
<td>5 hours</td>
<td>19 km</td>
<td>11,391</td>
</tr>
<tr>
<td>Tanivet</td>
<td>1584</td>
<td>6.25 hours</td>
<td>26 km</td>
<td>37,491</td>
</tr>
<tr>
<td>Mitla (center)</td>
<td>2354</td>
<td>7.9 hours</td>
<td>29 km</td>
<td>44,785</td>
</tr>
<tr>
<td>El Pamillo</td>
<td>5000</td>
<td>6.05 hours</td>
<td>30.25 km</td>
<td>87,426</td>
</tr>
<tr>
<td>Zaachila/Atoyac</td>
<td>2500</td>
<td>2.98 hours</td>
<td>14 km</td>
<td>50,000</td>
</tr>
</tbody>
</table>

In the gravity model results above, we see that when a site is larger and closer to an origin site, in this case Jalieza, the bigger the ‘pull’ that site has upon the origin site. To help visualize this model, I have graphed the results below in Figure 2.6.
As can be seen in Figure 2.6, the largest site population wise is Monte Albán with a population of 24,000 for ‘Greater Monte Albán’ and a ‘pull’ of 666,667. In contrast, the smallest site, Yaasuchi, has next to none with only 7,000 for gravity or ‘pull’. Next, the site of the Dainzú-Macuilxóchitl has a substantial pull at 225,741 approximately the same as Tlacochahuaya. Lastly, the site of Zaachila/Atoyac area has a solid pull at 198,653.

This is logical as these sites, along with Lambityeco and El Pamillo are all in the same Eastern arm of the valley, the Tlacolula sub valley. This shows that both population and distance determine how much gravity a site has; despite the greater distance to this area located in the Tlacolula arm, it has a greater pull than Yaasuchi. Thus, this model predicts that when provenance is obtained for Jaliezan ceramics, a large number should be from Monte Albán and areas in the Tlacolula arm like Dainzú-Macuilxóchitl or Lambityeco. In general, we see a larger pull towards the eastern part of the valley and this shows the provenance results should be at a greater rate for this area compared to the smallest pull, that of Yaasuchi.
Finally, I compiled these results in Table 2.3 which ranks the sites as potential trade partners for Jalieza dependent upon energetics and pull as predicted by the Gravitational model.

**Table 2.3 Rank of Trade Partners by Least cost Analysis and Gravity Model**

<table>
<thead>
<tr>
<th>Potential Trading Partner for Jalieza</th>
<th>Rank Based on Time according to Least Cost Predictions</th>
<th>Rank Based upon ‘Pull’ based upon Gravity Model Predictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zaachila/Atoyac Area</td>
<td>1 *</td>
<td>4</td>
</tr>
<tr>
<td>Yaasuchi</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Cuilapan and Ocotlán</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Dainzú-Macuilxóchit</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Tlacochahuaya</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Monte Albán</td>
<td>6</td>
<td>1*</td>
</tr>
<tr>
<td>Yagul</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>El Pamillo</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Lambityeco</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Mitla</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>

*I combined a few sites here such as the Zaachila/Atoyac site as they are next to one another.*

As can be seen in Table 2.3 above, the predictions each model makes are slightly different. Interestingly, although Monte Albán is predicted to be the number one trading partner for Jalieza based on ‘pull’, it is all the way down at sixth place when considering only the Least Cost model predictions based on travel time. These ranking systems shows that although some areas appear to have more ‘pull’ due to population, those areas might not be the best choice when considering energy expended for trade.

In summary, based on the first measure of the Least Cost Path model, the prediction shows that Jaliezans would be more likely to trade with areas closer to them and in concert with the use of the Least Cost path of the *Camino Antiguo*. Monte Albán, despite its large size, would have been still more time expensive and hence, more energy costly than some sites in the Tlacolula arm of the Valley. This site comes up as number one
when only considering the one variable of population which affects the gravitational ‘pull’.

The Least Cost paths predict a substantial amount of pottery should come from the Zaachila/Atoyac areas or Coyotepec. Additionally, this model predicts that when provenance testing is completed through trace element analysis, Jalieza should have pottery from this part of the Valley in greater amounts than other areas such as Monte Albán or Lambityeco which would require longer treks expending more energy. In contrast, the Gravity Model shows that sites with large populations should be showing up as trade partners in the provenance results once trace element analyses are completed.

In Chapter Three, I will next assess a pottery assemblage from two structures and a surface survey gathered from Jalieza. Using the provenance results of this trace element analysis, I will then compare the predictions of aforementioned Gravity Model analysis and the Least Cost Path analysis to evaluate what variables may have been affecting trade partner choice for the Late Classic Jaliezans.
Chapter 3. Xoo Phase (Late Classic) Jalieza

3.1 History of Investigations

The site of Jalieza was first discovered by the same archaeologists who first excavated Monte Albán: Ignacio Bernal, Alfonso Caso, and Jorge Acosta (Bernal et al. 1967; Finsten 1995; Blanton 1977). Later in 1977, the site was mapped and studied as part of the Valley of Oaxaca Settlement Pattern Project (Finsten 1995; Elson et al. 2010; Blanton et al. 1989). The Oaxaca Settlement Pattern Project found that Jalieza had been first settled in MA IIIA, approximately 200-500 A.D. and then expanded considerably by the Late Classic, as well as shifting further to the east. The survey revealed that the Late Classic settlement of Jalieza consisted mostly of residential terraces which extended up the sides of the mountains and hills, called cerros in Mexico (Finsten 1996; Elson et al. 2010).

In the early 2000s, Dr. Christina Elson and Dr. Luca Casparis embarked upon a study of this Jaliezan site (Elson and Casparis 2010). They surveyed and mapped many of the house terraces at Jalieza in addition to conducting a surface survey collecting artifacts from tombs, houses, and the ground around these sites. The hope of the survey by Elson and Casparis was to help illuminate the daily lives and political processes in evidence at Jalieza during the transition from the Early Classic to the Late Classic period.

3.2 Size and Significance of Jalieza

The Oaxaca Settlement Pattern Project recorded “698 terraces and 44 mounded structures dating to Monte Albán IIIA” (Finsten 1995:3; Blanton et al. 1989) at Jalieza showing the considerable size of this settlement. By the MA IIIB/V period (Xoo Phase), or the Late Classic, Jalieza had grown substantially and had a population of approximately 16,000 residents, second only to the Monte Albán settlement by this period (Blanton et al. 1982).
This population estimate could be considered equal if one is to consider that Monte Albán’s population estimate of 24,000 included the aforementioned ‘Greater Monte Albán’ instead of just the urban site itself. This population readily contests Monte Albán as the most populous Classic site and actually beats Monte Albán for the speed at which Jalieza grew from zero before its founding in 250 A.D. to 12,385 within a very short period (Blanton et al. 1982: 87). Lastly, the rate at which these sites were growing indicates that the growth was beyond human reproductive potential showing that Monte Albán, and therefore Jalieza, must have had immigration to account for their large population increases in such relatively short periods of time (Blanton et al. 1982: 87).

In terms of area, the large size of Jalieza should be considered to include two sites, not one, and was nicknamed “Greater Jalieza” by Finsten (1995). This moniker refers to both Early and Late Classic Jalieza. Finsten notes that “in total area (ca. 9 sq. km.), ‘Greater Jalieza’ may be in fact “the largest site in the Valley of Oaxaca and probably in all the southern Mexican highland” (Finsten 1995: 9). Hence, it is important to note that it was never all occupied at once.

Geographically, Jalieza sits roughly between Ocotlán, Tlacolula, and the Valle Grande parts of the Y-shaped valley settlement; this may have been advantageous for the Jaliezans at this time in the sense that this geography made the Jaliezans able to be fairly independent of the three main arms of the valley. This may have been the initial factor which made Jalieza eventually able to attempt independence as its settlement is squarely placed in a locale which enabled it to be far away enough from the other locales to be somewhat independent.

As noted in the introduction, with Barber and White’s discovery of the Camino Antiguo, Jalieza’s possible importance in trade is strengthened as it shows that Jalieza could also have
had a place as a strategic trade center for the ancient Zapotecs and that this route might have influenced the Jaliezans Late Classic shift in locale from west to east as it moves the site closer to this important trade route (Barber and White 2011).

This least cost path found by Barber and White which appears to follow the Camino Antiguo known archaeologically and still visible on the surface today (Elson and Casparis 2010) also appears to have been delineated by two mounds according placed on either side of the road, possibly showing the veracity of the hypothesis that these mounds “functioned in controlling access to the ceremonial center on the side of Ocotlán” (Elson and Casparis 2010: 10) and may have even been used to control access to this trade route. Thus, the possibility that Jalieza was functioning as an important trade stop became clear once this information was discovered.

With its great size and important trade connections, it has become increasingly clear that Jalieza is an excellent archaeological opportunity to see what the Late Classic dissolution of the Zapotec state meant to the many people living outside of the closest circle of the control of Monte Albán and its powerful elites.

3.3 The Sample Site Context

The areas surveyed by Drs. Elson and Casparis offer a chance to evaluate the economic trade practices as well as possibly show with whom Jalieza had alliances once trace element analysis was completed. Additionally, these structures had interesting artifact assemblages with a possible termination ceremony having been completed in one as well as clear status differentiation confirmed by status markers found by Elson and her team (Elson and Casparis 2010). All of these factors make Jalieza a perfect local to study the effect that Monte Albán’s dissolution had on places like Jalieza in MA IIIb/IV or the Late Classic.
The two dwellings sampled for this study, labeled Structure 2 and Structure 7, were
determined by Elson to be of either elite or semi-elite status. Dr. Elson hypothesized that
Structure 2 was of a more elite dwelling type than Structure 7 as the floor was covered in a
characteristic lime stone wash which would give the floor a white appearance (Elson and
Casparis 2010; Evans 2008). This sort of extra care could be a possible marker of an elite
Zapotec and Mesoamerican house as it is hypothesized that less elite houses would have an
earthen floor without the lime plaster cover. Additionally, the presence of a stone tomb in
Structure 2 with urns, a patio with a large number of various pottery vessels which were
apparently being stored there, as well as two additional rooms, adds to the theory this was
indeed a more upper class structure than the Structure 7 house.

Structure 7 was also determined to be somewhat elite but as it was smaller than Structure
2 and had no lime floor covering, it was in all likelihood to be a lower status structure.
Lastly, the Elson survey provided a number of different pottery vessel types from these
structures that ranged from utilitarian vessels such as comals and cajete conicos, all the way
to ritual pottery types such as figurines, urns and sahumadores which are used for incense
burning. All of these items could shed light upon the realities of Late Classic trading partners
of Jalieza, what types of items were being traded, what a Late Classic elite houses’ pottery
assemblage would look like, and whether these items were being mass produced or possibly
manufactured at home. Lastly, the type of market which existed can be illuminated by
researching the availability of items to various social statuses. Finally, I will explore these
two Jaliezan household’s economic patterns and their daily lives by evaluating this pottery
cache.
3.4 Structure 7

Structure 7 is a typical Late Classic terrace dwelling made from stone, brick, and adobe with lime-washed stucco flooring (Fig. 3.1). It is located near the Late Classic part of the ceremonial civic center of Jalieza in the locale delineated as Area D, as defined in the report on the Jalieza (Elson et al. 2010:2). It was considered a “semi elite” dwelling (Elson et al. 2010:18), with a large number of pottery sherds present both within and around the area.
Area D includes Structure 7 as well as its courtyard. The whole structure was determined to be about 13 meters by 13 meters in size, and consists of a series of rooms around an interior courtyard which measured approximately 6 meters by 6 meters in size. This courtyard may have been remodeled at some time as there appears to be a “partially...
preserved floor about 20 cm below the level of what is likely to be the floor of the house” (Elson et al. 2010: 18). The presence of this second floor beneath the newer floor is indicative of remodeling of the structure over various occupations over time and is common in many Mesoamerican dwellings where families live in the same place for generations (Feinman and Nichols 2011).

One of the more interesting aspects of this dwelling is the large collection of sherds lying around within the structure itself, particularly a set of vessels seemingly just inside the entrance to the patio which may have been blocking the entrance to the structure according Elson and her team (Elson et al. 2010). This concentration was designated as Elemento or Feature 7 (Fig. 3.1). These sherds were determined to be from semi-complete to complete vessels once they were taken back to the lab and reconstructed, and number at 91 vessels including a small collection of ceramic spindle whorls (10) for spinning. We did not sample the whorls as part of this study, but they also add to the possibility that Structure 7 was a household manufacturing locale, common in Oaxaca.

The dates discussed by Elson and her team were obtained by radiocarbon dating of burned adobe brick. In addition, Elson and her team dated the pottery located on the patio floor typologically as different types of pottery fit into different time periods. This was completed in order to estimate the time of occupation in addition to chronological estimates based on pottery types. The results show this dwelling was apparently first occupied late in the Early Classic period, then reoccupied again during the Late Classic, and then abandoned to be eventually reoccupied during the Post-Classic. This later date was confirmed by the presence of below floor burials which have Post-Classic types of pottery designs which are common from this period in the Oaxacan trajectory. To sum up, the radiocarbon dates taken by Elson
and her team range from as early as 440 A.D. to 490 A.D. for the Early Classic, to 740 A.D. to 790 A.D. for the Late Classic occupations, and after 900 A.D. for the possible Post-Classic occupation (Elson et al. 2010). Though the Post-Classic date is not from carbon dates from Structure 7, the pottery typing of the burial vessels is an adequate and respected dating method in these cases.

Our sample set from Late Classic Structure 7 focused on Feature 7, consisting of the 91 complete to semi-complete vessels that were found on the patio of Structure 7 were determined by pottery type to be from the Late Classic. Additionally, this feature is associated with burned charcoal from the burned adobe that resulted from Structure 7’s conflagration; this places Feature 7 in the Late Classic, after which point Structure 7 was abandoned for a period. Hence, the feature is most likely from the Late Classic occupation rather than earlier as shown by the carbon dating of the areas around this feature and the typology of the pottery pieces.

Of the 91 vessels in Feature 7, most were made of a brown or grey paste, a common medium for Late Classic non-elite vessels; most of the vessels were of utilitarian type. Along with the expected bowls and household items, figurine molds and figurines were found elsewhere scattered around the structure. The figurines and more elaborate pottery represent typical forms from the Late Classic; these include such types as funerary urns, monkey-footed pedestal bowls, and a bat or jaguar claw cup, as well as the molds used to make a series of figurines. These figurines depict such common Zapotec imagery as an old man, perhaps associated with the ancestor worship so common to Mesoamerica, as well as human-animal hybrid forms such as monkey-headed men and smaller figurines (citations on LC figurines); some have both male and female characteristics in appearance. As the mold forms
were present at this locale, it is unlikely these figures were made only for the family. Rather, considering the number of fragmentary figurines and complete figurines associated with this site, they were probably made for trade. The funerary urns, in contrast, are from the burials at the locale and do not appear to have been manufactured at Structure 7, though it is possible and the forms for making the urns may simply not have been found.

Table 3.1 covers the vessels from Structure 7 as described by Elson et al. (2010) and Markens and Martinez Lopez (Markens and Martínez Lopez, 2010) with type and form indicated.

<table>
<thead>
<tr>
<th>Table 3.1</th>
<th>Structure 7: Vessel Type and Paste Type (vessels in italics not sampled)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel Form</td>
<td>Grey Paste</td>
</tr>
<tr>
<td>Cajete cónico pequeño trípode</td>
<td>8, 9</td>
</tr>
<tr>
<td>Cajete cónico mediano</td>
<td>3, 23, 24</td>
</tr>
<tr>
<td>Cajete cónico mediano con soportes sólidos</td>
<td>5, 11</td>
</tr>
<tr>
<td>Cajete cónico mediano con soportes semiesféricos huecos</td>
<td>12, 13, 14, 15, 16, 17, 18, 19</td>
</tr>
<tr>
<td>Cajete cónico mediano con soportes semiesféricos huecos y engobe negro</td>
<td>0</td>
</tr>
<tr>
<td>Cajete cónico mediano con soportes cónicos sólidos y engobe negro</td>
<td>0</td>
</tr>
<tr>
<td>Cajete cónico grande</td>
<td>2, 7, 9</td>
</tr>
<tr>
<td>Cajete cónico grande con engobe negro</td>
<td>26, 27</td>
</tr>
<tr>
<td>Cajete cónico grande con soportes semiesféricos huecos</td>
<td>6, 10, 20, 22, 25</td>
</tr>
<tr>
<td>Cajete cónico grande con soportes</td>
<td>28</td>
</tr>
<tr>
<td>Nombre</td>
<td>Código 1</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>semiesféricos huecos con engobe negro</td>
<td></td>
</tr>
<tr>
<td>Cajete cónico grande con soportes semiesféricos sólidos</td>
<td>21</td>
</tr>
<tr>
<td>Cajete silueta compuesta</td>
<td>1, 4</td>
</tr>
<tr>
<td>Cajete semiesférico mediano</td>
<td>38,91</td>
</tr>
<tr>
<td>Cajete semiesférico grande</td>
<td>39</td>
</tr>
<tr>
<td>Vaso</td>
<td>40</td>
</tr>
<tr>
<td>Vaso miniatuра (Not sampled for INAA)</td>
<td>0</td>
</tr>
<tr>
<td>Vaso con engobe negro</td>
<td>41</td>
</tr>
<tr>
<td>Vaso garra (Not sampled for INAA)</td>
<td>46</td>
</tr>
<tr>
<td>Botellón</td>
<td>76</td>
</tr>
<tr>
<td>Cántaro</td>
<td>44,45</td>
</tr>
<tr>
<td>Olla pequeña</td>
<td>47, 93</td>
</tr>
<tr>
<td>Olla pequeña con vertedera de pico (Not sampled for INAA)</td>
<td>42, 43</td>
</tr>
<tr>
<td>Olla mediana</td>
<td>49, 50, 51</td>
</tr>
<tr>
<td>Olla mediana de silueta compuesta</td>
<td>52, 67, 68</td>
</tr>
<tr>
<td>Olla grande</td>
<td>64, 73, 74, 75</td>
</tr>
<tr>
<td>Olla grande con engobe</td>
<td>74</td>
</tr>
<tr>
<td>Apaxtle de silueta compuesta</td>
<td>53, 54, 55, 56, 57, 58, 59, 60, 61</td>
</tr>
<tr>
<td>Brasero con conos</td>
<td>89, 90</td>
</tr>
<tr>
<td>Brasero con decoración incisa</td>
<td>0</td>
</tr>
<tr>
<td>Comal</td>
<td>0</td>
</tr>
<tr>
<td>Tlecuil</td>
<td>0</td>
</tr>
<tr>
<td>Malacates (None of these were sampled for INAA)</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>
*Note:* The malacates, or spindle whirls, were not sampled as they were too small to nip. Additionally, the Vaso Garro was not sampled nor were the Olla Pequeña or the Vaso Miniature as these were complete vessels we did not wish to destroy. Hence, the final number sampled from Structure 7 is 78 shown in Table 3.3 later in this chapter.

As can be seen from this list, there was a solid variety of types located in Structure 7 which effectively gave us a snapshot of the period and life for the Late Classic Jaliezans. In addition to the unusually high number of semi-complete to complete vessels in Structure 7, the placement of this structure is also of interest, and may be important to the final assessment of this site as it lay very near to the possible trade route of the Camino Antiguo. This immediacy may be related to the production and the trade of the household produced items for instance. While difficult to prove, I believe it should be considered when assessing this structure’s position near the civic ceremonial area and the Camino Antiguo.

### 3.5 Structure 2

Along with the sample from Structure 7, we took samples from a second locale, that of Structure 2. This structure is located near the mounds 16 and 17 as well, and this structure was also a residential dwelling, but with two interior patios as can be seen from Figure 3.2. Structure 2 was assessed by Dr. Elson and her team to be of a higher status than Structure 7 based upon (1) its placement next to the Plaza of the ceremonial center, and (2) the fact it had two patios instead of the single patio design of Structure 7. Essentially the size of Structure 2 points to it being a more elite status household. Structure 2 was measured by Elson’s team at 13 meters east-west by 18 meters north-south (Elson et al. 2010), a bit larger than the size of
Structure 7. Lastly, one other aspect of this structure points to its possible higher status and that is the fact it is placed near to the main square of Late Classic Jalieza (Elson et al. 2010:20).

Figure 3.3. Plan of Structure 2
*Map adapted from Elson et al. (2010)*.

This residence was dated to the Late Classic, 650 A.D. to 770 A.D., via carbon dating of charcoal found within the corner of an associated stone-lined tomb. This charcoal sample for the carbon dating was taken from an undisturbed area to get the best possible date for the
structure, as some of the areas around this structure had been disturbed due to construction of roads, farming, and in rare cases looting of the site.

A second radiocarbon date is also mentioned by Elson et al. (2010:18). This charcoal sample was taken from directly inside Burial Three (see below); this sample gave a later, calibrated date of 980 A.D. to 1050 A.D. and 1090 to 1130 A.D., placing it within the Early Post-Classic. However, as the other parts of the structure are associated with the Late Classic (such as the majority of the pottery assemblage found here) and the house was mainly designed in a Late Classic style, it was hypothesized by the excavators that a stone had been taken from the Structure 2 during the Post-classic to build the tomb sometime after 850 A.D. This re-use of items from one building to build another is also a common practice throughout the Classic period and even now.

In association with Structure 2 are three burials, reflecting the continued occupation and rebuilding of the structure through time. Burial One was located directly underneath the floor in the Patio 1, while a Burial Two was located under the east corner of the same area. It is important to note that this burial practice is a common one for Oaxaca at this time, whereby the living relatives want to keep their ancestors as close as possible and so bury them within the actual familial dwelling or at least near to the main residence.

The artifact assemblage from Burial One includes two ceramic vessels as well as a green-stone mosaic associated with the Chila or Late Post-Classic Phase (Elson et al. 2010:20). The ceramic artifacts included a G3M pottery vessel and a large hemispherical bowl.

Burial Two was of the type of burial where “no doorway was present and one would have to enter through the roof” (Elson et al. 2010:21). These burial types are called a
‘Mixed’ due to this architectural type. It was measured by Elson’s team at about 2 meters long and 2 meters wide. This tomb was considered to be of low to medium status and there are many of this type of tomb throughout Oaxaca, from Monte Albán to Lambityeco (Elson et al. 2010; Martinez-Lopez, Winter, Markens, and Lind 2000). It also had some associated artifacts including four Gris and Café bowls all corresponding to the Xoo Phase. G35s were also present in this assemblage, as well as small tripod Cajete Conicos, a bowl with small supports that can be hollow or solid, made of Gris paste as well. Small vases, Vasijas, of Café paste were also present in the burial assemblage.

Burial Three was found near Structure 2. This burial included eleven pottery pieces as well as green-stone ornaments, and the construction of this tomb had a lintel as well as a door. The pottery was found to be associated with the Lioba Phase, or Early Post-Classic at around 850 A.D. -1150 A.D., based on carbon dates of 980-1050 A.D. and 1090-1130 A.D. (Elson et al. 2010). This burial had a much degraded skeleton and had been looted. It is important to note that this tomb had also incurred some damage due to plowing by the local populace as well as saguaro cactus growing in the area.

Along with the burials, there were many pottery types found. Most of the pottery assemblage were of a utilitarian type, from bowls to cooking and storage pottery. A large number of large sherds (Tepalcates Grandes) which represented large storage containers for the storage of corn and other necessary food items, were located on the second patio, Patio 2 (Elson et al. 2010) and the majority of the pottery from this locale is of the grey paste type.

The majority of our samples came from the two patios and the courtyard located to the south side of Structure 2. The largest number of semi-complete to complete vessels was found in Feature 6, in the Patio 2 area. These consisted of Late Classic cooking vessels,
G35s, as well as urn fragments (Elson et al. 2010). The assemblage is noted in Table 3.2 below.

**Table 3.2- Structure 2 Assemblage Sampled for INAA**

<table>
<thead>
<tr>
<th>Category Vessel Type</th>
<th>Grey Paste</th>
<th>Café Paste</th>
<th>Gris Oxidado Paste</th>
<th>Amarillo Paste</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cajete Conico (Bowl)</td>
<td>23</td>
<td>5</td>
<td>7</td>
<td>2</td>
<td>37</td>
</tr>
<tr>
<td>Cajete semi-esferico con engobe negro (Bowl with Black slip)</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Cajete Silueta Compuesta</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Cantaro</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Apaxtle</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Olla (Large Pot)</td>
<td>6</td>
<td>5</td>
<td>3</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Sahumador (Incense Burner)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Comal (Tortilla Griddle)</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Vaso Garro (Vase)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Cucharon (spoon)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Chimolera (Grater)</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Final Structure Two Sample</td>
<td>46</td>
<td>20</td>
<td>20</td>
<td>0</td>
<td>89 total</td>
</tr>
</tbody>
</table>

*Adapted from Elson et al. 2010.*
3.6 The Surface Survey: Context and Sample

The surface survey of Jalieza by Elson’s team was conducted after completing a topographic map of the area “using a Brunton compass at 1:1000-meter scale for contouring” (Elson 2010: 13). The team surveyed at “100 square meter units” (Elson 2010: 13) which added up to 103 squares surveyed, or 10,300 m². This included areas which were both public areas as well as artifact assemblages from domestic sites. Our sample utilized surface collections from seven areas (Area 2, 3, 5, 6, 7, 20, and 77) marked in blue squares in Figure 3.4. Surface Survey

*Map Adapted from Elson et al. (2010)*

The surface survey of Jalieza by Elson’s team was conducted after completing a topographic map of the area “using a Brunton compass at 1:1000-meter scale for contouring” (Elson 2010: 13). The team surveyed at “100 square meter units” (Elson 2010: 13) which added up to 103 squares surveyed, or 10,300 m². This included areas which were both public areas as well as artifact assemblages from domestic sites. Our sample utilized surface collections from seven areas (Area 2, 3, 5, 6, 7, 20, and 77) marked in blue squares in Figure 3.4. Surface Survey
3.4. These areas in particular were chosen as they had the highest percentage of Xoo phase ceramics and no evidence Post-classic ceramics, and thus would offer us a comparison point for the samples taken from the two structures. By doing a broad swath sample of these areas in Jalieza, the goal was to get an idea of what kinds of vessels were being used over the broader community, in contrast to the higher status household assemblages discussed above, as well as a more generalized picture of the Late Classic period.

Interestingly, the surface survey samples ended up also providing a localized snapshot of the Late Classic period, with an assemblage similar to the two structures discussed earlier in this paper. This was discovered once Dr. Elson took the 103 square assemblages to the laboratory for identification. The sherds showed the same pottery typology as what would be found elsewhere during the Late Classic with Gris paste predominating with a total rate of 85% of the assemblage being Gris paste, along with some Café paste types. Elson notes that this paste distribution follows a pattern established by Monte Albán during the Late Classic (Elson et al. 2010: 14; Martinez et al. 2003) and that in the assemblages for the period in that there are almost no Amarillo paste or Crema vessels, although the Amarillo and Crema wares were a common paste used in earlier periods, indicating again that production, or at the very least trade with Monte Albán for these items, had decreased in Jalieza by the Late Classic.

By sampling both the structures and the surface survey we were able to look at both a small time period as represented in the structures versus a larger time period, represented by the surface survey. The paste types from this surface survey, and both structures, are listed below (Table 3.3).
### Table 3.3

**Full Sample for Study: Paste Types from Each Sampled Locale**

<table>
<thead>
<tr>
<th>Paste Type</th>
<th>Surface Survey Total</th>
<th>Structure 2 Total</th>
<th>Structure 7 Total</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amarillo</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Café</td>
<td>14</td>
<td>20</td>
<td>14</td>
<td>48</td>
</tr>
<tr>
<td>Gris</td>
<td>44</td>
<td>44</td>
<td>55</td>
<td>143</td>
</tr>
<tr>
<td>Gris Oxidado</td>
<td>5</td>
<td>18</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>Gris con Engobe Negro</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Café con Engobe Negro</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Figurines</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>68</strong></td>
<td><strong>89</strong></td>
<td><strong>78</strong></td>
<td><strong>245</strong></td>
</tr>
</tbody>
</table>

#### 3.7 Interpretation of Structures 2 and 7

When assessing the origin of the assemblages from these two structures, it is important to consider their context. Structure 7, as noted above, had the anomalous and large collection of complete to semi-complete vessels numbering at 91 that were placed in such a fashion as to partially block the main entrance to the structure (Elson *et al.* 2010). This appears to be an abnormal amount of household pottery for the size of this structure, though it may be common as household pottery assemblage size for Late Classic Jalieza is not yet known with validity. and it is unlikely to have simply resulted from the accumulation of trash over time. Rather, its location on the patio and the fact all vessels were reconstructable underlines the possibility that these vessels were either from
some kind of ritual behavior like a Termination Ceremony or a feast prepared for the ancestors buried therein.

Termination Ceremonies have been found throughout Oaxaca, but unfortunately, Oaxaca Valley’s Termination Ceremonies have been studied very sparsely. However, among other cultural groups such as the Maya, these rituals have been recorded in the archaeological record quite commonly. These rituals involved a sort of cleansing of an area when someone dies or when there is construction upon a previous level (Mock 1998). Common items found in these ritual activities associated with household beliefs include not only sacrificial items like animals or even people but pottery offerings as well, which were left on the floors of the home, “the offerings were left on the final floors of the complex” (Gary Feinman).

When considering the possibility that Structure 7’s assemblage was the result of ritual behavior, one must take into account that among the Zapotec of this period, and earlier periods as well, the closing or changing of a house would require a ceremony which marked this occasion. These ceremonies were ritualized actions to either honor a person in the house who died or another life-altering event such as construction on the house. As noted by Gary Feinman, these household rituals would result in a context which included “the remains of non-mortuary rituals that occurred in or near a residential complex ...(and) may include dedicatory and termination rites” (Feinman: 180, 2008).

The ceremonies show the difference in the way many indigenous people in Mesoamerica would see objects that Europeans may see as inanimate or not alive: “material culture had a life cycle, and underwent a process of birth and death through

---

rituals of dedication and termination which mirrored the life of its owners” (Mock 1988; Harrison-Buck 2014: 103)

In the archaeological record these ritualized ceremonies can appear as “intensive burning: intentional structural damage: pot smashing and scattering: rapid deposition of material: dense concentrations of large sherds with sharp angular breaks: and large quantities of elite artifacts” (Harrison-Buck 2014: 182). However, many of the studies of Termination and Dedication Ceremony that have been done in Mesoamerican archaeology involved the Mayan people and their rituals rather than the Zapotec. Though these ceremonies have been seen in such places as the coast of Oaxaca and a few spots in the Valley, they are up to this point uncommon in the archaeological record. This leaves a large gap in the knowledge of what can be said about this ritual behavior among the Late Classic Zapotec and shows the need for further research into this phenomenon.

With that said, there are facts which strongly support the idea that the placement of the vessels in Structure 7 was ritual. For example, not only was there evidence of a conflagration after which the structure was abandoned, but it was also later reoccupied, as evidenced by the building of the second floor on the structure (Elson et al. 2010). In many of the Termination and Dedicatory ceremonies especially among the Maya to the south of Oaxaca, a structure is burnt and the belongings of the deceased are broken and strewn about the structure, which creates a specific artifact assemblage of the broken pieces of pottery after a structure has been abandoned. Hence, the abandonment and reoccupation in addition to the conflagration may have been the prerequisites needed for the Zapotec of this period to partake in these ceremonial and ritual behaviors. However, the 91 vessels of Structure 7 were not broken or scattered as is the Mayan tradition for
these types of ceremonies (Mock et al. 1998), but rather were placed in the entrance way of Structure 7, a possible incongruity with the practices so far recorded that have been ascertained to be either Termination or Dedicatory ceremonies.

An alternate hypothesis for these 91 vessels involves the structure being abandoned and then becoming a catch all for the neighboring peoples trash. This is, however, unlikely. Trash assemblages have been evaluated and these have different material remains present than what was found at Feature 7 of Structure 7. For example, the remains are often more scattered rather than centralized as the vessel assemblage is at this structure. In addition, the purposeful placement of the vessels, as well as the completeness of these vessels is more consistent with ritual behavior, as refuse is not commonly found in a complete state nor is it placed intentionally in such a way as to block the main entrance of a structure like this cache in Structure 7. Lastly, midden piles typically include all manner of cultural debris from shell to old, worn out tools, obsidian flakes, along with broken vessels. The assemblage of this feature is simply pottery and is still located in the house, an unusual spot for trash.

Further, in ethno-archaeological studies of such neighboring groups as the Maya it has been found that refuse is rarely left inside of a dwelling as these structures were regularly swept and cleaned, though sometimes a broken comal would be used and placed around a fire to act as a windbreak (Stanton et al. 2008). Hence, the Maya kept their dwellings debris free and “refuse was not kept in functioning houses, nor was it observed that abandoned structures were used as refuse dumps” (Stanton et al: 230, 2008). This behavior is not necessarily the same among the Zapotec but the fact that contemporaneous groups kept their structures clean and free from broken or possibly
unused pottery shows that this idea is reasonably applicable to the Zapotec as well.
Lastly, in reference to the placement of a midden or trash heaps, people rarely will place
a rubbish heap in a spot that interferes with daily activities, “people will only expend
effort in managing trash if they are forced to, and if the trash gets in the way of basic
household activities” (Hutson and Stanton 2007:125).

In summary, when looking at the fact that Structure 7 was occupied and reoccupied
over a long period of time, the number of associated burials in this structure, and the fact
that many of the vessels were semi-complete (not particularly ‘trash’ like), it seems
probable that these vessels were indeed a ritual behavior of some sort, possibly the result
of cleansing the structure ritually before adding another floor or doing other kinds of
construction. Thus, it seems likely that ritual behavior is the most compelling answer.

Structure 2, conversely, appears to have an assemblage related to storage or possible
trash accumulation as a result of being a dumping site. Elson characterized this
concentration as tepalcates grandes or large sherds, the majority of which represent
cooking pots and other kitchen wares (Elson et al. 2010:17). The pottery vessels from
which the sherds came would have been used to store corn or other foodstuffs but were
broken and scattered over time. As with Structure 7, there is a small chance these remains
were from a Termination Ceremony where the original inhabitant’s death resulted in the
belongings being broken in an intentional manner and then scattered, all resulting in a
“dense concentration of large sherds with sharp angular edges” (Harrison-Buck: 102,
2014). This is unlikely in this case, however, as the sherds do not look intentionally
arranged, but it is important to consider all possibilities when considering an
archaeological context and sample. Additionally, as the structure had been occupied for
many generations, the detritus of living would have accumulated in the area. Thus, I do
not see enough evidence in Structure 2 to point to ritual behavior and it is likely this
assemblage is what one would expect to find in an upper class Zapotec house of this
period.

3.8 Pottery Types and Forms at Late Classic Jalieza

In researching these two structures it became necessary to study the various types of
pottery within as these apply to various time periods in Oaxaca. Pottery form and paste
type are an important aspect in the study of the economic, social, and political realities of
many different ancient groups. For instance, Zapotec elites would use a different type of
pottery when compared to the lower status Zapotec people. Hence this typing of the sherd
samples can add to our knowledge of who lived at a particular locale as well as what sort
of vessel types were commonly used and by whom.

Between the two structures and the surface survey, the most common paste type for
these vessels is grey, or Gris. This pottery has a medium, dark grey paste common for
this period. This paste is usually quite rough to the touch and not well fired, as noted by
the weakness of these vessels which are made in this fashion. Alternately, a lighter and
finer grey paste was usually used by elite Zapotecs. These types of pottery vessels are
called “cremosas” for their light color and characteristic white inclusions. This type has a
far smoother feel and is frequently better fired compared to the more common grey paste
vessels that most of the Late Classic Zapotec used.

Within this Gris type of paste, there are three categories of grain size (fine, medium,
and coarse) that are associated with different forms. For instance, the apaxtles (basins)
and larger storage vessels such as ollas (large jars) were commonly made using a coarser paste, while the smaller and more complicated forms such as a beak-spouted jar, called an olla pequeña con vertedera de pico, were made with a finer, smaller grained paste (Elson et al. 2010).

Some items had an additional step included in their processing. This step involved painting a ‘slip’ or engobe onto the clay. The particular slips that were used in some of these vessels are called engobe negro or engobe gris (Elson 2010:10) which are either a black-colored slip painted on inside of the vessels with a black sheen or a grey slip which results in a lighter shaded layer. One vessel in particular in our sample, that of the jaguar clawed cup or vase, called vaso garra de jaguar de tamaño mediano de pasta gris fina con engobe negro (Elson et al. 2010:11) shows the engobe negro practice nicely on its interior and also visually demonstrates how finer clays were chosen for more artistic forms. As this cup is almost complete, we choose against sampling it for trace element analysis but we did sample many vessels with the engobe negro present.

The next type of pottery paste in our total sample is called Gris Oxidado, which is simply an oxidized form of the grey paste pottery. However, this type of pottery paste was only sampled from Structure 2. Oxidation is the chemical process that occurs as the pottery is fired when there is a sufficient amount of oxygen present in the firing environment, both kiln and open firing pits. An oxygen-rich atmosphere can change the color of the pottery as iron compounds in the clays become oxidized. For instance, though the potter might use a grey clay, the introduction of oxygen into the kiln atmosphere might result in a more brownish, or even an orange hued color, in the final
product, depending upon clay composition and firing time with longer firing times resulting in a brighter and brighter orange hue (Rice, Gibson, and Woods 1997).

An alternative process that can affect the shade of the final product is known as a reduced environment. A reducing kiln atmosphere will cause the clay to become a black, brown, or grey color as the pottery pieces are fired (Sinopoli 1991; Rice 1982). This occurs when there is less oxygen than required for the fire and causes less combustion to occur within the kiln, resulting in a buildup of carbon monoxide. In the Valley of Oaxaca, reduced grey pottery is present in large numbers, with gris, a grey color, being one of the main types of paste found in both Structure 7 as well as Structure 2. The presence of this type of fired pottery indicates that permanent built kilns, rather than only the open firing pits so common throughout Mesoamerica, were in use during the Late Classic. This kiln type would allow for the reduced atmosphere where the oxygen flow to the fire is constrained resulting in the desired gris, or grey, fired vessel. The presence of permanent kilns is not yet known in the archaeological record of Jalieza, despite the presence of a tremendous amount of apparently kiln-fired reduced vessels in sherd form lying about the countryside and archaeological sites of Jalieza from these vessel types. However, simple up-draft kilns are known from several Late Classic sites in the valley, including Monte Albán (Winter and Payne 1976; Markens and Martínez López 2009).

In addition to the grey paste and oxidized grey paste forms present in Structure 7 and Structure 2, there are also Café, or brown paste vessels present. These are a brown color, and many of these items were of a rougher paste, indicative of the presence of coarse temper. This clay type also had similar forms to the grey and oxidized grey forms. Interestingly, the café paste also appears to have small black flecks present which are a
common occurrence in the Late Classic Jaliezan pottery (Elson et al. 2010:24), although these have been found at Monte Albán as well.

I looked at the distribution of these paste types in the structures to evaluate the frequency of paste types as well as the difference between the paste types from each structure to determine if there are differences between them that might indicate a difference in market participation depending upon status, perhaps. These results are summarized in the figure below (Figure 3.5).

As can be seen from these results below, the assemblages from the two structures are generally quite similar and match what we would expect would be most common in Late Classic houses. Even though the one structure, Structure 2, is considered to be of a higher status due to its size and the presence of the stone tomb and lime flooring, it has approximately the same paste type distribution as the less elite Structure 7 house, except for a somewhat higher percentage of the gris oxidado paste type. The equal distribution between the other paste types shows the availability of those paste types and the fact that they were equally available to different statuses within Zapotec society, presumably through their availability in the market place (Hirth 2010).
As noted, the one incongruity in paste distribution between the houses that stands out is that of the Gris Oxidado paste type. This paste type is found almost entirely at Structure 2 but not in Structure 7, and only in a small number of sampled contexts in the surface survey. In order to evaluate the validity of this apparent difference, I ran a statistical analysis to test the null hypothesis that there was no significant association between the structures and specific pastes.

3.9 Statistical Evaluation of Ceramic Frequencies

Next, I performed a Chi-Square test for homogeneity, for paste types across these three contexts (the structures and the surface survey), with the expectation that all three would have similar paste distributions. I found that although the other paste types were similar
between the three sample locations, the difference between the structures and surface survey are indeed statistically significant when looking at the Gris Oxidado type of paste. As can be seen in Table 3.4 below, the expected count for the Gris Oxidado type sampled from Structure 2 is only 8.46 while the actual count found is 17, almost double the predicted value, while Structure 7 has a predicted frequency of 7 Gris Oxidado paste vessels but 0 in the sample. In balance, Structure 2 has more Café pastes than expected, while Structure 7 has fewer (Fig. 3.4). Thus, it appears that Gris Oxidado was preferred to Café vessels in the higher status residence.

Table 3. 4 Paste by Provenience

<table>
<thead>
<tr>
<th>Paste</th>
<th>Provenience</th>
<th>Count</th>
<th>Est. 2</th>
<th>Est. 7</th>
<th>Surface</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amanillo</td>
<td></td>
<td>2</td>
<td>0</td>
<td>1</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Café</td>
<td></td>
<td>24</td>
<td>14</td>
<td>15</td>
<td></td>
<td>53</td>
</tr>
<tr>
<td>Café con engobe negro</td>
<td></td>
<td>2</td>
<td>5</td>
<td>2</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Café cremosa</td>
<td></td>
<td>0</td>
<td>0</td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Café o gris oxidado</td>
<td></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Gris</td>
<td></td>
<td>45</td>
<td>55</td>
<td>44</td>
<td></td>
<td>144</td>
</tr>
<tr>
<td>Gris con engobe negro</td>
<td></td>
<td>3</td>
<td>4</td>
<td>1</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Gris oxidado</td>
<td></td>
<td>17</td>
<td>0</td>
<td>5</td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>Gris oxidado con engobe negro</td>
<td></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>94</td>
<td>78</td>
<td>71</td>
<td></td>
<td>243</td>
</tr>
</tbody>
</table>

In addition to the difference in frequency counts for expected and actual frequencies, the null hypothesis, that the two houses and the surface survey samples had the same paste
distributions, is shown to be incorrect. This is proven by the highly significant chi-square value, $X^2 = 35.12$ (df =16, N= 243; $p < .001$) indicating that there is an association between structure and paste, owing largely to the difference in the Gris Oxidado and Café paste frequencies. The reasons behind why the more elite structure had such a high proportion of Gris Oxidado paste types may have to do with certain paste types being preferred by higher status people.

As far as vessel forms, there are many different vessel types for many different purposes at this site, showing a good cross-section of the vessel forms which were available and in use during the Late Classic in Oaxaca. For example, the G.35, a diagnostic Late Classic vessel form, was present in Structure 7 and in Structure 2. G.35s are a type of bowl with straight or out-curving walls that was used and produced in Classic Oaxaca at this time. Additionally, some of the G.35 forms have three to four small supports that are placed equidistant apart. Some of these legs are hollow while others are solid. In the solid form, small holes are placed in the ‘leg’ to allow for hot air to escape, in order to keep the support/leg from cracking during firing.

Other utilitarian forms were present as well from Tlecuils (braziers) to Ollas. Ollas (jars) are a common vessel form in Mexico for storage and tend to be fairly large, although there are small ollas made during this period as well. One very important utilitarian type present in Mesoamerican homes from this period, that of a comal, or tortilla griddle, was also in this surveys artifact assemblage. Comals are an important main cooking utensil for the Zapotec. They have been shown to be effective at predicting family size, and archaeologists can use them as population measurement devices of dwellings from the archaeological record fairly effectively (Brumfiel, 1980).
Finally, household ritual items include *Sahumadores*. These were used to burn incense, for instance during a termination ceremonial activity such as the Maya practiced to the south (Rice, 1999) or during a bloodletting ceremony common among the Zapotec as well as other groups at this time (Marcus, 1978).

I next evaluated the frequency of vessel forms at the two structures, again using a Chi-square test for homogeneity of the different pottery shapes. This is illustrated first in a chart below in Figure 3.6.

**Figure 3.6. Relative Frequency of Type by Structure**

In both structures, cajetes are clearly the most common vessel form, followed by ollas.
Beyond that, there are some significant points which are different. For instance, the number of comals (tortilla griddles) is much higher in Structure 2 than in Structure 7. This difference might be the result of higher population in the larger house as comals are an excellent predictor of household size and Structure 2 is bigger than Structure 7 (Brumfiel 1980). Additionally, Structure 7 has both a higher percentage of malacates (spindle whorls for weaving) and vasos (vases). This might also be a result of the household production which was occurring in Structure 7. There were no malacates found at Structure 2 indicating there might be a higher production level of textiles in lower status houses.

I evaluated these results in another Chi-Square table for the vessel type by provenience to see if there was a statistical difference between the two structures and the surface survey.

As can be seen from Table 3.5 below, the overall distribution of all forms relative to provenience are shown to be non-homogeneous as shown by the highly significant chi-square value $X^2 = 45.82$ (df =16, N= 243; $p < .0001$). These differences in form between structures could be related to production; if the structures were producing ceramics in the Late Classic, whatever form they produced would be in greater number than predicted value as they would have a larger number to trade at market, for example. Lastly in the case of the comal, a vessel type which has been used to predict the population of a structure, there is a large difference in distribution.
Structure 2 has 11 comals vs. a predicted value of 1.37, while the surface survey shows 7 comals with a predicted frequency of less than 1; in contrast, Structure 7 has very few of these forms. The fact that there is such a disparity between the predicted values for Structure 2, for instance, might be due to the size of the household. Alternatively, comals were being produced there, as is common to this day in Oaxaca where comals are made by specific artisans.
3.10 Figurines

Along with the sample of mostly utilitarian items from the two structures, there were also many figurines found including ‘anthropomorphic whistles’ called silbatos. Zoomorphic figurines were found in both Structure 7 and Structure 2 as well; these are a common type of figurine in the Late Classic period of Oaxaca. Of the figurines found, 38 were found at Structure 2, and 66 were found at Structure 7. We took a small sample of these figurines from the pieces present in all three contexts, Structure 2, Structure 7 and the Surface Survey. However, it is important to note that of the figurines found by Elson’s team, and of which we sampled, “over 80% were found to be from Structure 2 or Structure 7 (not the surface survey or other structures evaluated in the survey by Elson’s team)” (Elson et al. 2010: 42). This shows that these two structures were probably either manufacturing these ritual items or possibly doing some other ritual activity. It is important to note, however, that ritual household activity was common for the Classic period Zapotecs and many houses would have this sort of assemblage. It is not unique in that sense.

Although the number of figurines we sampled was limited, it does allow us to get a preliminary idea of where the figurines were being made and open up the possibility for future research into the production, trade, and distribution of these household ritual items.

In addition to these figurines, the excavations encountered numerous figurine molds. These clay molds were used to create figurines in a standardized manner, another indication of commercial activity at the household level. The figurines had been shaped by placing the clay into the mold when it was wet and still pliable; it appears that then small individual variances would be added as each figurine has particular unique additions such as a different
eyebrow expression, mouth placement or other small changes to the mold form. When considering the presence of the molds, we can extrapolate that these types of ritual items were made at a household level during the Late Classic in Oaxaca.

3.11 Summary

These two structures along with the surface survey offer a chance to see the range of pottery forms and pastes present in a household assemblage during the Late Classic at Jalieza. By analyzing the statistical variation of the forms and pastes types, I was able to show (1) that in all cases the assemblage is dominated by gris and café bowls and jars as is typical for a Late Classic household assemblage; but that (2) the distribution of other vessel pastes and forms varied somewhat by context. This variation was probably the result of factors such as household production, status, or the difference in household size between the structures. Taken as a group, however, these three contexts represent an average view of Late Classic Jalieza. The next step in my research was to evaluate the items using trace element analysis at Oregon State University to discover the vessels provenance. In my next chapter, Chapter Four, I discuss this process of trace element analysis step by step as well as describe the different clay groups and ceramic production sources present in the Oaxaca Valley.
Chapter 4. INAA of Ceramics and Geochemical Groups for the Valley of Oaxaca

4.1 Introduction: Selection of Ceramic Samples

In archaeology, in order to understand past societies, it is necessary to have a solid material record from which to obtain data. Pottery is an excellent material method for this as it was used ubiquitously in Mesoamerica for many different purposes. From burial to food, to storage and ritual items, pottery was everywhere. Additionally, because of the Oaxaca Clay Survey done by Minc and Sherman (2011), a Oaxaca clay database was created which allows one to match geochemical signatures to their origin from the valley. This database allows for provenance determination effectively helping to show with whom the Zapotec of Jalieza, or other locales, were trading.

In the summer field season of 2013, we traveled to Jalieza, Oaxaca to assess the Jalieza assemblage and take a sampling of the items stored for INAA. The whole of the artifacts from the Elson excavation and survey were stored in the community center at Santo Tomas Jalieza, a small farming and weaving community about 20 miles south of Oaxaca City. We started by looking at the culturally defined assemblages or features from the two structures, and we attempted to sample every vessel that we could within those features. Later, we added in a sampling of the surface survey material to get a baseline idea of the types and forms of vessels in Jalieza at this period. We took a random sample of the surface survey collections with the larger and more complete sherd pieces being chosen if possible, following Neff’s sampling strategy to sample a diversity of different types. Neff advises that in order to obtain solid provenance data, one should start “by spreading the collection out on a large horizontal surface and sorting it into groups in a manner that maximizes intragroup similarity and intergroup difference” (1993:29).
4.2 Documentation and Sampling

All vessels were photographed in the field, prior to removing a small portion for analysis. We then cleaned off the items with a brush and sampled from the rims, walls, and bottoms of the various vessels. In the case of more complete vessels, we carefully chose the spot to nip in order to do the least amount of damage to the vessel. In the case of figurines, we looked for pieces which had already begun to become separated from the whole in order to protect the figurine if possible. If the vessel was indeed entirely complete, we did not nip from it but only photographed it, as was the case for the majority of figurines and all of the figurine molds. In the case of the mortuary goods, we choose to not sample these items at all due to our desire to both preserve complete pieces as well maintain respect for objects associated with burials. The nipped samples were then numbered, bagged, and then re-photographed and then exported.

4.3 Preparation of Samples for Trace Element Analysis

All ceramic samples were processed at the Archaeometry Lab, located within the Radiation Center at Oregon State University. First, the sample was assigned a unique identification number. All samples were then documented to create a photographic record; each sample was recorded three times from three different perspectives: inside, outside, and the profile of the vessel. Paste characteristics of the samples were also studied visually. To do this, the sample was photographed on a fresh break using a high resolution microscope, a Keyence Digital Microscope, at three different magnifications, 50x, 100x, and then finally 200x. Through the microscopic picture, overall texture, the
size and color of mineral inclusions and other significant features can be assessed which help show such important things about the pottery such as whether temper was used, and if the minerals appear local to the site.

4.4 Sample Preparation for INAA

Once this recording process was complete, the samples were then washed in deionized water and placed in a low temperature oven at about 150 degrees Fahrenheit to dry for approximately 24 hours. Once this sample was dry, it was pulverized into a fine and even powder using an agate mortar and pestle which is cleaned between samples with the deionized water. This process also required the use latex gloves by the preparer in order to keep out contamination from possible dirt, skin oils, and other foreign objects. Finally, ca. 250 milligrams of the resultant sherd powder was measured at into a high purity polyethylene vial.

Along with the samples, standards were prepared. The standards used in the study are NIST1633 (coal fly ash), and NIST688 (basalt). These provide a known chemical signature against which the unknown ceramic samples can be compared. In addition, check-standards were included to ensure that the analyses are giving us accurate results. If the check-standards come back with incorrect levels for the various elements, then we know something is amiss and can rerun the test.

4.5 Irradiation Protocols

The samples were irradiated in the TRIGA reactor at Oregon State University in order to bombard the samples with neutrons and obtain a chemical signature. First, using the pneumatic tube system, the samples were irradiated for 20 seconds with a flux of $10^{13} \text{n} \cdot$
cm$^2 \cdot s^{-1}$) (Minc and Pink, 2014), and then the gamma spectra collected for a real time count of 540 seconds after a decay of 22 minutes. This first irradiation provided data on the short half-life isotopes, such as Al, Ca, Dy, Mn, Ti and V, as well as the intermediate half-life isotopes Na and K.

The samples were then irradiated again for 14 hours in the rotating rack around the reactor core at a lower neutron flux of $10^{12} \text{ n} \cdot \text{cm}^{-2} \cdot \text{s}^{-1}$ (Minc and Pink, 2014). This process activates the longer half-life isotopes. The resultant activity was allowed to decay for approximately five days and then evaluated using a 5000 s live-time count to characterize the medium half-life isotopes such as As, La, Lu, Sm, Na, U, and Yb. Finally, four weeks later the sample was examined again with a 10000s live-time count of activity to look for the longer half-life isotopes. Thus the process is done in three steps, where the sample is bombarded two times and examined three times to allow for all of the isotopes to decay and allowing us to obtain their signatures within each sample.

Based on direct comparison with the standards, the observed activities were converted to element concentrations. All concentrations were reported in parts per million (ppm) and converted to log(10) values for statistical analysis.

### 4.6 Establishing Ceramic Provenance

The goal of provenance determination is to look for chemical signatures in the pottery which match ceramics or clays from various areas within the region. Prior analyses of natural clays in the valley as part of the Oaxaca Clay Survey (Minc and Sherman, 2011) have established chemical signatures for different subareas within the valley with which
to compare results. Jalieza pottery displayed a number of chemical signatures which made it possible to match the pottery to the locale from which the pottery had come. The Valley of Oaxaca has a fairly complex geology as noted earlier which strongly affects the chemistry of the clay (Minc and Sherman, 2011). Major geological units are defined as:

1) Metamorphic complex from the Precambrian era. This type of parent material along the western part of the valley comes mostly from dioritic gneisses. There are also cases of “localized outcrops of meta-granites and meta-anorthosites” (Minc and Pink: 3, 2014).

2) Sedimentary complexes from the Cretaceous. This is made of conglomerates, limestone as well as fine-grained “calcareous mudstones known locally as calcilutites that extend in an irregular band through the center” (Minc and Pink: 3, 2014).

3) Andesite and ignimbrite from volcanic activities which are located in the eastern arm of the valley as well as along the eastern side of the southern arm (Minc and Pink: 4, 2014).

The chemical differences of these different parent materials provide a template against which the results of the INAA testing were compared. For the analysis, 29 different elements were included and assessed in this process. The results were then analyzed using multivariate statistics and were also compared to known sample results from groups of Late Classic Valley of Oaxaca sherds (Minc, 2013; Minc and Pink, 2014; Pink, 2014).

Jalieza was part of a larger study in which more than 1300 Late Classic sherds were assessed in the same manner. Because there was this large, regional sample of sherds, Minc and Pink (2014) were able to distinguish 17 chemical signatures for Late Classic
pottery within the valley of Oaxaca and link them to specific locations based on the chemistry of the clays at the locale. These groups were defined using both the Oaxaca Clay survey data and what is known about the geology of the valley. These so-called “reference groups” were then used to identify the source of the Jalieza sherds. The methods used by this study are summarized next.

4.7 Statistical Analysis of the Trace-element Data

The Oaxaca Project encompassed 1300 ceramic samples from Late Classic sites throughout the valley. We statistically evaluated the chemical data using a series of steps to find from where these samples originated. These steps started with exploratory data analysis whereby we looked for similarities and groups among the sherd samples. This was done by creating a series of bivariate plots displaying pairs of elements (Baxter, MJ, 1999; Kriegal et al, 2011; Pink, 2014). Additionally, cluster analysis was used whereby samples (sherds) which have more similarities are grouped together, resulting in a series of ‘clusters’ which represent samples with a similar chemistry indicating similar provenance or same provenance.

The clusters were developed by using a core series of chemical signatures common to the cluster groups while “clear outliers and major divisions between groups were identified, as were elements important in discrimination between the groups” (Pink: 86, 2014). This process is difficult as noted by Neff (1998) and Baxter (2001) who describe the analysis of multivariate plots as a process of “align(ing) geographic co-ordinate units

The coherence of these preliminary groups was tested using the Mahalanobis distance measure which assesses the distance between the centroid or the mean of the group and a particular sample (Baxter, 1999). Thus, it quantifies how many standard deviations the sample is away from the centroid, or mean. This is a statistical method by which the similarity a sample has to the reference group is assessed statistically.

Group affiliation was assessed using principal components analysis (PCA), owing to small group sizes in some cases. In multivariate analyses, a “rule of thumb suggests that group membership should be at least three times the number of variables (or elements) used in the analysis” (Minc and Pink 2014:15). PCA is a method which uses weighted linear combinations of variables or components rather than the actual elemental concentrations in order to account for this issue. This process was completed by obtaining the principal components based on the original Oaxaca Clay Survey samples (Minc and Sherman 2011). Seven principal components were developed and used to assess the reference groups and samples (see Minc and Pink 2014 for details).

**4.8 Geochemical Groups for the Late Classic Oaxaca Valley**

The provenance study indicates that by the Late Classic fully 17 different areas in the Valley were producing pottery. This included a variety of elementally specific geochemical groups which can be grouped in five sub-regions (Minc and Pink, 2014). These groups include:
1) The Anorthosite group from the northern Etla branch;

2) The Gneiss group from the Western Valle Grande (WVG);

3) The Calcareous sedimentary rock group of the Eastern Valle Grande (EVG);

4) The Andesite-derived clay group of the southeastern Valle Grande (SEVG);

5) The Ignimbrite and Andesite clay type from the Tlacolula branch of the Valley.

From these groups, the locale and type of pottery manufactured was derived. This includes the results described below (after Minc and Pink, 2014).

1) **Cremosa Ceramic Group** - Cremosa potteries are an elite ware which is a whitish or light grey in color. They tend to be highly fired and made with smooth and even clays. This pottery type is connected to the anorthosite group from the Etla area. The Cremosa refers to “the presence of whitish, plagioclase inclusions… located to the north of Monte Albán” (Minc and Pink 2014:18).

   A) **Monte Albán-Trapiche Cremosa Group** - Of the Cremosa types there are two subtypes of Cremosas. Type A refers to the Monte Albán-Trapiche Cremosas which are rich in aluminum and sodium (Al and Na) derived from the plagioclase inclusions, a type of feldspar which consists of aluminosilicates rich in sodium and calcium which tend to be white (Milam, 2010: Minc and Pink, 2014).

   B) **High Iron or Fe Cremosas Group** - This group is also high in aluminum and sodium like the Cremosa ‘A’ group but “are somewhat higher in Iron and Rare Earth Elements” (Minc and Pink: 18, 2014).

2) **Western Valle Grande Group** - This group has five subgroups all high in Rare Earth Elements (REE) and come from Gneiss clays.
A) **The Northwest Valle Grande Group** which is high in scandium (Sc) and low in thorium (Th) and rubidium (Rb). The clays in this group, and the potteries from these clays are from the Cuilapan area of Oaxaca, near the Valle Grande area.

B) **The Yaasuchi Medium Rare Earth Group** which is from the area of Yaasuchi, to the west of the central part of the valley is most closely similar to Zimatlán clay in its chemical signature; thus, this makes Yaasuchi its most probable origin locale.

C) **The Yaasuchi High Rare Earth Group** which is from clay that is located approximately 1.5 km away from the site of Yaasuchi. It is high in the Rare Earth Elements (REE) and low in europium (Eu).

D) **The Middle Atoyac and Zaachila Group** which is low in Rare Earth Metals and higher than the surrounding areas of the Oaxaca Valley in Cesium (Cs); this group is from clay derived from the Zaachila and Atoyac areas.

E) **The Monte Albán Gris Group** which is a Grey ware that is high in calcium (Ca) but is also similar to the Atoyac/Zaachila Group (2D).

3) **The Monte Albán- Eastern Valle Grande Group** - This group consists of clay derived from calcilutites, basically limestone rich clay (Flügel, 2010). This group has high amounts of calcium (Ca) and is from the eastern side of the Valle Grande. This type of clay however, is patchily located all the way from San Agustin de las Juntas to Cerro Tilcajete, just north of Tilcajete. This means pottery from this group could come from a variety of manufacturing locales. The clays from the northern Valle Grande are higher in
Calcium (Ca) near San Agustin while Ca is lower in clays from the Cerro Tilcajete area and subsequently the pottery made from these locales.

4) **The Southeast Valle Grande-Ocotlán Group**- This group is localized near Jalieza, in the middle of the Valley in a very geologically complex area. Sedimentary, metamorphic, and volcanic rock are common in this locale leading to a possible mixture of clay chemical signatures. Jalieza clay has high andesite, an extrusive volcanic rock, shown by the low calcium (Ca) in the potteries from this area.

   A) **The Jalieza High Chromium (Cr) Group**- This group is high in chromium while being equal in Iron (Fe) to the rest of the valley (Minc and Pink, 2014). It is found to be from a narrow strip of land which goes across the Jaliezan pass to Santa Cecilia Jalieza and all the way to the eastern part of San Martin Tilcajete.

   B) **The Jalieza Low Chromium (Cr) Group**- This group is low in chromium (Cr) and is more similar to the clays found in Ocotlán to the south and Santo Domingo Jalieza.

   C) **The Southern Group**- Lastly, a small proportion of the Jaliezan samples were similar to the clays found around Ejutla to the south.

5) **Tlacolula Ceramics**- This group has “at least seven different composition groups” (Minc and Pink: 20, 2014) which share high concentrations of cesium (Cs), rubidium (Rb) and arsenic (As) derived from “ignimbrites and andesites” (Minc and Pink: 20, 2014). The location of these groups is in the east arm of the Valley.

   A) **The Dainzú Café Group**- This group is from the Dainzu area of Tlacolula, and are thought to be from the clays located to the south of the eastern side of
Cerro Chavagua. Both *amarillo* and *café* wares, yellow and brown, are in this group despite the name.

**B) The Central Tlacolula Group** - This group includes both the wares called *Gris* (grey) or *Amarillo* (yellow). This group is from the Lambityeco as well as the Dainzú-Macuilxochitl sites located in this area. As the potteries from these two sites have such a similar chemical signature, it is likely they were from the same locale.

**C) The Eastern Tlacolula (perhaps Yagul) Low Thorium (Th) Group** - This group is also from the Tlacolula sub-valley but has both higher concentrations of cesium (Cs) and rubidium (Rb) as well as thorium (Th) when compared to the Central Tlacolula Group defined above. This concentration shows an ignimbrite influence, ignimbrite being the result of pyroclastic flows and mainly composed of silica such as is common for felsic rocks. Ignimbrite can be associated with andesites, a brownish volcanic rock, as well. The clays which match these ceramics are closest to Matamoras de Tlacolula.

**D) The El Pamillo 1 and El Pamillo 2 Groups** - These groups are high in rubidium and cesium from the Ignimbrite influence common to the Tlacolula sub-valley’s geologic composition. The El Pamillo 1 Group matches clays from the SE Piedmont of the Tlacolula arm while the El Pamillo 2 Group matches the same general area but further north.

**E) The Eastern Tlacolula High Cesium (Cs) Group** - This group is considered “Dispersed and held together by extreme concentration values of cesium indicating a strong influence of ignimbrite” (Minc and Pink: 22, 2014).
F) The Eastern Tlacolula High Arsenic (As) Group - This group was determined to be of unknown provenance but seems to most closely match the El Pamillo Groups. Two clay samples from the Taniyvet area, in the eastern Tlacolula branch, appear to match this group, but there are not enough ceramic samples to do a multivariate statistical comparison.

![Provenance Results](image)

**Figure 4.1- Provenance Results for Jalieza Ceramic Sample**

4.9 Geochemical Groups represented at Late Classic Jalieza

As can be seen in Figure 4.1, two main composition groups are associated with the Jaliezan assemblage: (1) the Low Ca, or the low calcium group, and (2) the high Cr, or
high chromium group; these account for over 70% of the total sample. Both are considered local to Jalieza showing that Jalieza produced most of its own ceramics for consumption. The remaining 29.4% comes from a variety of sources, with only 2.9% from Monte Albán indicating that this was not a main trade site for Jalieza. This group, the MA/EVG group, is not necessarily indicative of trade with the elite state seat but rather it means that the clay from near this site matches 2.9% of the Jalieza assemblage. The area associated with the MA/EVG group (Minc and Pink 2014) includes areas outside of Monte Albán and in fact the clays which exhibit this chemical signature have been traced to the Valle Grande as well: “similar clays also extend for a considerable distance along the eastern Valle Grande, from San Agustín de las Juntas to south around Cerro Tilcajete” (Minc and Pink 2014:19).

The next group that Jalieza traded with as shown by these results is the Atoyac/Zaachila area. This are makes up 14.3% of the total assemblage and is quite close to the site of Jalieza. This source matches clays from the alluvial zone near the Atoyac river. Another 2% at Yaasuchi shows that Jalieza was in some contact with this neighboring Late Classic settlement, although Yaasuchi has none of the High Cr or Low Ca groups associated with Jalieza, indicating one-way trade. Next is the Eastern Tlacolula High As compositional group which amounts to at 3% of Jalieza’s assemblage, while less than 1% came from Central Tlacolula. This shows that the Jaliezans were making it all the way over to the Tlacolula sub valley for trade purposes, and that the people of Jalieza were traveling to areas that were as far as 23 km away via Least Cost Path distance or 20 km for straight line distance (see Chapter 3 of this thesis). Hence the sherds sampled traveled a substantial distance, indicating Jaliezans were trading with more distant areas,
along with areas that were easier to reach energy expenditure wise. Lastly, 7% of the Jalieza assemblage was undefined. This means that the clays matched no known source within the valley, although they are probably local to the valley (L. Minc, pers. comm.).

The results from this provenance study can now be evaluated in order to assess the validity of the predictive models I developed in GIS and with the gravity model. The next chapter, the conclusion, I will go over these results and discuss what they may mean to the trade of Jalieza.
Chapter Five: Conclusions
5.1 Conclusion and Discussion
In this final chapter I assess and summarize the findings from the GIS study as well as use the gravity model data from other Late Classic sites to ascertain the veracity of the prediction of Jalieza’s attempt at independence. I look at the results from the whole of the Late Classic Oaxaca INAA Project and compare these provenance results from the larger study to the results in my study to discover if a pattern exists between them. And finally I will formulate a conclusion as to Jalieza’s economic status at the time when Monte Albán was dissolving and whether it was indeed becoming an independent political state.

5.2 Summary and Evidence of Pottery Exchange
The trace element results for the Jalieza collection show that 70.6% of the Jalieza pottery sample from Structure 7, Structure 2, and the Surface Survey were made locally. This percentage (70.6%) is the combined number of the two Jaliezan compositional groups, Low Ca group and High Cr group, showing that the potters of Jalieza were utilizing two local sources for their clay to manufacture pottery. This finding highlights that Jalieza was indeed more locally dependent upon pottery made in their households, rather than pottery made at Monte Albán.

Additionally, the majority of the remaining sherds sampled from Jalieza came generally from the areas closest to Jalieza, consistent with considerations of economic efficiency which would have the Jaliezans obtaining necessary goods from the least energy consumptive locales. This portion includes 14.3% of the total sherds linked to the Atoyac and Zaachila areas as discussed in Chapter 4. These are areas that are both quite close to the site of Jalieza and easily within a half day walk as shown by my GIS model. For instance, the distance from Jalieza to Zaachila is 14.19 km or about a 3 hour walk
when taking into account slope at a 5 km per hour rate of walking. That is quite near and would be a reasonable distance to travel in a half day.

**Table 5.1- Provenance Results with ‘Pull’ and Travel Times**

<table>
<thead>
<tr>
<th>Source of Ceramics</th>
<th>% of Jalieza Assemblage</th>
<th>Straight line Distance from Jalieza</th>
<th>Travel Distance (hrs) From Jalieza</th>
<th>Relative “pull” of Settlement using Travel Time instead of distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jalieza High Cr</td>
<td>46.9</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Jalieza Low Ca</td>
<td>23.7</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tlacolula (Both Tlacolula Compositional groups)</td>
<td>3.04%</td>
<td>20 Km</td>
<td>5.25 hours</td>
<td>10434783</td>
</tr>
<tr>
<td>Yaasuchi Medium REE group</td>
<td>2 %</td>
<td>16 km</td>
<td>3.2 hours</td>
<td>175000</td>
</tr>
<tr>
<td>MA/EVG Group from Monte Albán area</td>
<td>2.9%</td>
<td>22 km</td>
<td>4.93 hours</td>
<td>15360000</td>
</tr>
<tr>
<td>Atoyac/Zaachila</td>
<td>14.3%</td>
<td>14.19 km</td>
<td>2.83 hours</td>
<td>4285714</td>
</tr>
</tbody>
</table>
An additional 2% of the total was linked to the Yaasuchi High Rare Earth Element (REE) group. Yaasuchi, like Zaachila, is quite close to Jalieza and can be reached in approximately 4.5 hours on foot. However, the small percentage of the Jalieza sample found to be associated with Yaasuchi, as well as the lack of any Jaliezan pottery at Yaasuchi (Pink 2014), may be partly due to the fact that the vessels were obtained indirectly from the Atoyac/Zaachila area, near to both the Jalieza and Yaasuchi settlements. As Yaasuchi was a very small settlement in the Late Classic with only a few hundred people living there, a more likely scenario is that Zaachila, an important site in the Late Classic, acted as an intermediary and probable market center between the two settlements as its Late Classic population was 2,100 (Lind and Urcid 2011).

Interestingly, when taking this into consideration, the number of the samples from Yaasuchi actually strengthens the argument that a shorter distance equals more trade. This is because the number of samples from Monte Albán becomes statistically less powerful as the population there was so much larger than Yaasuchi in the Late Classic, or Zaachila. As only 2.9% of the total Jalieza sample can be linked provenance wise to the Monte Albán locale, about 5 hours at the 5 km/h rate, it again appears that the Jaliezans were picking their trade destinations dependent upon the amount of effort they must expend. However, these sherds reported to be from the MA-EVG group might not be actually manufactured at Monte Albán but rather the at the nearby site of San Agustin de Las Juntas as deduced from the clay samples with which the sherds were matched. Lastly, 7% of the Jalieza sample was considered indeterminate. This indicates that 7% of the
ceramics sampled came from unknown sources of the area of the Clay survey, but probably within the Valley of Oaxaca. Finally, as there was 3.0% linked to the Tlacolula sub-valley to the east in the Central Tlacolula area it is important to note that the sites in this area are accessible via the Camino Antiguo, helping to verify the possibility that this route was important to Late Classic Jaliezan trade.

All of these results point to a few facts. Firstly, like the other sites which were sampled in the Oaxaca project overseen by Dr. Leah Minc of Oregon State University, Jalieza was both trading with other locales as well as locally manufacturing its own pottery. The choice of where the Jaliezans went to trade appears to be dependent upon distance in the majority of the cases. In general, the closer a fellow Late Classic site was, such as Zaachila or Yaasuchi, to Jalieza, the more likely it was that Jalieza traded with them. However, there was a larger percentage of vessels associated with the Lambityeco area, a more distant locale, than from the capital of Monte Albán. The question is then, what was the reasoning behind Jalieza’s choice and what does that show us about the Late Classic political situation?

5.3 Pottery Imports Relative to Least Cost Predictions

In order to evaluate whether Jalieza was avoiding Monte Albán for political reasons, or out of convenience, I next examined how trade was affected by travel-time distance and the gravitational “pull” of larger settlements. First, I utilized the Brainerd Robinson (B-R) coefficient to assess similarities in assemblage composition based on sources of pottery. The B-R coefficient essentially measures similarity between two assemblages, by comparing the absolute differences in their percentages and subtracting from 200. In this measure, 200 equals no difference in sources of pottery, while 0 equals completely
different. According to the model of economic efficiency, as distance increases, similarity would decrease, and would declines from 200 eventually down to 0.

In Figure 5.1 below is the equation for this analysis. The sum of the two assemblages are subtracted from the main coefficient of 200.

\[
S = 200 - \sum_{k=1}^{p} \left| P_{ik} - P_{jk} \right|
\]

Figure 5.1 B-R Coefficient Equation


Figure 5.2 B-R Coefficient for Each Site showing Similarity to Jalieza
In the graph above are the different compositional groups associated with a site compared against Jalieza’s assemblage for similarity. Normally, as distance increases, we would see a reduction in similarity but here we see the exact opposite with sites such as Lambityeco and El Pamillo having a much more similar assemblage with 154.72 for the site of Lambityeco, 152.27 for the site of El Pamillo whilst the site of Monte Albán, which is closer and energetically less consumptive, is lower at 115.46.

Next in order to fully analysis this difference ad incongruity in the BR Coefficient with similarity actually increasing with distance, I then graphed the B-R coefficient relative to travel time as predicted by the Least Cost model using Tobler’s Hiking Function in Figure 5.3 below. This plot nicely demonstrates that normally as distance increases from my origin site of Jalieza, the degree of interaction between the sites (as indicated by the B-R coefficient) decreases. This figure shows that the assemblage from Jalieza is closest in similarity to Yaasuchi, and this similarity between Jalieza and Yaasuchi is reaffirmed by the fact that both obtained pottery from the same source, that of the Atoyac/Zaachila compositional group. This is logical as this is a close site for both settlements. Lastly, the 200 for the group from Jalieza allowed me to check my work as it would not come out as 200 if I had done this wrong. This is a failsafe which helps show the veracity of the analysis.
Figure 5.3 Bivariate of BR Coefficient by Travel Time in Hours

Once again, note that as travel time increases, the similarity normally decreases except in the case of the El Pamillo and Lambityeco site, further strengthening the possibility Jalieza is intentionally avoiding Monte Albán in economic transactions.

5.4 BR Coefficient by Travel Time to Sites

Finally, I plotted the B-R coefficient by gravitational pull (Figure 5.4 below), with pull shown on the vertical axis and the B-R coefficient on the horizontal axis. This plot shows some interesting results. For instance, although Monte Albán’s ‘pull’ is the highest, its B-R coefficient is very low, showing that Monte Albán’s ceramic assemblage had almost no similarity to Jalieza. This shows again these sites were not obtaining their pottery from similar sources, further supporting and enhancing the possibility that Jalieza was operating in a separate sphere from the elite run Monte Albán.
5.5 Jaliezan Exports

In order to get a larger picture of ceramic trade, I next looked at what places in the Valley were getting their pottery from Jalieza. This would be shown as the presence of the Jaliezan Low Ca group or the Jaliezan High Cr group in the local assemblages. The only sites with the Jaliezan compositional group in evidence were Dainzú and Lambityeco, both in the Tlacolula sub-valley. Specifically, Jaliezan imports represent 1.7% of the assemblage at Dainzú and 5.3% of the assemblage at Lambityeco (Minc and Pink 2015:28). Both are from the Jalieza low Ca group.

In looking at this pattern more closely, we discovered that the Jaliezan vessels recovered from the Lambityeco site were all one specific type of vessel, the Cajete Semiesférico. This might be due to Jalieza trading with Lambityeco for salt, bringing a specific vessel type for this transaction as Lambityeco was the main salt producer for the Valley (Lind and Urcid 2011). The lack of Jaliezan pottery at any of the other areas other
than the Tlacolula arm, shows that Jalieza was not exporting to these spots. Oddly, Yaasuchi ceramics were found in Jalieza but not the reverse. This supports the possibility that Jalieza prioritized the Camino Antiguo trade route, perhaps functioning as an important trade stop and trading locale. However, to fully assess this, more research into both the Camino Antiguo and Jalieza would be needed.

5.6 Summary

To summarize, it would appear that by the Late Classic, multiple settlements were possibly existing with their own elite lineages separate from Monte Albán, as shown by the genealogical records (Marcus 1983). Further, it appears that trade among these settlements was in general dependent upon considerations of travel and transport efficiency. In this context, Jalieza’s economic independence from Monte Albán appears to be a reality, based on actual data reflecting with whom Jalieza was trading. When the Least Cost Path results are combined with the gravity model’s predictions and the provenance data, there is a compelling argument that Jalieza was operating fairly independently of Monte Albán. Monte Albán was large, with lots of “pull”, and was fairly close; yet Jalieza imported almost no pottery from this center and overall their assemblages reflect very different sources of pottery.

Further, other sites in this Late Classic study exhibited similar behaviors to Jalieza. The sites all appear to have two main rules in relation to pottery, that of (1) local pottery being most commonly used, as well as (2) the use of imported pottery but only if it did not require a long journey to obtain it. Even in the case of Lambityeco’s possession of pottery from the Jaliezan compositional group of Jalieza Low Ca, the travel time when
utilizing least cost paths amounted to no more than 6 hours, a reasonable hike. This localized trading behavior supports the theory put forth by researchers Joyce Marcus and Kent Flannery (1996) who argue that by the end of the Late Classic, the Oaxaca Valley was experiencing a sort of political and economic Balkanization of the various sites.

5.7 Further Research

As Jalieza has been so sparsely studied, many of the questions posed in this study could be more fully answered if further and more extensive survey of the Jalieza site was done. The study of Jalieza’s figurine iconography, a trace element analysis of pottery collections from structures of the Early Classic, as well as further survey to try and locate genealogical markers for the site, would all add to the increasing library of information which is helping to paint a picture of the Valley of Oaxaca and particularly, this important site. Lastly, a more complete study of the trade routes used by Jaliezans appears to be in order. Specifically, it would be helpful to explain the undefined 7% from the Late Classic Jaliezan sample. Given Jalieza’s apparent reliance on primarily local pottery, this would require more intensive study of the clays around this site to attempt to obtain a provenance for the 7% as well as an assessment of least cost paths to these possible sites. With further research, more of the Jaliezan economy, its social structure, as well as the overall structure of Zapotec society as a whole could be advanced.
Bibliography

Arnold, Dean

Balkansky, Andrew K.

Balkansky, Andrew K., Gary M. Feinman, and Linda M. Nichols

Banning, E.B., A. Hawkins, and S. T. Stewart

Baxter, M.J.

Baxter, M.J.

Bentley, R. Alexander, Herbert D.G. Maschner, and Christopher Chippendale
2008 *Handbook of Archaeological Theories*. Altamira Press, United Kingdom.

Blanton, Richard, Gary Feinman, Stephen Kowalski, and Linda M. Nichols

Blanton, Richard E., Jill Appel, Laura Finsten, Steve Kowalewski, Gary Feinman, and Eva Fisch

Bonatto, S.L., and F.M. Salzano
Carballo, David

Caso, Alfonso

Caso, Alfonso, Ignacio Bernal, and Jorge Acosta

Craig, J.H.

Elson, Christina, and R. Jason Sherman

Evans, Susan Toby, and David L. Webster

Faulseit, Ronald K.

Feinman, Gary M., and Linda Nicholas

Feinman, Gary M., and Linda M. Nicholas
Feinman, Gary M., and R.K. Faulseit  

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

Feinman, Gary M., and Linda Nicholas  

Finsten, Laura  

Flannery, Kent V., Joyce Marcus  

Flannery, Kent V., and Joyce Marcus  

Flannery, Kent V., and Joyce Marcus  

Flügel, E  

Gibson, Alex, and Ann Woods  

Gonzalez, Reyes, Liliana Carla, and Marcus Winter  
Grove, David C., and Rosemary A. Joyce  

Harrison-Buck, Ellie  
2014 *Rituals of Death and Disempowerment among the Maya*. University of Utah Press, Salt Lake City.

Hirth, Kenneth G.  

Joyce, Arthur  

Joyce, Arthur, Hector Neff, Mary S. Thieme, Marcus J. Winter, Michael Elam, and Andrew Workinger  

Joyce, Arthur, and Marc Levine  

Joyce, Arthur, and Marcus Winter  

Kamp, Katherine A., John C. Whittaker, Rafael Guerra, Kimberly McLean, Peter Brands, and José V. Guerra Awe  

Kowalewski, Stephen A.  

Kowalewski, Stephen A and Laura Finsten  
Kowalewski, Stephen A.

Lind, Michael, and Javier Urceid

Marcus, Joyce, and Kent V. Flannery

MacNeish, Richard

Martinez-Lopez, Cira, Robert Markens, Marcus Winter, and Michael Lind

Matejowsky, Ty, Donald C. Wood, and Jim Goes

Minc, Leah, and Sherman, R. J.

Minc, Leah, and Jeremias Pink
2013  *Trace-Element Analysis of Oaxacan Ceramics: Insights into the Regional Organization of Ceramic Production and Exchange in the Valley of Oaxaca during the Late Classic (AD 550-850).* Final technical report circulated to collaborators for analyses supported by NSF award 1005945: Support of Coordinated, Regional Trace-Element Studies at the OSU-RC.

Mock, S.B.
Nicholas, Linda, Gary Feinman, Stephen A. Kowalewski, Richard E. Blanton, and Laura Finsten

O’Brien, Michael, and Dennis E. Lewarch

Palmer, R.H.

Peregrine, Lawrence
2012 What Happened in Prehistory. *Faculty Monographs*, Book 1, Lawrence University, Appleton, Wisconsin.

Rice, Prudence

Sanders, William T., and Deborah Nichols

Sellen, Adam T.
2010 Sowing the Blood with the Maize: Zapotec Effigy Vessel and Agricultural Ritual. *Ancient Mesoamerica* 22(1) 71-89.

Separd, Anna O.

Sherman, R. Jason, Andrew K. Balkansky, Charles S. Spencer, and Brian D. Nichols

Sinopoli, Carla

Skibo, James M., and Gary Feinman
1999  Pottery and People: A Dynamic Interaction, University of Utah Press, United States of America.

Spencer, Charles, Elsa Redmond, and Christina Elson

Spencer, Charles, and Elsa Redmond

Spencer, Charles, and Elsa Redmond

Spencer, Charles, and Elsa Redmond

Thornthwaite, C.W.

Walker, S.T., C. Elson, and L. Minc

Webb, Malcolm C.

Whitecotton, Joseph

Winter, Marcus
1974  Residential Patterns at Monte Albán. American Association for the Advancement of Science, Oaxaca, Mexico 186(168): 981-987.

Winter, M., and W.O. Payne
Winter, Marcus

Zeitlin, Robert N., and Arthur Joyce