

Monumental Foundations: An Investigation of the Preclassic Development of Civic-Ceremonial Plazas in the Cival Region, Guatemala

by

Kaitlin R. Ahern

May 2020

A dissertation submitted to
the faculty of the Graduate School of
the University at Buffalo, The State University of New York
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy
Department of Anthropology

This page is intentionally left blank.

Copyright by
Kaitlin R. Ahern
2020

ACKNOWLEDGEMENTS:

There is a long list of individuals and organizations that have both contributed to my formation as both an archaeologist and as a scholar. I am immensely grateful to my advisor, Dr. Timothy Chevril and committee members Dr. Douglas Perrelli and Dr. Sarunas Milisauskas, for their guidance and assistance in the completion of my doctorate. I am thankful to Warren Barbour for warmly accepting me into the Master's program at the University at Buffalo and welcoming me into UB's Teotihuacan Archaeology Laboratory. I will always treasure my memories with him discussing the formation of cities and states, especially urban planning and Teotihuacan. He will be greatly missed.

Timothy Chevril graciously became my new chair once Warren Barbour retired. Throughout my graduate school education, he taught a wide array of courses that served to enrich my anthropological and archaeological understanding. His courses also greatly enhanced my knowledge regarding archaeological theory and introduced me to the archaeological sciences. Douglas Perrelli provided me with a North American perspective to my research and spent time helping me prepare for my advanced exams. Sarunas Milisauskas taught me about the history of archaeology and how it has impacted archaeological approaches in other countries.

This dissertation was made possible through the generous funding opportunities offered by the University at Buffalo and its Anthropology Department. My fieldwork and data analysis were supported by multiple Mark Diamond Research Foundation (MDRF) awards and the Morris and Lucille Opler Dissertation Research scholarship. I am also appreciative of Medaille College for providing me with conference funding in 2018, 2019, and 2020 through the Medaille College Faculty Travel Award.

I want to express my utmost gratitude to Francisco Estrada-Belli for inviting me to excavate with the Holmul Archaeological Project in 2013 and for allowing me to conduct my dissertation research on plazas in the Cival region. My research was heavily shaped by my first excavation with the project, which focused on the western radial pyramid in Cival's Central E-Group assemblage. I am grateful to Ana Lucía Arroyave for both helping me obtain the permit to get the lime plaster samples out of Guatemala and for eventually shipping them to Buffalo, NY. Additionally, I want to thank the Guatemalan Institute of Anthropology and History (*Instituto de Antropología e Historia de Guatemala*) for providing me with this permit. I am immensely grateful to all of the Guatemalan workers who assisted me in my excavations. In particular, I want to thank Don Israeli for his insightful knowledge regarding archaeology and forestry. I also offer my appreciation to Selvin and his drivers, especially Yobany, for safely transporting me to and from the archaeological sites in the jungle.

During the summer of 2014, Mary Neivens graciously allowed me to spend nearly a month in her house in Antigua, which also served as the temporary location of the Holmul Archaeological Project's laboratory. I grew immensely as a researcher during this brief stay through engaging in valuable conversation with Mary Neivens, Mike Callaghan, Bridgette Kovacevich, Nina Neivens, Diana Mendez, Tom Garrison, and Astrid Runggaldier. I cannot thank them enough for sharing their knowledge and expertise with me!

I am also indebted to those individuals and organizations that facilitated my formative interactions and engagements in archaeology and the ancient Maya. I begin by thanking Curtiss Hoffman for serving as my undergraduate advisor and facilitating my first field school at the Middleboro Little League site in Massachusetts. In addition, I express my sincere appreciation to Sandra Faiman-Silva and Louise Badiane for organizing the 2009 study abroad winter trip to

Belize at my undergraduate institution of Bridgewater State University. I am also grateful for my opportunity to attend a month-long field school in Belize with the University of Rhode Island, where we spent time working with both BVAR at Baking Pot and with AFAR at Cahal Pech.

The data analysis of my plaster samples was only possible with the help of Peter Bush, who graciously provided me with access to the South Campus Instrument Center and allowed me to utilize SEM-EDS, optical and polarizing microscopes. I am also grateful for the assistance of Aaron Shugar, located at Buffalo State College, who allowed me to examine my lime plaster samples with portable XRF. Additionally, I am appreciative to the National Petrography Laboratory for producing quality thin sections from my collected lime plaster samples.

During my summers in the field, I met and became friends with a lot of amazing people in Guatemala and Belize. In particular, I want to express my gratitude to Angel Castillo and Maria Mercedes Colindres Díaz for both their friendship and for teaching me how to improve my excavation drawings. I am also thankful for the support and friendship of Diana Mendez, Antolin Velásquez Lopez, Sheryl Carcuz Chinchilla, Josue Calvo, Alex Posadas, and Manuel Antonio Portillo, aka Tony.

I am immensely grateful for the support of my friends and family in the United States – you know who you are. There are so many individuals that have had a profound impact on me throughout this journey and contributed to the qualities that allowed me to pursue and complete this doctorate. For this, I thank you. I sincerely thank all the faculty and staff in my anthropology department for providing me with an enriching education. I want to sincerely thank Joshua Kwoka for providing support and assistance in helping me complete my degree and dissertation. Additionally, I am grateful for the support of my fellow graduate students who accompanied me throughout this journey. In particular, I am grateful to Erika Ruhl and Susan Cozzi for providing

me with encouragement, support, and someone to vent to while we each worked to complete our dissertations.

Finally, I am forever appreciative of the support of my family and husband. I want to express my gratitude to my mom, dad, and Jessie, for always believing in me, even when I did not believe in myself. I am also grateful for Jessie's feedback on this dissertation. I love you all so much! I am also thankful for my cats Deckard and Cain, who were always there to remind me to take a much-needed break. This dissertation would have been significantly harder without the encouragement, love, and support of Parker Simpson. I am immensely grateful for his uttermost support throughout my entire academic journey.

TABLE OF CONTENTS

SECTION	PAGE
Acknowledgments	III
Table of Contents	VII
List of Figures	XI
List of Tables	XIII
Abstract	XIV
Chapter 1: Introduction	
1.1 Introduction.....	1
1.2 Contribution.....	3
1.3 Outline of Chapters.....	5
Chapter 2: Theoretical Approaches to Understanding Plazas	
2.1 Introduction.....	9
2.2 Agency, Practice, Structuration, and Historical-processualism.....	10
2.2.1 Structuration and Historical-processualism.....	11
2.3 Place, Place-Making, and Sacred Place.....	13
2.4 Social Memory.....	16
2.4.1 Practice, Place, and Social Memory.....	19
2.5 Ancient Maya Caches, Place, and Social Memory.....	20
2.6 Community of Practice.....	24
2.7 Theorizing Plazas.....	27
2.8 Summary.....	29
Chapter 3: Environmental and Background of Cival, Holmul, and Witzna	
3.1 Introduction	31
3.2 Environment.....	33
3.3 Early Understandings of the Maya lowlands and Origins of the Maya.....	35
3.3.1 Discovery of the Preclassic Period.....	38
3.3.2 Contemporary Theories.....	39
3.3.3 Brief History of the Preclassic.....	40
3.3.3a Archaic and Early Preclassic period.....	41
3.3.3b Middle Preclassic period.....	43
3.3.3c Late Preclassic period.....	45
3.3.3d Conclusion.....	46

3.4 Plaza Ritual.....	47
3.4.1 Caches and E-Group Plazas.....	49
3.5 Cival Region.....	51
3.5.1 Cival.....	55
3.5.2 Holmul.....	62
3.5.3 Witzna.....	67
3.5.4 Watchtower.....	70
3.6 Discussion.....	75

Chapter 4: Plazas, Lime Plaster, and Methodologies

4.1 Introduction.....	77
4.2 Excavation.....	77
4.3 Plaza Analysis via GIS and Google Earth Pro.....	80
4.4 Proxemics and Estimated Plaza Capacity.....	81
4.4.1 Estimating Plaza Capacities.....	82
4.5 A Brief Background of Lime Plaster.....	86
4.5.1 Chemistry of Lime Plaster Production.....	86
4.5.2 Brief Overview of Old-World Lime Production.....	89
4.6. Mesoamerican and Maya Lime Production.....	92
4.6.1 Archaeological Evidence.....	93
4.6.2 Archaeological Evidence of Lime Plaster Production Sites.....	94
4.6.3 Characterization of Archaeological Lime Plasters.....	96
4.7 Acquisition of Plaster Samples.....	103
4.8 Research Design, Petrographic, and Chemical Analysis of Lime Plaster.....	103
4.8.1 Petrographic Analysis.....	104
4.8.2 Portable X-Ray Fluorescence Spectrometry (pXRF).....	105
4.8.3 Scanning Electron Microscopy with energy dispersive spectrometry (SEM-EDS).....	106
4.9 Summary.....	107

Chapter 5: The Data Chapter – An Examination of Plazas and Plaster

5.1 Introduction.....	109
5.2 Excavations.....	110
5.2.1 Cival.....	111
5.2.1a CIV.T.12.....	111
5.2.1b CIV.T.71.....	112
5.2.1c Summary of Findings at Cival.....	114

5.2.2 Excavations at the Watchtower, East Witzna.....	114
5.2.2a WIT.T.13.....	116
5.2.2b WIT.T.14.....	124
5.2.2c WIT.T.15 and WIT.T.19.....	125
5.2.2d WIT.T.22.....	125
5.2.2e Summary of Findings at East Witzna.....	126
5.3 Estimated Plaza Capacity.....	127
5.3.1 Cival.....	128
5.3.2. Holmul.....	132
5.3.2a Ceremonial Core.....	132
5.3.2b La Sufricaya Complex at Holmul.....	134
5.3.3 Witzna.....	136
5.3.3a Ceremonial Core.....	136
5.3.3b Watchtower.....	138
5.4 Plaster Results.....	139
5.4.1 Cival.....	142
5.4.2 Holmul.....	143
5.4.3 Witzna.....	146
5.4.4 Similarities between the Samples.....	148
5.5 Summary.....	150

Chapter 6: Plaza and Plaster Analysis

6.1 Introduction.....	151
6.2 E-Groups and Public Plazas.....	151
6.3 Cival.....	155
6.4 Holmul.....	158
6.4.1 Plaster Analysis - Community and Plaster.....	162
6.4.2 Emergence of Barite Tradition.....	165
6.5 Witzna.....	167
6.5.1 East Witzna and the Watchtower.....	169
6.5.2 Plaster Analysis.....	171
6.6 Proxemics.....	171
6.7 Discussion.....	175

Chapter 7: Plazas as Monumental Foundations: Summaries and Conclusions

7.1 Introduction.....	177
7.2 Practice and Plazas.....	177

7.2.1 Plaza Development.....	180
7.3 Place, Social Memory, and Plazas.....	181
7.3.1 Caches and Stelae.....	182
7.3.2 Sites of Memory.....	186
7.4 Communities of Practice.....	189
7.4.1 Community of Practice and E-Groups in the Cival region.....	189
7.4.2 Communities of Practice and Barite.....	191
7.5 Conclusions.....	192
7.6 Future Directions.....	193
Appendix A: Thin-sections.....	195
Appendix B: Bulk portable XRF data.....	204
Bibliography.....	209

LIST OF FIGURES

Chapter 1

Figure 1.1: GIS image illustrating the location of the major sites discussed in this dissertation.

Chapter 2

Figure 2.1: Image of the cruciform cache discovered at Cival.

Chapter 3

Figure 3.1: GIS image of the environment and the location of the central Maya lowlands.

Figure 3.2: Topographic map of sites in the Cival region.

Figure 3.3: GIS image showing the location of the three major sites examined in this dissertation.

Figure 3.4: Map of the site of Cival.

Figure 3.5: East Profile of CIV.T.12 and CIV.T.68.

Figure 3.6: Map of Holmul's civic ceremonial center.

Figure 3.7: Map of La Sufricaya.

Figure 3.8: Map of the civic ceremonial center at Witzna.

Figure 3.9: LiDAR map from the 2017 report by the Holmul Archaeological Project that shows the site of Witzna.

Figure 3.10: LiDAR image of the Watchtower.

Figure 3.11: East profile of the Watchtower, including the excavations WIT.T.13, WIT.T.14, and WIT.T.16.

Chapter 4

Figure 4.1: Image of a simplified lime cycle for high-calcium lime.

Chapter 5

Figure 5.1: East profile of CIV.T.71.

Figure 5.2: South profile of the excavation CIV.T.71 and the Chaak mask.

Figure 5.3: Plan view of the excavations WIT.T.13, WIT.T.15, WIT.T.19, and WIT.T.22.

Figure 5.4: Plan view of the excavation WIT.T.13.

Figure 5.5: Profile view of the excavation WIT.T.13.

Figure 5.6: Chultun and the location of the first miniature.

Figure 5.7: Cranium fragment discovered in the chultun.

Figure 5.8: Image of the four miniature vessels.

Figure 5.9: Plate discovered in the chultun.

Figure 5.10: View of the completely excavated chultun.

Figure 5.11: Image of the stone slab platform.

Figure 5.12: Plan view for the WIT.T.13 tunnel.

Figure 5.13: East profile of the Watchtower.

Figure 5.14: East profile view of the excavation WIT.T.14.

Figure 5.15: Altar fragment found in the plaza of the Watchtower complex.

Figure 5.16: Altar fragment found in the plaza of the Watchtower complex.

Figure 5.17: Modified image of the inner structures located in Cival's ceremonial core.

Figure 5.18: Updated map of Cival's ceremonial center that marks the location of certain plazas.

Figure 5.19: Updated map of Holmul's ceremonial core that marks the location of certain plazas.

Figure 5.20: Updated map of La Sufricaya.

Figure 5.21: Map of Witzna's ceremonial core that marks the location of certain plazas.

Figure 5.22: Optimal microscopy image of the red plaster layer on sample Hol4.

Figure 5.23: SEM-EDS image of the red plaster layer on sample Hol4.

Figure 5.24: Barite located in the thin-plaster layer of sample Hol2.

Figure 5.25: Image of peloids in sample Wit3.

Figure 5.26: SEM-EDS image of dolomite grains in sample Wit6.

Figure 5.27: SEM-EDS image of dolomite grains in sample Wit4.

Figure 5.28: Organic material discovered in sample Hol3.

Figure 5.29: Organic material discovered in sample Wit6.

Chapter 6

Figure 6.1: Barite located in a chunk of aggregate in sample Hol7.

Figure 6.2: EDS analysis of a barite grain found in sample Hol7.

Figure 6.3: Chart of plaza area for Preclassic period plazas at Cival, Holmul, and Witzna.

Figure 6.4: Chart of the plaza area for all the plazas examined at Cival, Holmul, and Witzna.

Chapter 7

No Figures

LIST OF TABLES

Chapter 1

No tables

Chapter 2

Table 2.1: Pre-Colombian Chronological Period of the Maya Region.

Chapter 3

No tables

Chapter 4

Table 4.1: Excavations conducted on Structure 9 at Cival.

Table 4.2: Excavations conducted at the Watchtower complex located in East Witzna.

Table 4.3: Distance and perception based on data in Hall 1966 (After Moore 1996).

Chapter 5

Table 5.1: Sizes and Estimated Capacities of Plazas at Cival.

Table 5.2: Sizes and Estimated Capacities of Plazas at Holmul.

Table 5.3: Sizes and Estimated Capacities of Plazas at Witzna.

Table 5.4: Context for the lime plaster floor samples.

Chapter 6

Table 6.1: Late Preclassic period plaza measures from Tikal and El Palmar.

Chapter 7

Table 7.1: Caches and stelae discussed in this dissertation.

ABSTRACT

This dissertation investigates the role of civic-ceremonial plazas in the formation and maintenance of the Preclassic period Maya centers of Cival, Holmul, and Witzna located in the Cival region in northern Guatemala. Ancient Maya public plazas are largely understudied by archaeologists, despite filling a critical role in the understanding of community formation and interaction through the practices associated with the commemorative and ceremonial rituals held in these locations. These public plazas were places of interaction that ranged from public, open places to restricted spaces. The theories of practice, structuration, place, social memory, and communities of practice are utilized here to critically examine the types of interactions and

This examination of civic-ceremonial plazas in the Cival region draws upon excavations, GIS data, proxemics, estimated plaza capacity, and archaeological evidence of ritual activities to understand practices, which resulted in the emergence and continued occupation of public plazas. Lime plaster samples acquired from plaza floors are used to provide insight into the interaction and exchange of practices between the sites of Cival, Holmul, and Witzna. Thin section petrography, SEM-EDS, and x-ray fluorescence spectrometry (pXRF) are used to analyze the mineralogical and elemental composition of lime plaster, which is subsequently used to determine the quality of the plaster and in the identification of communities of practice.

Findings from this study confirm the strong connection between Cival and Holmul during the Late Preclassic period by demonstrating the existence of multiple communities of practice involving the addition of barite to lime plaster production and the semi-standardization of E-Groups in the region. Additionally, it was discovered that the centers of Cival, Holmul, and Witzna each experienced a distinct trajectory regarding the construction and spatial positioning

of public and private plazas. Despite these differences, public plazas remained essential focal points of community activity and as locations for commemorative and ceremonial rituals for each of these three sites throughout the Preclassic and Classic periods. Private plazas were also essential locations for ceremonial and ritual events conducted among a more restricted community, such as seen at the Watchtower plaza in East Witzna. The practices associated with the ritual events in these plazas were preserved in the material remains of lime plaster surfaces, caches, and stelae. These physical remains are used to provide insight into the types of rituals conducted in these plazas.

CHAPTER I

Introduction

“The plaza most likely served to tie the past, present, and future of the community in the mind and discourse of people. As a monument and a stage, the plaza constantly reminded people of their collective labor and communal gatherings that took place in the past, and it shaped people’s imagination, planning, and narratives on future constructions and gatherings”.

- Takeshi Inomata 2014: 27.

1.1 Introduction

This dissertation ties together practice theory, plazas, and plaster analysis to explore the practices and interactions that led to the formation and continued occupation of public plazas in the Maya lowlands during the Preclassic period. Plazas are viewed as a distinct form of architecture that can transform in meaning throughout a site’s history, and that serves a wide array of functions ranging from secular to sacred (Kidder 2004). Certain types of plazas, like public civic-ceremonial plazas, can be viewed as monuments that serve to create and unify a community (Inomata 2014).

Additionally, this project examines the emergence of public plazas and discuss their role in the development of urbanization among the ancient Maya. Although extensive research continues to be conducted on the origins of the ancient Maya civilization (Adams 1977; Coe 1987; Lohse 2010; Hansen 2016; Traxler and Sharer 2016), Maya archaeologists have rarely considered the role of civic-ceremonial plazas and monumental space in the emergence of early cities due to an overemphasis on monumental structures (Inomata and Tsukamoto 2014). This project compensates for this oversight by primarily focusing on public civic-ceremonial plazas and their roles as constructed places.

Plazas are places of interaction and range from public open spaces to intimate and more restricted spaces (Moore 1996; Low 2000). The ancient Maya used public space in plazas as

locations for political theatre (Inomata 2006), ritual deposits (Schwake and Iannone 2010), processions (Wagner, Box, and Morehead 2013; Schele and Matthews 1998; Inomata 2006), and commemoration (Jones 1969; Ashmore 1989), as well as more mundane uses, such as for markets (Freidel 1981). Public plazas also functioned as focal points of community activities and ceremonies (Clark 2004; Inomata 2014; Connerton 1989).

Public plazas first emerged in the broader Mesoamerican region during the Early Preclassic period (approximately 1650 BCE) (Clark 2004). The first civic-ceremonial plaza in the Maya lowlands emerged at Ceibal around 1000 BCE (Inomata et al. 2013; Inomata 2014). This plaza accompanied a transition in the Maya lowlands during the Middle Preclassic period (1000 – 400 BCE) as villages and hamlets became large towns and cities (Hammond and Gerhardt 1990; Henderson 1997; Sharer 2006). This transformative process was shaped by social practices and resulted in the creation of public civic-ceremonial plazas (Inomata 2014) and sacred spaces (Clark 2004). By the Late Preclassic period (400 BCE – 250 CE), access to certain civic-ceremonial plazas became more restrictive and exclusionary. Evidence from Cival and other ancient Maya lowland centers suggests that the changing accessibility to civic-ceremonial plazas was linked to increased sociopolitical complexity and the formation of centralized rulership (Estrada-Belli 2006; Tsukamoto 2014a, 2014b).

This research highlights the role of civic-ceremonial plazas, plaster, and community practices in the formation of Preclassic period Maya centers. Additionally, it highlights the connection between utilitarian floors, the community practices involved in creating and maintaining them, and the ultimate civic-ceremonial plazas that were central to the formation of the Preclassic period Maya centers. This project also investigates the emergence and transformation of public plazas through archaeological excavations, estimated plaza capacity,

and analysis of lime plaster composition to determine the level of interaction and exchange between the neighboring sites of Cival, Holmul, and Witzna, which are located in the modern-day country of Guatemala (See Figure 1.1). Petrographical and chemical analysis are used to investigate the development of civic-ceremonial plazas and lime plaster among these three sites. Finally, this study is multi-scalar, as it ranges from the broad societal impacts to the more humble creation of building materials, and the practices in between.

1.2 Contribution

This project uses multiple theoretical concepts to assess the different processes at work in plaza creation and development. Structuration is used to understand the formation, use, and alteration of public places and plazas. Although plazas are monumental on their own (Kidder 2004), the majority of literature on ancient Maya plazas primarily focuses on plazas as part of a larger monumental complex, such as royal courts (Folan et al. 2001; Clark and Hansen 2001) and as components in specific architectural patterns, such as E-Groups (Blom 1924; Ricketson and Ricketson 1937; Coggins 1980; Aimers and Rice 2006; Doyle 2012). This lack of plaza centric studies was partially a consequence of an overemphasis on monumental structures (Inomata and Tsukamoto 2014). A small number of Maya archaeologists have recently studied plazas as independent entities (Inomata 2006; Tsukamoto 2014a, 2014b) as the examination of plazas is an excellent way to make inference about archaeologically intangible activities, such as place-making and the formation of social memory. This proposal continues with this trend by focusing on plazas rather than the adjacent architecture.

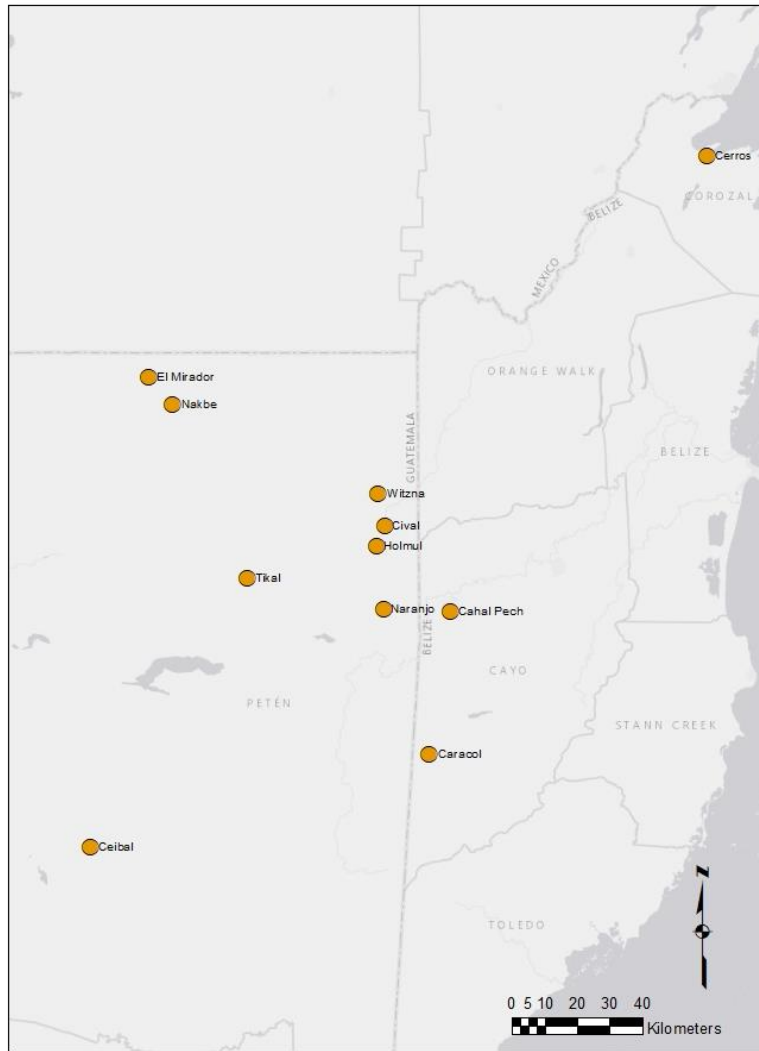


Figure 1.1: GIS image illustrating the location of the major sites discussed in this dissertation. Map by Kaitlin R. Ahern.

Additionally, it improves upon contemporary plaster analysis in northern Guatemala. Lime plaster is a valuable subject to examine because it was the most complex manufactured building component in ancient Maya architecture (Abrams and Freter 1996). Recent research has focused on the replicative technologies of Maya plaster production (Schreiner 2002; Russel and Dahlin 2007; Seligson 2016; Seligson, Ortiz Ruiz, and Barba 2018) and the elemental signatures of lime plaster in the Maya lowlands (Abrams et al. 2012; Hansen 2000; Magaloni et al. 1995; Magaloni 1996; Villaseñor 2009; Villaseñor et al. 2011). In the last twenty years, three

dissertations incorporated plaster analysis in the Maya lowlands, and each utilized technological choice to examine the technical aspects of plaster production (Hansen 2000; Hurst 2009; Villaseñor 2009). This project differs as it is the first to use practice and structuration to examine how lime plaster and plazas can be used as tools to examine the ancient Maya people, their practices, and their sense of place and how it can change through time. Practice theory, structuration, and historical-processualism provide a low-level approach towards understanding plaza formation and plaster analysis. These theories add to the broader understanding of the agency of ordinary, everyday people in the Cival region by exploring the results of their actions. Practice theory provides a platform for exploring the theories of sacred places and memory in both the formation of plazas and in the use of plaster.

Finally, this project is the first study to focus on plaster production at a cluster of neighboring sites. This proximity provides tremendous insight into the dispersal and exchange of plaster and plaza technology between sites in the Cival region. Furthermore, it illuminates the individual traditions and practices at sites, while also demonstrating divergence in plaster technology. Plaster analysis also provides information on the individual trajectories of plaster and plaza development throughout the region.

1.3 Outline of Chapters

This dissertation is divided into seven chapters. *Chapter 1* serves as an introduction to the dissertation. It briefly discusses the contributions of the project and provides an overview of the remaining six chapters.

Chapter 2 establishes the practice-based theoretical framework that is utilized in this dissertation to investigate the formation, maintenance, and continued occupation of public plazas

in the Maya lowlands. The approach incorporates the theories of practice, place, social memory, and communities of practice. Practice theory is viewed through the lens of Giddens's structuration and Pauketat's historical processualism to create a framework for examining the formation of plazas and the continued importance of these locations. This framework of practice is utilized to examine the emergence of place and social memory in early public plazas located in the Maya lowlands. Social memory is utilized to explain the sacredness and alternation of meanings associated with these plazas. It also serves as a tool for understanding the history of the site. Communities of practice is discussed to provide insight into the practices and community involvement in both plaza construction and lime plaster production.

Chapter 3 provides a brief overview of the geography, chronology, and history of the Maya lowlands, with particular emphasis on the Middle Preclassic (ca. 1000-400 BCE) and the Late Preclassic period (ca. 400 BCE—250 CE). It also includes a discussion regarding the traditional and contemporary approaches to the origin of the Maya. This examination serves to provide insight into the current understanding of the initial development of the Maya lowlands and the crucial role of early public plazas. Additionally, the chapter provides a detailed examination of the research conducted at the sites of Cival, Holmul, and Witzna. This site-based research is arranged to create a rough chronology of the history for each center and includes the relevant findings of the excavations conducted at Cival and East Witzna.

Chapter 4 examines the major methodological approaches used in this dissertation. These methods include excavations, proxemics, and estimated plaza capacity, and petrographic, mineral, and chemical analysis of lime plaster samples. Thus, this chapter provides a brief description of the excavation methods utilized during the four summers spent excavating with the Holmul Archaeological Project at the sites of Cival and East Witzna. Edwin Hall's (1968)

proxemics and estimated plaza capacity analysis are utilized to examine various sized plazas from the sites of Cival, Holmul, and Witzna. The majority of spatial information for these plazas came from Google Earth Pro, as this geographical data allowed for the visualization, measurement, and calculation of the size of plazas.

The section on lime plaster begins with a brief explanation of the chemical processes required to produce plaster. It also includes a literature review regarding the early uses and applications of lime plaster to better contextualize the importance of this essential building material. The methodology utilized for the lime plaster analysis consists of petrographic and optical microscopy, Scanning Electron Microscopy with energy dispersive spectrometry (SEM-EDS), and Portable X-Ray Fluorescence Spectrometry (pXRF). These approaches are used to examine the physical and chemical composition of 19 lime plaster samples obtained from the sites of Cival, Holmul, and Witzna during the summer of 2018.

Chapter 5 is composed of the raw data that was obtained for this project and includes excavations, the spatial GIS data of plazas, and lime plaster samples acquired from the sites of Cival, Holmul, and Witzna. The data is divided into two sections, which are plaza and plaster analysis. The plaza investigation incorporates the measurements of 26 public and restricted plazas located across the three sites. The majority of these plazas were first constructed during the Preclassic period. The section on lime plaster involves the examination of 19 samples that broken into groups based on their location in one of the sites. These samples are analyzed through the aforementioned methodology.

Chapter 6 examines and interprets the data from estimated plaza capacity and lime plaster analysis to provide an examination of the plazas at Cival, Holmul, and Witzna. The results are divided into five sections. The first part contextualizes the plaza findings regarding

early public plazas by providing an understanding of the emergence of the Middle Preclassic period E-Group assemblages. Additionally, each site is discussed individually regarding the results of the plaza and plaster analysis. The final section utilizes the theory of proxemics to divide the examined plazas into three approximate groups, which are public, semi-restricted, and restricted plazas. This division results in a broader discussion of the plazas.

Chapter 7 analyzes the results of the dissertation through the specific theoretical framework that was first established in chapter 2. Additionally, this chapter discusses the findings of this dissertation across the three sites and confirm the clear connections between Cival and Holmul during the Preclassic period, which impacted public plazas and shared practices regarding lime plaster techniques. The chapter ends with a summary of the results and the broader significance of this project. The conclusion also includes a discussion of future directions of investigations and explores potential avenues for further research.

CHAPTER 2

Theoretical Approaches to Understanding Plazas

2.1 Introduction

The Cival region was first occupied by a small population around 1100 – 900 BCE (Neivens de Estrada 2006). In 800 BCE, the center of Cival (see Figure 1.1) was altered from jungle to an area showing its first signs of transformation and later into a new and innovative place by the hands and labor of local people. By 400 BCE, it was a structured architectural space with several regular uses and probably featured in the thoughts of its users in multiple strong and clear ways - where we gather, where we worship, obey, celebrate. Why might this have happened? How did it happen? What does how it happened tell us about 'why'?

This dissertation uses structuration theory (Giddens 1979, 1984), discussed below, to examine how an empty area is transformed through intentional actions into a different type of space – an empty area becomes a plaza, a communal, political, ideological space – and how these practices create a new structure of society – a form of gathering in a central meeting and sharing space to express cultural and social beliefs. The people who made these early plazas at Cival, Holmul, and Witzna set the stage through their practice for later generations who would come to see that practice as ‘how things were always done.’

In addition to practice and structuration theories, this dissertation also incorporates theories of place, social memory, and a ‘communities of practice’ approach to establish a theoretical framework to investigate the construction and maintenance of plazas in the Maya lowlands. The use of multiple practice-based theories is particularly advantageous to archaeological investigations as material remains are the physical remnants of people’s past actions. The theories discussed in this research are first examined separately to establish the core

principles associated with the theory, before being brought together in the concluding chapter. However, before addressing these theories, it is important to briefly note that frequently the entry of these ideas into archaeology was subjected to a ‘theoretical lag’ as the discipline was quite resistant to the incorporation of social theories of the later 20th century. This avoidance was primarily based on the processual ideas of what could and could not be studied, and thus, what ‘could be ignored’ (Liebmann 2008).

The first section provides the framework for the remaining theories by discussing the application of practice and structuration found in this dissertation. In the next two sections, the theories of place and social memory are discussed to establish the individual and community connections, interactions, and use of these plazas. The fourth section introduces communities of practice and provides a brief review of the previous uses of the theory in archaeology.

Ultimately, the theory of communities of practice is utilized for examining particular knowledge regarding lime plaster production and as an analytical tool used in association with social memory. In the final section, these practice-based theories are ultimately woven together to provide insight into the social changes that occurred to plazas during the Middle and Late Preclassic periods in the Cival region.

2.2 Agency, Practice, Structuration, and Historical-processualism

In the 1980s, anthropologists and later archaeologists began to incorporate the irreducible components of agency, practice, and structure into a social science approach that developed from the work Bourdieu (1977, 1990), Foucault, Giddens (1979, 1984, 1991), and other social theorists (Ortner 1984). This theoretical shift was part of a rejection of earlier theories that excluded both practice and agency, in favor of the ‘structure’ approaches that dominated the

post-WWII era. Agency, practice, and structure are intrinsically linked to each other in such theorizations.

Theories of agency, practice, and structure seek to explain the dynamic relationship between human agency and social structure. They also examine “how social beings, with their diverse motives and their diverse intentions, make and transform the world in which they live” (Ortner 1996:193). As there are conflicting definitions associated with agency and practice theory (Dobres and Robb 2000), the terms agency, structure, and practice are briefly discussed below. Agency can be defined as the capacity to act, specifically through directed action. The term structure refers to the rules and expectations of a given society that can influence or limit an actor’s agency. Practice is defined as what agents do and think they are doing to change the structure (Harker et al. 2016). This project will incorporate and merge additional theories about practice from both Giddens’ structuration and Pauketat’s adaptation for structuration in archaeology, which he termed historical-processualism.

2.2.1 Structuration and Historical-processualism

The theory of structuration was the creation of Anthony Giddens as an attempt to construct a unified theory linking agency, practice, and structure, which established an explicit connection that was lacking in earlier theorists’ work. It describes the process by which people reproduce, with modifications, the structure of their society, which happens continually, but especially as new generations of people are born into ‘new normals.’ The changes can be minor or major but are firmly incorporated into the habitus as people who lived under different structures age and die out of society. Habitus refers to ingrained skills, habits, and dispositions

(Bourdieu 1990; Swartz 1997). Additionally, practice is subject to change because there is “room in every instance of practice for creativity and innovation” (Giddens 1979; Dornan 2002:307).

Societies inherit a structure and its practices; then, actors intentionally or unintentionally push the boundaries in some way – they can be young or old, motivated by any number of issues; however, they push the boundaries by introducing new practices that often lead to unintentional consequences that serve to transform the structure. For example, agents may push boundaries by organizing large-scale construction projects intended to create unity and shared space, but which resulted in unintentional consequences, such as increased social stratification (Pauketat 2001). These new practices and structures may at first seem unusual until enough people are ‘born into’ the new conditions that never knew the old conditions. Even if they maintain a historical consciousness of the prior conditions-practices-structures, it is simply perceived as ‘the way things used to be.’ Then, the old normal is replaced by a new normal, which is, of course, a continuous process that never ends (Giddens 1984). Structuration is used here to think about how specific spaces are transformed through agency, practice, and structure into a place and how the social idea of the place and a new set of practices become permanently incorporated into the society.

Historical-processualism is an explicitly archaeological theory, created by Timothy Pauketat to blend history, historical processes, and traditions with practice theory and structuration. It places a strong emphasis on the belief that moments and practices are not isolated, but instead, they are historical processes that are shaped by the past and continually serve to shape the future (Pauketat 2001 following Bourdieu 1977; Pauketat 2000). Thus, events and actions are directly intertwined. Historical-processualism primarily focuses on how people do things rather than why people do them, and this emphasizes proximate explanations over

ultimate explanations. This approach can enable archaeologists to work with these concepts from the low-level data on up, often before they can guess at the broad, larger ‘intentions’ of people. In contrast, a sociologist of current or recent times usually knows the motives and has to study the method. Additionally, Pauketat’s (2001) version of structuration concentrates on the creative moments in time and space. It also focuses on how meanings and traditions can be constructed and transmitted through agents’ participation in ritual and subsequent monument building.

2.3 Place, Place-Making, and Sacred Place

This section examines in more detail how the transformation of space into place can be theorized. Space and place are a set of ideas and theories that were revisited in geography during and after the 1970s, by influential scholars such as Yi-Fu Tuan (1974) and Edward Relph (1976). The development of these terms was part of a larger paradigm shift that moved away from processualist ideology and towards new ideas, like those of Giddens. This theoretical transition impacted all of the social sciences at the time, including anthropology, although there was some delay in their adoption into archaeology (Liebmann 2008).

Both Relph (1976) and Tuan (1975) utilized a phenomenological and humanistic approach to place, which viewed place as having an integral role in the human experience (Relph 1976). They also perceived place as a locality of emotional attachment between a person and place (Seamon and Sowers 2008). These earlier approaches were later critiqued by Allen Pred (1984) for generally viewing place as an inert, experienced location that represented a frozen scene of human activity. In an attempt to resolve this issue, Pred (1984) developed a theory of place that incorporated Giddens’s structuration and the concept of time-geography. This new

approach viewed places as always becoming as a result of historically contingent processes and changes that occur in a location.

This dissertation views space as an abstract entity that encompasses all interactions between subjects, objects, and the environment on local, regional, and global levels. It is a non-modifiable entity and is unaffected by human alteration, yet it influences human interactions. Space can retain its meanings and significances over extensive periods, which is ideal for the exchange of shared identities, social memories, and histories. Place refers to socially constructed locales that are embedded with personal and collective significance and consist of the lived experiences of individuals and communities located in the past and present (Preucel and Meskell 2004; Rodman 1992; Tuan 1975). These places are formed through individual and community interaction and engagement with a locale, which results in the attachment of meaning to a specific space (Cresswell 2009). They are also always in the process of becoming (Pred 1984). Additionally, places are dynamic as a single place can contain multiple meanings to various individuals, groups, and communities. These differing perceptions can cause a place to become contested (Low and Lawrence-Zúñiga 2003; Rodman 1992). This project also draws upon the theories of place-making and sacred place.

Place-making is an active process where space is intentionally taken to be modified into a place that contains meaning and significance to its creators. It differs from space, as place is a location with human-defined attributes and meanings. Place-making typically occurs through human-made construction or modification to natural features in the landscape, such as cenotes, which are frequently found in the Maya lowlands. Places can also be designed to mimic the natural landscape (Reese-Taylor 2012a). The creation of place can also enable individuals and communities to modify specific places to express certain selective ideologies (Ashmore 1991)

and to legitimize their authority or claims to the place (Cyphers and Castro 2009). Sacred places emerge through the active process of place-making and result in a socially constructed place or landscape. A place is made sacred through active practices of ritual and commemoration. Once sacred, a place remains meaningful as long as the actions performed there remain in the social memory (Reese-Taylor 2012a). A sacred place can be open, enclosed, or covered by architecture, where it is further subjected to alterations by human modification (Blake 2004).

The cultures of the ancient Mesoamerican civilizations, including the Maya, perceived their natural landscapes as containing sacred qualities, which is supported through the ancient's Maya emphasis on water sources, caves, hills, and mountains (Sharer 2006). Grove and Gillespie (2009) elaborated on this belief by discussing how the ancient people of Mesoamerica experienced their existence as consisting of both a visible and invisible world, which co-existed with one another. Therefore, they suggested that the locations where these two realms intersect were the ideal locales for the creation of sacred places. These locations included mountains, caves, and hills, which symbolize small mountains (Grove and Gillespie 2009:56-57; Kunen, Galindo, and Chase 2000). Hills were a particularly important religious and ritual feature for the ancient Maya, as the majority of the sites and ceremonial centers established during the Middle Preclassic period were built on hills (Estrada-Belli 2014; Hansen, Howell, and Guenter 2008; Awe 1992). Additionally, the decision to settle on hilltops likely emerged from a desire for ceremonies to occur in a space where the supernatural and human realms came together. This claim is supported by ancient Maya art and iconography, as these mediums often emphasized the ritual importance of communicating with the spiritual world. Each of the three sites discussed in this dissertation was located on a hill.

2.4 Social Memory

The concepts surrounding the idea of social memory are a vital tool in investigating prehistoric and historic archaeological sites. Maurice Halbwachs conducted the first modern examination into collective memory in his 1925 publication of *Social Frameworks of Memory*. Halbwachs (1992) viewed memory as inherently tied to society and structured by social arrangements. Thus, memories are mainly recalled and recognized through interactions with others in society. These societal interactions also influenced what memories were perceived to be significant to remember. His emphasis on collective memory deliberately downplayed psychology, the individual, and Jungian concepts like ‘collective consciousness’ by stressing that society was the primary locale for recalling memories (Halbwachs 1992).

During the 1980s and early 1990s, memory studies became a prominent approach among anthropologists, as researchers sought to utilize memory-based theorizations. Once again, there was a delay in the initial incorporation of memory studies into archaeological theory, and it only became a major avenue of research less than fifteen years ago, with the publication of Ruth M. Van Dyke and Susan E. Alcock (2003) edited volume *Archaeologies of Memory*. Despite its late incorporation into archaeological theory, memory studies quickly became a widespread approach throughout the discipline, as it provides archaeologists with an interpretative tool that can be used to examine how multiple levels of society viewed the past (Borgstede 2010). The application of social memory also allows archaeologists to study how historic and prehistoric groups engaged with their past and how they actively constructed and shaped that past (Van Dyke and Alcock 2013).

The term social memory is used instead of collective memory as it places greater emphasis on the social. Social memory was a term adopted in anthropology as a means of

divorcing memory from the collectivist overtones associated with Halbwachs' academic background (Fentress and Wickham 1992; Olick and Robbins 1998). Additionally, social memory is also viewed as an expansion to Maurice Halbwachs's (1992) concept of collective memory with the specific goal of incorporating the conflicting and opposing memories shared by a group or community (Hendon 2010; Gillespie 2010).

Before going into depth about the utilization of social memory in archaeology, it is crucial to examine the restraints that limit the use of memory-based approaches. One of the most significant challenges to investigating social memory is the temporal distance that separates archaeologists from historic and prehistoric cultural remains. Archaeologists are temporally removed from the experience of social memory and often only recover fragmented or partial memories from the past through evidence of repetition, iconography, or places of commemoration (Van Dyke and Alcock 2003). These temporal differences extend to the perception of the memory, as archaeologists aim to recover these memories by looking towards the past, whereas, these historic and prehistoric acts of remembering are future-orientated and served to influence future circumstances (Gillespie 2010). Archaeologists also select which memories they want to recover, which often results in an interpretation that portrays a smooth and cohesive past (Van Dyke and Alcock 2003), rather than one full of fragments and multiplicity. Another constraint to memory studies is the inability of modern researchers to understand historical or prehistorical human cognition. Additionally, Stanton and Magnoni (2008) argue that archaeologists can never truly know individual memory, as it is not possible to reconstruct the individual process of memory recall. By identifying these limitations, archaeologists have begun to establish improved methods towards the investigation of memories that constrained, guided, or motivated past people. The remainder of this section addresses some

of these updated approaches and discusses how prehistoric social memory can be obtained from the archaeological record.

The use of memory studies in archaeology is a challenging yet rewarding task, as it provides archaeologists with an interpretative tool that can be used to examine how multiple levels of society viewed the past (Borgstede 2010). Additionally, the concept of social memory allows archaeologists to study how historic and prehistoric groups engaged with their past and how they actively constructed and shaped that past (Van Dyke and Alcock 2003). Memory is a “social practice intimately bound up in the relations people develop with one another and with the world around them through what they do, where and how they do it, and with whom or what—and results in physical traces that make up the archaeological record” (Hendon 2010:2). Social memory is a lived memory that is held by any number of individuals and is commonly shared by a group. It is an active, ongoing process that is social, yet also tied to materiality, and thus it is constructed, shaped, and mediated by its social and historical context (Halbwachs 1992; Assmann 1995; Schudson 1997). In addition, social memory transcends the life span of any individual (Hendon 2010).

Social memories are formed through the social negotiation of individual memories, and this process is often assisted through similar acculturation by the individuals sharing the memory (Stanton and Magnoni 2008). These memories are also produced through ceremonial rituals and everyday practices (Hendon 2010) and are transferred through means such as oral communications, bodily practices, and commemorative ceremonies (Connerton 1989). Social memory is also selective, as only specific dominant memories are reconstructed, which can result in contention and the coexistence of multiple conflicting views. It is also vulnerable to manipulation as social memory can be used to legitimate authority, identity, and ancestry,

regardless of whether it reflects reality (Nora 1989; Van Dyke and Alcock 2003; Schudson 1997).

Memories and social memories are expressed and engaged with through performances, embodiment, and objectified or inscribed mediums (Gillespie 2010). Social memory is often performative, and it can emerge through rituals and commemoration ceremonies (Connerton 1989). In particular, rituals are a powerful medium for expressing social memory because they result in the formation of cultural tradition. Paul Connerton (1989) defines ritual as a “rule-governed activity of a symbolic character which draws the attention of its participants to objects of thought and feeling, which they hold to be of special significance” (1989: 44). He also emphasizes that rituals can transcend the physical ceremony by permeating into non-ritual behavior, thus providing significance to the entire community. Rituals and commemorative ceremonies also enable the alteration and conservation of social memories. Maya archaeologists have obtained insight into social memories through examining the material traces of social memory in portable objects, architecture, text, and other forms of media (Golden 2010; Hendon 2000, 2010; Joyce 2000, 2003; McAnany 1995; Stanton and Magnoni 2008; Tokovinine and Estrada-Belli 2015).

2.4.1 Practice, Place, and Social Memory

The theories of both practice and place are useful tools in identifying the existence of social memory in the archaeological record. First, the practices of participating in repetitive commemorative activities and rituals can result in the linking of the past and present through social memories (Connerton 1989). This continuity is often achieved through rituals and local engagement in traditional practices as social repetition instills and reinforces cultural

remembering. Practices are connected to how people produce, alter, and reproduce structure and thus generating memory. Second, the creation of a place can result in the formation of memories that reflect multiple significances and ideologies imbued through continuous interaction with a location by the surrounding human agents (Gillespie 2010; Schwake and Iannone 2010). Thus, the construction of place functions to record memory. Place can also serve as a location where memories are activity shaped, remembered, or forgotten. Finally, these processes result in memories influencing the perception of a place or landscape, which can cause places to become sites of memory (Connerton 1989; Nora 1989). Greg Borgstede (2010:357) defined sites of memory as “locales of practices – often ritual action – that reinforces the cohesion of the community,” and this is achieved through collective activities that emerge from shared social memories. These sites of memory are locations of commemorative activities, ceremonies, and ritual practices. However, it is only through the embodiment of these ceremonial activities that sites of memory become sacred places of social memory.

2.5 Ancient Maya Caches, Place, and Social Memory

As mentioned above, social memory can be embedded in material remains, such as caches. The term cache refers to the grouping of objects that were intentionally interred as an offering. Kunen and her co-authors (2002) further define a cache as the material remains that accompanied rituals involving the consecrating of space. The ancient Maya participated in a tradition of interring ritual deposits or caches into previous phases of construction, which included plaza floors. Due to the location of these caches, they are largely invisible to archaeologists and are predominately discovered through excavation. These caches frequently accompanied the construction of new phases of architecture, such as the remodeling, repair, and

the expansion of a structure or plaza. The construction or modification of these buildings served as ritual activities and forms of commemoration that corresponded to the sacred space and the maintenance of social memory. These modifications also served to promote legitimate claims to the sacred place.

Ritual caches were commonly placed in several different contexts, which included restrictive plazas, ceremonial complexes, and occasionally domestic buildings. In addition, caches were offered and interred for a wide variety of ritual traditions, customs, and practices (Kunen, Galindo, and Chase 2002). It is worth noting that there was some level of overlap between ceremonial and domestic caches regarding the selection of artifacts and their associated functions. However, there were also some significant differences, as ceremonial caches were generally more elaborate and often served to sanctify the ritual place (Chase and Chase 1998). Depending on its spatial location, a ritual cache can represent an ideational landscape (Brown and Garber 2008). Chase and Chase (1998) claimed that these caches served to link the external world with the underworld, and thus they established pathways of sacred space.

Additionally, caches resemble another type of common ritual deposit found in ancient Maya centers, which were burials. Archaeologists have traditionally perceived caches and burials as two distinct types of ritual deposits that were predominately distinguished from one another by the presence or absence of human skeletal remains (Coe 1956; Pedersen 2016). However, it is essential to note that there are problems with this division, as there is frequent overlap in the material artifacts found in caches and burials (Kunen, Galindo, and Chase 2002; Becker 1992).

One of the clearest examples of a ritual cache that ties together the theories of practice, place, and social memory was the Middle Preclassic period cruciform cache discovered in the Central E-Group plaza at Cival. This cache was spatially arranged into a cruciform shape with

four tiers that were carved into the soft bedrock of the plaza. The first level of the cache was the outer arms of the cruciform. The second tier was composed of the inner arms of the cruciform shape and supported four jars that were positioned in the cardinal directions. The third level was a squared pit that contained 114 greenstone pebbles and another black jar (See figure 2.1). Additionally, there were four upright greenstone celts placed along the sides of the squared pit. In the middle of the pit was a small hole that contained a single upright green-blue jadeite celt (Estrada-Belli 2006; Estrada-Belli 2011; Morgan and Bauer 2004). During the final act of this ritual, five jars were smashed and liquid-filled the cache. Afterwards, the villagers coated the plaza and cache with a layer of plaster. Finally, a wooden post was placed above the offering (Estrada-Belli 2011).



Figure 2.1: Image of the cruciform cache discovered at Cival. Image by Francisco Estrada-Belli.

Francisco Estrada-Belli (2006) provides a thorough interpretation of the cruciform cache and its connection to early political ideology. In particular, he discusses the cache as representing the quadripartite division of the Maya universe and as the axis mundi. The ancient Maya perceived their world as containing a horizontal division that was composed of four quarters and center (Ashmore 1991; Chase and Chase 1998; Coggins 1980; Houston 1998). Thus, the arrangement of the five jars and five greenstone celts in the cruciform cache represented this quadripartite division. The interment of the cache was part of a ritual event that centered the ancient Maya universe and the site of Cival around the cruciform cache, or more specifically, the center of the offering. The cache was placed along the centerline of the plaza and was positioned in front of the eastern elongated platform of Cival's Central E-group assemblage.

This act of ritual centering also transformed the plaza into a sacred space and an essential place for the maintenance and transformation of social memory. The inhabitants of Cival actively selected to construct the Central E-Group plaza and the cruciform cache on the top of a hill. As previously mentioned, the ancient Maya perceived hills as important ritual locales that were ideal locations for the creation of sacred space. Thus, the placement of a cache into the hill served to activate the sacred qualities of the newly created place.

The Central E-Group plaza continued to be ritually re-centered throughout the site's history with the interment of additional caches and the placement of stelae. There were five additional ritual deposits placed in proximity to the cruciform cache over hundreds of years (Morgan and Bauer 2004; Estrada-Belli et al. 2003). The continued ritual activity in the plaza provides insight into the social memory, as, despite the substantial time difference between the caches, they were all placed within 1 meter of each other. Thus, the location of the cruciform cache and the sacredness of the place was preserved through social memory. The ritual act of

centering even extended to the site layout at Cival, as during the early Late Preclassic period, new construction continued to both literally and symbolically center the Central E-Group plaza with the erection of four new pyramids that were positioned in the four cardinal directions around the plaza (Estrada-Belli 2011).

2.6 Community of Practice

Theories of practice are also used to examine the transmission and distribution of practices and knowledge across generations. The exchange of knowledge regarding the construction and maintenance of plazas and their protective coating of plaster was partially the result of a community of practice approach. This term was first introduced in 1991 by Jean Lave and Etienne Wenger, who used it alongside the theory of situated learning to examine learning as a social process. The theory of situated learning was used to propose that learning occurs through practice and participation in an active, lived-in world (Lave and Wenger 1991) that extends beyond individual learning. A component of this theory was the concept of legitimate peripheral participation, which was viewed as the central process for the transfer of knowledge. Additionally, the term community of practice was developed to represent the group engaging in this situated learning.

In 1998, Etienne Wenger abandoned the idea of legitimate peripheral participation and instead elaborated upon the concept of communities of practice. In 2002, Wenger and his colleagues returned to this theory to expand upon the idea of learning as social participation. According to Wenger and his colleagues (2002), there are three characteristics for a community of practice, and these are domain, community, and practice. These three elements serve to replace the terms originally introduced by situated learning theory and “make a community of

practice an ideal knowledge structure—a social structure that can assume responsibility for developing and sharing knowledge” (Wegner, McDermott, and Snyder 2002:29).

In the updated version of the community of practice based-approach, the *domain* serves as a binding element that brings people together through a shared interest, passion, or sense of obligation. This shared domain can result in the formation of these communities, which can create a sense of collective identity. The *community* is formed around its members’ pursuit of the domain. It provides the social fabric of learning where members of the community interact, build relationships, and learn together through engaging in joint activities and discussions (Wegner, McDermott, and Snyder 2002). Finally, the term *practice* represents that the members of the community are practitioners, who through interacting with one another, share resources about the domain, such as experiences, helpful tools, information, and ideas. These interactions result in the formation of a shared practice, which is the knowledge that the community develops, shares, and maintains. Additionally, these practices can be shared either intentionally, such as members working together to create a knowledge base or unintentionally through general discussions among the members (Wegner, McDermott, and Snyder 2002). These three characteristics are rarely discussed in the archaeological literature, as this new interpretation of community of practice was explicitly developed for more modern applications, especially within the field of knowledge management. However, there are elements of this updated view that are likely applicable to historic and prehistoric communities of practice, as they can provide a model of how learning can occur in a community of practice.

Communities of practice is a useful approach in archaeology in that its “focus on participatory learning locates practice, meaning, identity, and community specifically within the material world” (Blair 2015:36-37). In archaeology, the community of practice approach is

frequently used to examine ceramics (Eckert, Schleher, and James 2015; Fenn, Mills, and Hopkins 2006; Kohring 2012; Roddick 2009; Sassaman and Rudolphi 2001; Wendrich 2013). However, a small number of archaeologists have utilized this theory to examine stone tools (Kwoka 2017; Starzmann 2013), households (Hendon 2010), and monumental architecture (Munson 2012).

Both Hendon (2010) and Munson (2012) utilized communities of practice as an isolated theory, rather than its common application as a critical component in situated learning theory. They primarily draw upon Wenger's (1998) analytical concept of communities of practice, which enabled the theoretical approach to extend beyond the investigation of craft production to the topics of architecture and domestic spaces. Julia Hendon (2010) utilizes the analytical concepts of communities of practice and social memory to investigate how communities created ties to the past. She particularly emphasizes the everyday practices associated with domestic spaces in prehispanic Honduras.

In 2012, Jessica Munson extended this analytical concept to investigate monumental buildings and ritual practices over a substantial period at the small center of Caobal, located in the Pasión region in Guatemala. Her examination perceives the "ways people used and constructed these buildings as shared endeavors that define and integrate communities through practice" (Munson 2010:53). These ritual practices are obtained by investigating the community practices inscribed by the architecture and subsequent episodes of building construction. Ultimately, this dissertation draws upon the research of both Hendon (2010) and Munson (2012) to create a more comprehensive understanding of the communities of practice associated with Preclassic period plazas at the sites of Cival, Holmul, and Witzna, which are located in the Cival region.

2.7 Theorizing Plazas

This dissertation emphasizes the role of practice, place, social memory, and collective memory in relation to the construction and remodeling of plazas in the Maya lowlands. Plazas are physically and culturally constructed places of human interaction that are often defined as open spaces surrounded by or adjacent to architecture. The construction of early plazas in the Mesoamerican region resulted in the formation of community and identity by bringing together groups of people. Local participation in the construction and public activities that occur in the plaza serves to create, reproduce, and transform both the community (Inomata 2014; Clark 2004) and the structure of the society. Additionally, plazas are locales for practice where the participation in public events provides opportunities to create, reshape, and transform meaning and memory (Inomata and Tsukamoto 2014). Plazas are not static, but instead, they are continually transforming (Joyce 2009) as practices, identities, and traditions shift. Plazas are subjected to various historical processes and trajectories that were shaped by the past and continue to shape the physical and ideational aspects of each plaza (Pauketat 2001).

The practices involved in the construction of plazas can result in the creation of sociopolitical complexity and political power (Joyce 2009; Urcid and Joyce 2014; Pauketat 2000) that transforms a community. Additionally, the practices and rituals conducted in public spaces can serve to create and maintain legitimacy and power in a locale. Plazas also function as a ‘site of memory’ where people come together and commemorate. It is a place that is remembered throughout the site’s history as a location where people remake and transform society and social norms. It is a locus of memory, where people associate specific memories with the public events that occurred in the locale. There are two components of plazas, which are the physical and practical aspects of plazas and the abstract and ideational aspects, such as meaning

and memories associated with the plaza (Inomata and Tsukamoto 2014). This dissertation explores the physical aspects through plaza capacity, phases of construction, and lime plaster analysis. The ideational aspects are discussed through the examination of ritual practices and social memory associated with the plazas at Cival, Holmul, and Witzna.

The concept of communities of practice is used to examine lime plaster production and architectural patterns involving public plazas. Additionally, this approach is utilized to examine the communities of practice involved in the daily and ritual activities occurring in public plazas by investigating the construction, maintenance, and placement of material remains, such as caches and stelae, in plazas located in the Cival region. The interaction, use, construction, and modification of these plazas are viewed as practices associated with a community of practice that emphasized the ritualization of these plazas. Due to the wide range of investigated practices, this project ultimately identified multiple communities of practice that emphasized different domains, such as construction processes and rituals. Although these communities were distinct, they also likely overlapped with one another, as people generally participate in multiple communities of practice (Hendon 2010).

Additionally, communities of practice were an important source of social memory and identity (Hendon 2010). Social memory in these plazas emerged from people interested in recreating the past for the future and frequently resulted in the placement of caches and stelae in public plazas. There are specific acts of social memory that serve to incorporate the past into everyday life through selective remembering and forgetting. These acts or practices include caching, construction, burying of the dead (Hendon 2010), replastering of plazas, and architectural modification. The material remains of these practices are found in plazas, which provides a method for investigating the communities of practice and social memories associated

with specific plazas. The most commonly discussed methods for the production of social memory are ceremonial and commemorative rituals, however, everyday practices also contribute to the production of social memory (Hendon 2010). This research examines both the larger ritual events and the more everyday practices associated with plaza modification and lime plaster production.

2.8 Summary

The theories of structuration, place, social memory, and communities of practices are used in this dissertation to better understand the initial construction and continued use of plazas in the Cival region. These early plazas were created through the active process of place-making as local groups came together to modify space into a place that contained meaning to its creators. Plazas also served as places where individuals and communities created, modified, and transformed the structure of society through everyday practices and ceremonial rituals. Local community engagement and continuous interaction with these plazas resulted in social memory being imbued into these places and in the formation of communities of practice. Many of the plazas in the Cival region served as places for commemorative ceremonies and ritual events, which resulted in their transformation into sites of memory.

Additionally, the theories of communities of practice and social memory are used to examine the material remains discussed in this dissertation, which includes lime plaster production, plaza dimensions, the placement of caches, and the standardization of specific architectural complexes and plazas in the Cival region. The labor involved in the physical construction and maintenance of these plazas can be used to inform us about the additional practices associated with these plazas and can provide insight into the communities of practice

that were involved in the upkeep and plastering of these plazas. Together, these practice-based theoretical approaches enable a multifaceted approach towards investigating plazas, and their material remains.

CHAPTER 3

Environmental and Background of Cival, Holmul, and Witzna

3.1 Introduction

One of the earliest centers of population agglomeration occurred in Central America, in a geographic and cultural region commonly referred to as Mesoamerica. In this cultural zone, many socially complex civilizations developed and thrived. The Maya Civilization was one of these cultures, and it first experienced urban development in northern Guatemala and Belize around the Middle Preclassic period (1000 – 400 BCE). Although there is no clear demarcation for the extent of the ancient Maya civilization, it is commonly proposed that the ancient Maya inhabited sections of the modern-day countries of Guatemala, Mexico, Belize, Honduras, and El Salvador.

Table 3.1: Pre-Colombian Chronological Period of the Maya Region (After Sharer 2006).

Period	Estimated Dates
Archaic	8000 - 2000 BCE
Early Preclassic	2000 - 1000 BCE
Middle Preclassic	1000 - 400 BCE
Late Preclassic	400 BCE - 250 CE
Early Classic	250 - 600 CE
Late Classic	600 - 800 CE
Terminal Classic	800 - 900/1100
Early Postclassic	900/1100 – 1519

Archaeologists have established a three-tier chronology system that divides the ancient Maya culture into periods known as the Preclassic, the Classic, and the Post-Classic. This temporal classification is only applicable in the examination of the ancient Maya as the rest of ancient Mesoamerica relies upon a separate chronological system. The Pre-Classic period corresponds to 2000 BCE to 250 CE, whereas the Classic period occurred between 250 to 900

CE. This last temporal category is the Post Classic period, which correlates to 900 through 1519 CE (Sharer 2006:98). Although this classificatory system ends at 1519 CE, there is still a large Maya presence located in the contemporary societies of Mesoamerica.

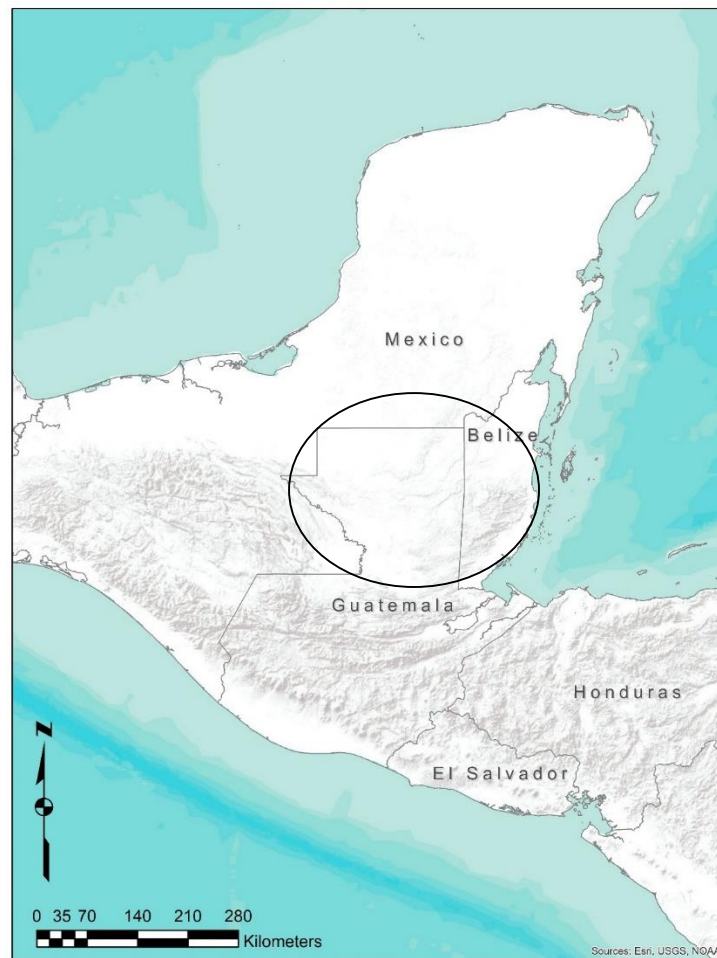


Figure 3.1: GIS image demonstrating both the environment and the location of the central Maya lowlands. Map by Kaitlin R. Ahern.

This chapter begins with an overview of the geography and chronology of the central Maya lowlands. The following section explores the traditional and contemporary understandings of the initial settlement of the Maya lowlands and the emergence of the ancient Maya. Afterward, there is a brief discussion of the ancient Maya during the Archaic, Early, Middle, and

Late Preclassic periods in the central Maya lowlands, which is followed by an examination of the plaza rituals associated with these periods. The chapter ends with an overview of the Holmul Archaeological Project and a detailed examination of the prior research conducted at the three sites of Cival, Holmul, and Witzna. Each site is discussed chronologically to establish a more cohesive understanding of the history of the three centers. The findings from previous excavations at Cival and the Watchtower complex located in East Witzna are also woven into the individual site histories.

3.2 Environment

Archaeologists have traditionally subdivided the ancient Maya region into three geographical zones consisting of the lowlands to the north, the Pacific Coastal plain located to the south, and the highlands positioned in the center of the region (Sharer 2006). These zones are often further divided into sub-delimitations. The Maya lowlands are commonly described as containing two or three sub-zones, known as the northern, central, and southern lowlands. This project focuses on the central Maya lowlands as it incorporates substantial portions of both Guatemala and Belize. More specifically, it focuses on three sites located in the northern half of Guatemala, in an area known as the Petén.

The central Maya lowlands is predominately a tropical jungle, although it also contains several large lakes and a southern patch of savanna grasslands (Sharer 2006). The region is known for its plethora of *bajos* or seasonal swamps, which are spread across the geographical area. Approximately 60-70% of the Petén's landscape is composed of bajos, which are interspersed between the well-drained hills or uplands. These bajos are mostly forested and can extend up to five kilometers in length and width (Hansen et al. 2002); however, these particular dimensions vary throughout the different sub-regions of the Petén.

The region experiences a two-season weather cycle where it is either rainy or dry. The rainy season typically occurs between June and January, and it known for brief periods of torrential rain (Sharer 2006). During this season, the Petén averages between 900 and 2500 millimeters of rain (Rosenmeier et al. 2002). The dry season usually lasts from February to May and is identified by a lack of rain and a shortage of natural surface water. Since the bedrock of the central Maya lowlands is a naturally porous limestone, rainfall and water drain through the soil rather than contributing to the formation of rivers, groundwater, or any other form of surface water (Wahl et al. 2006). As a result, the bajos typically serve as the only natural sources of water during the dry season. The ancient Maya addressed this seasonal shortage of water through the creation of artificial reservoirs and hydraulic systems (Scarborough 1998). Historically, the intensity of the seasonal rainfall resulted in the weathering or erosion of the limestone bedrock, and this resulted in the creation of the montmorillonite clay, also known as *Maya clay*, that functioned as an impermeable layer. As this clay was commonly washed into the bajos, it inevitably created temporary reservoirs that can store seasonal water (Wahl et al. 2006). The Petén is also composed of *civales* or treeless, perennially wet marshes that are located within or adjacent to the bajos (Hansen et al. 2002; Wahl et al. 2006). These *civales* also serve as temporary reservoirs. The landscape is further dotted with *aguadas*, which refer to both natural water holes and artificially constructed reservoirs that were built by the ancient Maya (Hansen et al. 2002).

In the contemporary region of the Petén, the average annual temperature ranges between 25°C and 28°C (Leyden 2002). These temperatures vary throughout the two seasons and across the sub-regions of the Petén. Additionally, there are two distinct classifications of the vegetation that grows in the Petén, and these categories are the result of their corresponding habitats. These

groupings of vegetation are composed of the uplands, which consist of tropical semi-deciduous forests, and the bajos that contain an evergreen habitat (Rosenmeier et al. 2002). Notably, the vegetation in the Uplands is largely comprised of a closed canopy tropical forest, whereas the habitat of the bajos typically consists of twisted, thorny trees that are commonly less than ten meters in height. It is suspected that the vegetation in the bajos had grown in this particular manner as a consequence of the seasonal increase in the water levels, which continuously interferes with the annual deposit of clay soil (Wahl et al. 2006).

3.3 Early Understandings of the Maya lowlands and Origins of the Maya

Since the discovery of city centers in the Maya lowlands, researchers have been concerned with explaining how a civilization independently developed in the jungle, especially as most of the earliest civilizations found throughout the world were established in fertile river valleys. There continue to be difficulties in determining the origins of the Maya civilization as the region inhabited by the ancient Maya is located across a series of diverse environments, which include areas in both the highlands and lowlands. Due to these difficulties, researchers began to formulate various theories by the late 1970s to explain the development of these ancient Maya centers. Scholars mainly focused on the development of the ancient Maya in the lowlands, which was the location of the jungle. These early examinations led to the theorization that the region was not occupied by the ancient Maya until sometime between 0 CE and 250 CE. Instead, it was thought that the lowlands were inhabited by local people, who were eventually replaced by the Classic period Maya (Coe 1977; Estrada-Belli 2012; Sharer 2006). These early beliefs led to various theories suggesting that the Maya lowlands were invaded by outsiders who introduced certain traditions to the ancient Maya culture. These theories specifically emphasized diffusion

and influences from distinct cultures that existed outside of the region (Adams and Culbert 1977).

A majority of these hypotheses proposed that during the Classic period, the Maya lowlands were populated by several diverse cultural groups that had originated from distant locations in Mexico and Guatemala, such as Southern Chiapas, Southern Veracruz, and Southwest Guatemala (Coe 1977; Culbert 1977; Lowe 1977). These claims were based on linguistic (Lowe 1977) and ceramic similarities between the Maya lowlands and other cultural groups located throughout the region. Another hypothesis proposed a Highland to Lowland migration to explain the similarities between the ceramics found in the Guatemalan highlands and El Salvador with those found at specific sites in the Maya lowlands. This theory fueled the idea that the Maya lowlands had experienced a Highland invasion or intrusion that resulted in a cultural break between the Preclassic and Classic period inhabitants of the region (Pring 1977; Brady et al. 1998; Willey and Gifford 1961).

Although these migration theories proposed the introduction of an external stimulus in the Maya lowlands that resulted in the Classic period Maya, their claims were based entirely on the material remains of a population that had developed ceramic production. Therefore, these theories neglected to acknowledge the possibility of a previous habitation or migration of an aceramic people to the Maya lowlands. This oversight led to a marginalization of hunter-gatherers, foragers, and aceramic populations, as these theories failed to speculate that there could be a non-sedentary, local population that influenced the development of the Classic period Maya.

Another widely accepted theory regarding the origin of the ancient Maya emphasizes the shared traditions found throughout Mesoamerica. It specifically claims that the ancient Maya

civilization developed out of a broad Pan-Mesoamerican tradition, which consisted of regional characteristics that were largely shared among the different cultures in Mesoamerica. The term Mesoamerica referred to the cultural area or region that contained the cultures and people who engaged with Mesoamerican traditions (Pye and Clark 2000). Although the utilization of Mesoamerica has become more generalized to refer to the broader region, it is essential to remember that the term refers to a flexible boundary that has grown and shrunk over time. This flexibility resulted in the creation of a shifting landscape with stable and dynamic changes that established distinct Mesoamerican traditions. Some of the most notable Mesoamerican traditions included the existence of the rubber ball game, complex ritual calendars, human sacrifice, a maize cult, and the cultivation of chocolate (Pye and Clark 2000). These Mesoamerican traditions also included the sharing of particular worldviews, political systems, highly specialized markets, architecture, motifs, and the use of the four cardinal directions (Adams 2005; Coe 1987).

Since these traits are predominately found in each of the ancient Mesoamerican cultures, scholars have sought to discover the origin of these traditions and illuminate the processes that led to these shared practices. Early investigations resulted in a theory that these Mesoamerican traditions emerged from a single culture or a mother culture. These early speculations were reinforced by the belief that the cultural sphere known as the Olmec had the earliest urban settlements located throughout Central America. Thus, scholars developed a theory of inter-regional interaction among the ancient Mesoamerican cultures that revolved around the idea of the Olmecs as the ‘mother’ culture. This theory proposed that the Olmec inhabitants of San Lorenzo developed the majority of these Mesoamerican traditions and ideas, which were subsequently spread to the rest of the region through elite exchanges, conquest, and trade

(Rosenswig 2010). In particular, it was proposed that the Maya civilization was influenced by the Izapan culture, which itself was substantially shaped by the Olmec centers of San Lorenzo and La Venta (Coe 1977).

3.3.1 Discovery of the Preclassic Period

These origin theories emerged under the premise that the Maya lowlands were only inhabited by the ancient Maya during the Classic period. This belief was rooted in the lack of information regarding the ancient Maya during the Preclassic period, especially in the Maya lowlands. This initial belief was a consequence of logical restraints, such as the jungle environment, and early archaeological misconceptions, like those discussed above. An additional constraint was the difficulty in accessing Preclassic period structures as many of them were modified or buried under Classic period construction (Chase and Chase 1995). Thus, the majority of early information regarding this period was acquired from sites and buildings abandoned during the Preclassic or Early Classic period.

The first Preclassic period structure discovered in the Maya lowlands was identified at the site of Uaxactún in the late 1930s, and it was excavated by the Carnegie Institute. Before this discovery, there was almost no indication of occupation in the Maya lowlands that preceded the Classic period Maya (Estrada-Belli 2011; Ricketson and Ricketson 1937). Despite the magnitude of this find, there was little effort in excavating and examining the Preclassic period in the Maya lowlands for over thirty years.

The early perceptions of the Preclassic period were shattered with the discovery of El Mirador, which was located in the Petén, Guatemala. Although the site was first mapped in 1962, primary excavations did not begin at El Mirador until 1978. Researchers quickly noted that El

Mirador was one of the largest and grandest ceremonial centers in the Petén with *sacbeob* or causeways that extended over a distance of ten kilometers and connected the site with other nearby centers (Estrada-Belli 2011). After several years of excavation, it was determined that El Mirador was established during the Middle-to-Late Preclassic period and was eventually abandoned around the start of the Early Classic period. This prestigious site led to the realization that the ancient Maya had established centers and formed early states in the Maya lowlands during the Late Preclassic period. By the 1980s, it was apparent that the Maya lowlands were widely inhabited during the Preclassic period, and this assertion was supported by an influx of site reports. A significant amount of this data came from the Belizean center of Cuello, which demonstrated substantial site occupation during the Preclassic period (Hammond and Miksic 1981), along with the site of Altar de Sacrificios (Wiley 1973). These reports provided early evidence of residential and ceremonial structures dating to the Middle and Late Preclassic periods. Additional scholarly reports and articles in the 1990s and 2000s continued to revolutionize archaeologists' understanding of the Preclassic period and the emergence of the ancient Maya in the lowlands.

3.3.2 Contemporary Theories

Over the last twenty to thirty years, there was a shift in the conceptualization of the lowlands as more research was conducted to provide context for the development of the broader region. These examinations provided ample evidence that the Maya lowlands were inhabited much earlier than previously theorized by revealing early occupation of the region (Pohl et al. 1996) and the extent of long-distance trading among the cultures of Mesoamerica (Garber et al. 2004a; Estrada-Belli 2012; Lohse 2010). Consequently, a new theory was developed that

emphasized the role of multiple cultures, or sister cultures, in the formation of these Pan-Mesoamerican traditions. In particular, this theory countered the earlier model of the Olmec's as the mother culture and instead focused on the extensive interregional interactions between multiple Mesoamerican cultures during the Early and Middle Preclassic periods. These groups each contributed distinct cultural developments, such as ideas, art styles, political systems, and practices. Thus, these Pan-Mesoamerican traditions were formed through the majority of cultures adopting and modifying specific cultural traits (Adams 2005; Rosenswig 2010; Sharer and Traxler 2006). Additionally, this period of interregional interaction resulted in the implementation and use of similar ceramic styles, symbols, and motifs by Middle Preclassic period cultures located across Mesoamerica (Garber et al. 2004a; Estrada-Belli 2012). In the Maya lowlands, this system of symbols was commonly associated with Pre-Mamon ceramics. To conclude, the Middle Preclassic was a dynamic and fluid period where the ancient Mesoamerican cultures were participating in and transforming a system of interaction that was relatively balanced and served to establish a shared Mesoamerican ethos.

3.3.3 Brief History of the Preclassic

As mentioned above, the broader shift in the perception and origin of the Maya lowlands was the result of archaeological excavations that focused on the Preclassic period. The application of data-driven excavations resulted in improved comprehension of the history of the Maya lowlands and enabled archaeologists to begin reconstructing early occupation in the region. This section briefly discusses some of the major feats that occurred during the Archaic and Preclassic periods and introduces the origin of various elements associated with the ancient Maya culture. It also provides a background to the individual sites discussed later in the chapter.

Most of the data on the Archaic and Early Preclassic periods in the Maya lowlands comes from northern Belize, as unfortunately, there is an absence of investigation into the Archaic in the other regions of the Maya lowlands. This deficit has led to a fragmented understanding of the development of the ancient Maya. Additionally, it has resulted in a lack of knowledge regarding the transitional periods in the Maya lowlands.

3.3.3a Archaic and Early Preclassic period

During the Archaic period, early foragers in the Maya lowlands were utilizing stone tools (Harrison 1999). Recent studies determined that tool production developed as early as 3000 BCE in selective areas in the Maya lowlands, such as the Colha lithic tradition, which utilized chert outcrops in the Northern Belize Chert-Bearing Zone. The Colha lithic tradition remained mostly unchanged for 4,000 years, as it continued to utilize the same underlying technologies and relied upon hard-hammer percussion (Iceland 2005). Additionally, the Colha lithic tradition was the only known trade production of chert during the Early, Middle and Late Preclassic periods, due to the lack of evidence of long-distance trading of this material (Lohse 2010).

The Archaic period was marked by an absence of early settlements and the lack of ceramics. Agriculture first emerged in northern Belize between 3500 BCE and 3000 BCE (Lohse 2010; Lohse et al. 2006; Pohl et al. 1996) before spreading to the rest of the Maya lowlands by at least 1400 BCE (Wahl et al. 2006; Wahl, Estrada-Belli, and Lysanna 2013). The development of maize agriculture was likely a result of diffusion from outside the region. However, the variations exhibited in the macrobotanical remains found in sediment cores taken from nearby lakes indicated that specific local communities in the lowlands had a distinct role in shaping the crop (Pohl et al. 1996). Between 2000 and 1000 BCE, there was a noticeable increase of *Zea*

Mays or maize pollen and a decrease of tree pollen found within the sediment cores, which indicated the intensification of agriculture and subsequent deforestation (Wahl et al. 2006; Pohl et al. 1996).

Pollen analysis and the excavation of several middens revealed that the Archaic period Maya were relying on a diet that was composed of hunting, gathering, fishing, and some small-scale agriculture (Lohse 2010). This assortment of techniques was classified by Mary Pohl and her colleagues (1996:363) as a “mixed indigenous economy” where the local people consumed food that was obtained through multiple different substance strategies, such as forest gardens and agriculture. This mixed economy of relying on natural resources continued into the Preclassic period, and in some areas, it made up a more substantial portion of the local diet than maize consumption (Pohl et al. 1996). It is possible that this continued reliance on a mixed economy resulted in a delay in the emergence of permanent villages in the region until approximately 1300 to 1000 BCE (Lohse 2010) or later, as seen in parts of the Petén. The absence of these villages may have also delayed the development of ceramic production.

Between 1500 and 1000 BCE, the Maya lowlands were inhabited by several early agricultural communities such as Cuello (Gerhardt 1988; Hammond and Gerhardt 1990; Gerhardt and Hammond 1991) and Blackman Eddy (Garber et al. 2004b). Around this time, the local inhabitants began constructing domestic groupings that consisted of residential mounds. At some of these settlements, the earliest occupants modified the limestone bedrock to use as a living surface (Awe 1992; Gerhardt 1988; Brown and Garber 2008). Additionally, small villages and communities were established near the later sites of ancient Maya cities, and these centers participated in regional and local economic trade networks. These early exchange systems

indicated that the Early Preclassic period in the Maya lowlands contained some degree of inequality (Henderson 1997).

By 1100 BCE, a selective number of ancient Maya centers began to both produce and utilize ceramics in parts of Belize. These early ceramic assemblages were predominately found at sites in northern Belize and in the Belize Valley, but they were also occasionally located at sites along the Guatemalan border (Gerhardt 1988). A few of these sites containing late Early Preclassic and early Middle Preclassic period ceramic types include Xunantunich, Blackman Eddy, Pachitun, Cuello, and Cahal Pech (Awe 1992; Garber et al. 2004a; Garber and Awe 2009; Gerhardt 1988).

3.3.3b Middle Preclassic period

By the beginning of the Middle Preclassic period, there was a greater range of interactions and communications between the various settlements in the Maya lowlands, and this was a consequence of the expansion of trade networks utilized during the Early Preclassic period (Henderson 1997). These established trade networks covered extensive regions, which enabled increased inter-regional interaction that spread throughout Mesoamerica. By 1000 BCE, there was evidence in the Belize Valley of long-distance exchanges that resulted in the trade of exotic goods such as greenstone, obsidian, and marine shell from the Caribbean Sea (Garber et al. 2004). These specific exotic goods indicated the occurrence of long-distance trade with cultures located in the Guatemalan highlands and the Gulf of Mexico. Additionally, the ancient Maya were constructing public and monumental architecture by 950 BCE (Inomata et al. 2013; Inomata 2017). Thus, these discoveries led archaeologists to propose that the Preclassic period

Maya were active participants in both interactions and trade with regions as distant as the Olmec center of La Venta (Inomata et al. 2013).

Although small villages appeared in parts of Belize during the early Middle Preclassic period, specific sites in the Petén, like Ceibal, contained a mixture of sedentary and semi-nomadic groups until the beginning of the Late Preclassic period (Inomata et al. 2015). At Ceibal, semi-nomadic groups participated in the construction of monumental ceremonial complexes and formed early communities around these centers by 950 BCE. These groups practiced residential mobility and lived in temporary structures. Over time, the Ceibal community became more sedentary, and by 300 BCE, most of the population lived in residential groups located around the city center (Inomata et al. 2015). Other early ceremonial centers, such as Cival and Holmul, were also formed by a mixture of sedentary and semi-nomadic groups (Estrada-Belli 2016a; Neivens 2018).

The earliest monumental structures found in the Maya lowlands were an architectural complex known as E-Groups. An E-Group assemblage is a series of structures that contain a western radial pyramid, an eastern elongated platform, and a connecting plaza that are positioned along an imaginary east-west axis (Ricketson 1933; Ricketson and Ricketson 1937). Additionally, the eastern elongated platform frequently supported three linearly positioned temples. E-Group assemblages were predominately constructed during the Middle and Late Preclassic periods; however, variations of the complex continued to be built into the Late Classic period. Although E-Groups were often associated with astronomical alignments and solar observatories (Blom 1924; Ricketson 1928), the earliest E-Groups assemblages generally lacked these particular functions. Instead, early E-Groups assemblages seemed to serve as public architecture, and their plaza functioned as a local gathering place for ceremonial and

commemorative rituals (Doyle 2012; Laporte and Fialko 1990). Some of the earliest E-Groups complexes in the Maya lowlands were found at the sites of Ceibal, Cival, and Tikal. E-Group assemblages are discussed in further detail in chapter 6.

3.3.3c Late Preclassic period

Significant social and political modifications accompanied the Late Preclassic period in the Maya lowlands. During this period, early rulers or kings emerged at various sites across the central Maya lowlands. Some of the earliest evidence of kings come from the sites of Cival and San Bartolo. At Cival, a stone monument was discovered, known as Stela 2, that currently contains the earliest identified depiction of a king. Stela 2 was carved and erected around 300-200 BCE (Estrada-Belli 2011). The site of San Bartolo contained one of the earliest murals discovered in the Maya lowlands, which was completed around 100 CE. The mural contained a scene depicting the inauguration of a Late Preclassic period ruler (Saturno et al. 2005; Sharer 2006). Both of these early depictions of rulers indicated that by the Late Preclassic period, kingship was an established institution in ancient Maya society. The discovery of early elite tombs also supports this claim. At Tikal, a Late Preclassic period royal burial was discovered, and it likely contained the founder of the Tikal dynasty, Yax Ehb Xook, who died around 100 CE (Martin and Grube 2008). These discoveries also correlate with the suspected emergence of kings at other Late Preclassic period sites, such as El Mirador (Hansen 2016).

Around 300 BCE, there was a significant transformation in the architectural layout at Cival and other Preclassic period sites as a new architectural form, known as a triadic group, was developed. A triadic group was an architectural complex where a central pyramid is flanked by two smaller pyramids, and this grouping was often found on the top of a steep pyramidal

platform. Some triadic groups were built to the east of an E-Group assemblage and used the same east-west axis, such as the sites of Cival, Nakbe, El Mirador, and Yaxha (Estrada-Belli 2011; Hansen 1998). However, some triadic groups exist independently of any E-Group complex (Estrada-Belli 2011). Early Maya writing also appeared during the Late Preclassic period and was discovered at various Preclassic period sites, such as San Bartolo, El Mirador, and El Porton (Saturno, Stuart, and Beltrán 2006).

Towards the end of the Late Preclassic period, many ancient Maya cities, such as Cival, El Mirador, and Cerro, experienced a significant decline and eventual abandonment. The collapse of these centers was often a result of accumulating events involving environmental factors followed by increased conflict. Some of these environmental factors included significant droughts (Brenner et al. 2002; Dunning et al. 2014; Webster et al. 2007), environmental degradation (Beach et al. 2006; Sharer 2006), and the shrinking of water sources (Wahl, Byrne, and Lysanna 2014). There was also increased conflict and warfare, as seen through the construction of defensive walls, such as at Cival (Estrada-Belli 2011), and at Muralla de Leon (Rice and Rice 1981), and in the creation of fortifications, such as the dry-ditch and parapet at Becan (Webster 1976). It is plausible that El Mirador was also attacked during this decline, as some of the structures in the city were suddenly abandoned with their inhabitants leaving behind ceramic vessels (Hansen et al. 2008).

3.3.3d Conclusion

Despite the collapse of numerous cities, many Preclassic period sites continued to thrive during the Classic period. For example, the ancient Maya city of Tikal emerged during the Middle Preclassic period, and by the Early Classic period, the city became a dominant and

hegemonic power in the Maya lowlands. Early Classic and Late Classic period cities formed new dynasties and built upon Preclassic period antecedents resulting in the production of more writing and more elaborate architectural techniques. The Maya lowlands experienced another period of collapse during the Terminal Classic period. This collapse was not a uniform event, but instead, it was staggered across the region. There was significant variation among each of the cities regarding when they were abandoned and the causes leading to their collapse. Some of the most common causes included droughts (Webster et al. 2007), ecological collapse (Turner and Sabloff 2012), warfare (Inomata 1997), and internal conflicts (Folan et al. 2000; Sharer 2006). However, not all cities in the Maya lowlands collapsed during this period. For example, the site of Lamanai, located in northern Belize, was continuously occupied until the Contact period with the Spanish. Additionally, several ancient Maya cities in the Yucatán continued to flourish into the Postclassic period.

3.4 Plaza Ritual

Over the years, Maya archaeologists have established a basic understanding of the ancient Maya rituals and commemorative practices from epigraphy, iconography, and archaeological evidence. Although each of these three types of evidence has provided substantial insight into these practices, archaeological evidence is the most applicable to the Preclassic period because of its temporal inclusion and almost complete lack of text. One of the clearest archaeological examples of ancient Maya ritual is the caches and burials interred in public plazas. Caches, like buildings, are found in one of the following three states: whole, broken, or burnt (Chase and Chase 1998).

The investigation of caches is a vital tool in deciphering ritual practices that occurred in

plazas as caches contain the material residue of ceremonial activities and rituals. Additionally, caches provide valuable insight into the comprehension and reconstruction of ancient Maya practices, the creation of place, and the formation and transmission of social memory. Caches were frequently interred in plazas during specific events, such as the completion of a construction project (Inomata 2014) or in association with ceremonial rituals regarding the placement of upright stone monuments or stelae. Researchers have developed multiple terms to describe the different types of caches and ritual events, such as dedication, consecration, and termination rituals. This research primarily examines dedication ritual caches interred in plazas. However, termination rituals are briefly discussed below as they are significant to contextualizing the ritual burning that occurred at Witzna and the Watchtower during the Early and Late Classic periods.

Dedication or consecration caches were offerings that were either interred into a previous phase of architecture or placed into the fill before the completion of construction. Caches were placed in plazas, civic-ceremonial structures, and residential buildings. These caches were frequently positioned under stelae and along the centerline of plazas and buildings. Additionally, caches often contained materials that were used to imbue a place with supernatural and cosmological power. A dedicatory cache was composed of items that created associations between the ideas of the supernatural world and the location of the offering (Kunen, Galindo, and Chase 2002). These caches were generally non-destructive, and they often contained remains that included deposits of pottery, marine shells, greenstone (or jadeite), and obsidian and chert eccentrics.

Another type of ritual regarding caches were termination rituals, which served to sever the connection between a structure or plaza with a sacred place. A termination ritual was the

intentional destruction of architecture, ceramics, and material goods, and it often incorporated burnt and broken objects (Rice 2009; Stanton, Brown, and Pagliaro 2008). This act of ritual burning was occasionally carried out on cache items, floors, specific architecture, or on the entire complex. Occasionally, an entire center was burnt following their defeat against a neighboring polity, such as seen at Witzna.

3.4.1 Caches and E-Group Plazas

In the Maya lowlands, it is generally rare to discover caches that date to the Middle Preclassic period (Munson 2012), and this is partially a consequence of the difficulty in accessing Middle and Late Preclassic period construction. An additional factor is that plazas remain relatively understudied in comparison to the research conducted on monumental architecture. Nevertheless, researchers have obtained some information regarding Middle Preclassic period caches. During this period, dedication caches were frequently placed in the bedrock and were found at the sites of Blackman Eddy (Garber et al. 2004a; Garber et al. 2004b), Ceibal (Aoyama et al. 2017; Inomata and Triadan 2015; Smith 1982), Cival (Estrada-Belli 2006, 2011), Cuello (Kosakowsky and Pring 1998), Ka'Kabish (Lockett-Harris 2016), Ixlú (Rice 2015), and Tikal (Coe 1990). Additionally, Middle Preclassic period dedication offerings were occasionally placed in chultuns that were carved into the bedrock and contained a mixture of offerings, such as ceramics, and human remains (Estrada-Belli 2008; Ricketson and Ricketson 1937; Rice 2015).

The majority of the information on Middle Preclassic period plaza caches has emerged from recent research conducted on E-Group assemblages and their plazas (Doyle 2012; Estrada-Belli 2006, 2017; Inomata et al. 2013; Inomata and Triadan 2015). Thus, it is valuable to explore

the material remains associated with the E-Group plazas to establish a better understanding of the ceremonial use of Middle and Late Preclassic period plazas. These offerings or caches found in various E-Group plazas included ceramics, obsidian, greenstone, and other precious materials. In particular, there was a long association of greenstone celt caches among Middle Formative Chiapas architectural complexes and early E-Groups assemblages. Greenstone cruciform caches emerged in the broader Mesoamerican area around 800 BCE and were often found along the east-west axis of E-Group assemblages, such as at Cival (Estrada-Belli 2011), Ceibal (Inomata 2014; Inomata and Triadan 2015; Smith 1982), and in Middle Formative Chiapas (MFC) complexes, as seen at San Isidro, Chiapas (Lowe 1981), La Venta (Drunker, Heizer, and Squier 1959), and Chiapa de Corzo (Inomata 2017). Cruciform caches were cuts made in the bedrock that were arranged in a quadripartite pattern and were aligned with the cardinal directions. These caches are frequently interpreted as a ritual that imbued the site with cosmological principles and established the plaza as a place. This tradition was short-lived in the Maya lowlands as these cruciform caches were only found at two centers, which were Ceibal and Cival. The E-Group plaza at Ceibal contained multiple cruciform caches carved into the bedrock (Inomata and Triadan 2015). This plaza was also discovered to contain 20 additional greenstone caches that dated to the Middle Preclassic period. Additionally, some of these ritual deposits also had greenstone and obsidian artifacts that were positioned in a cruciform arrangement (Aoyama et al. 2017). Finally, these caches were all located on the east-west axis of the E-Group assemblage at Ceibal (Inomata et al. 2015; Inomata and Triadan 2015). There was only a single cruciform cache discovered at Cival, and it was also located on the east-axis of an E-Group assemblage.

By the end of the Middle Preclassic period, the type of offerings left in specific E-Groups assemblages shifted from greenstone caches to sacrificial burials and deposits of ceramics

(Inomata et al. 2017), and obsidian (Aoyama et al. 2017). At Ceibal, archaeologists uncovered a mass grave at the base of one of the E-Group's eastern temples, which contained the skeletal remains of eleven individuals of all ages (Aimers and Rice 2006; Inomata et al. 2017). Human remains were also discovered at other E-Group assemblages in the Maya lowlands. For example, several decapitated heads were buried in the E-Group plaza at Uaxactún (Aveni, Dowd, and Vining 2003), and another mass grave was discovered in the plaza of Tikal's Mundo Perdido, directly in front of the eastern platform. The burial at Tikal contained the remains of seventeen individuals and was deposited around 250 – 300 CE (Laporte and Fialko 1995). Overall, the types of offerings found in the Late Preclassic period E-Group plazas reflected caching activity discovered at other sites in the Maya lowlands.

3.5 Cival Region

This section shifts from plaza rituals and caches to a detailed discussion of the individual site history for the three ancient Maya centers of Cival, Holmul, and Witzna. These three sites were discovered in a region now known as the Cival or Holmul region, which is located in the central Maya lowlands along the Holmul River. The region is commonly referred to as either the Cival or Holmul region based on the period referenced. For example, the Cival region is used to refer to this area during the Preclassic period as Cival was the dominant center at this time. Since this dissertation primarily focuses on the Preclassic period, this area is referred to as the Cival region.

The site of Holmul was first excavated between 1909 and 1911 by Raymond Merwin (Merwin and Vaillant 1932). After this expedition, no excavations were conducted at Holmul for almost 90 years. The site of Cival was rediscovered in 1984 by Ian Graham, who accidentally

located the site while mapping and exploring the jungle between Guatemala and Belize (Estrada-Belli 2001). Witzna is located 15 km north of Holmul, and it was first excavated in 2004 by the Petén Archaeological Site Protection Project, which was headed by Vilma Fialko (Fialko 2005).

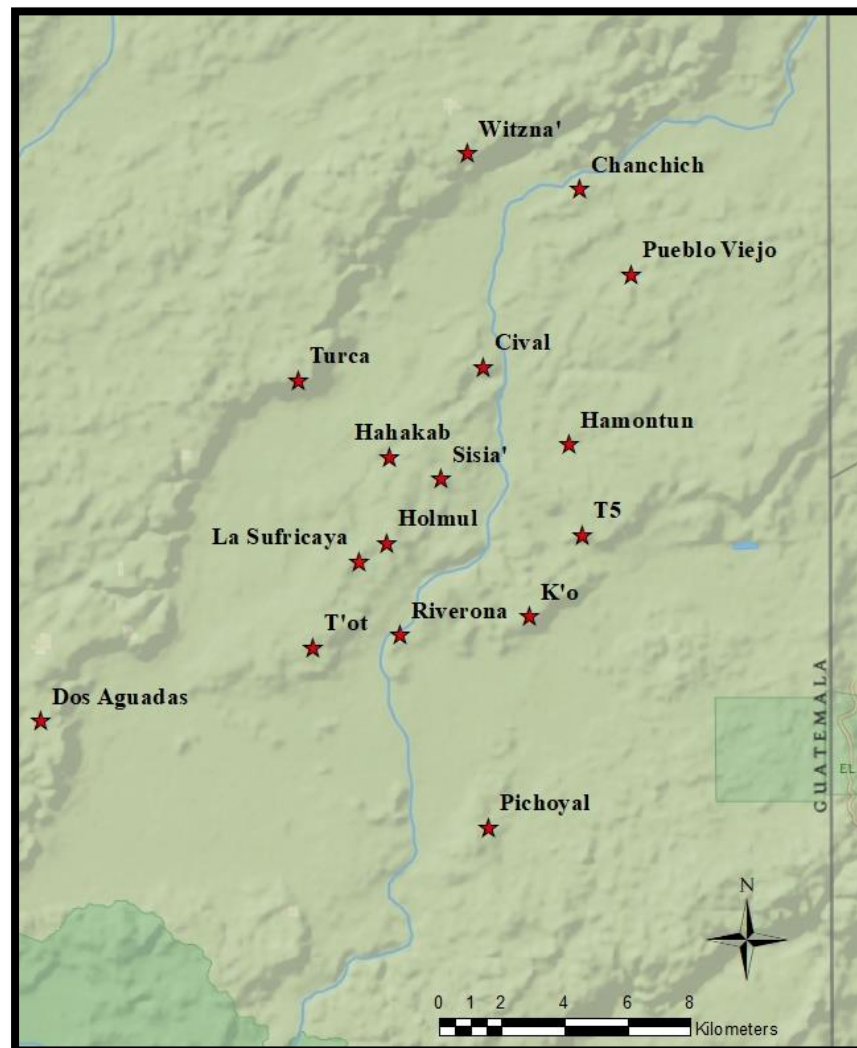


Figure 3.2: Topographic map of sites in the Cival region. Map by Kaitlin R. Ahern.

Beginning in the summer of 2000, Francisco Estrada-Belli and Boston University began an archaeological project in Guatemala at the ancient Maya site of Holmul. The first season of excavations quickly transformed into a multidisciplinary project known as the Holmul

Archaeological Project or HAP (Estrada-Belli 2011), and it rapidly incorporated all of the archaeological sites in the entire Cival region. This project focuses on a cluster of ancient Maya sites in the northern Petén near Guatemala's border with Belize. The project has conducted a wide range of investigations that includes ceramic, lithic, faunal, osteological, architectural, iconographic, and epigraphic analysis. Additionally, the project uses GIS, remote sensing, ground-based surveying techniques, and most recently, Airborne LiDAR data (Canuto et al. 2018). It has also analyzed pollen and sediment cores acquired from nearby lakes (Wahl, Estrada-Belli, and Lysanna 2013; Wahl et al. 2019).

The archaeological site of Holmul is situated in a dense jungle environment located 35 km east of Tikal. The sites in the Cival region range temporally from the Middle Preclassic until the Terminal Classic period. The major sites located in the region are Cival, Holmul, Witzna, and Xmakabatun. Some of the minor sites included in the Cival region are Chanchich, Dos Aguadas, Hahakab, Hamontun, K'o, Riverona, and T'ot (Estrada-Belli 2016a).

The Cival region first showed signs of ecological disturbance around 1400 BCE, and by 1380 BCE, there was evidence of agricultural production in the area (Wahl, Estrada-Belli, and Lysanna 2013). The earliest ceramics were produced in the region between 1100 BCE and 900 BCE (Neivens 2018; Estrada-Belli 2012; Callaghan 2008; Neivens de Estrada 2006). These early ceramics were part of the K'awil phase, which was part of the larger pre-Mamon ceramic sphere. The K'awil ceramics date to the Early Middle Preclassic period (1000-840 BCE) and were predominately found in Holmul's Group II plaza and the construction fill of the Central E-Group assemblage at Cival (Callaghan and Neivens de Estrada 2016; Neivens 2018). The majority of the K'awil phase ceramics were found at Holmul in Buildings N, B, and F, which were located in Group II. The K'awil phase ceramics were also frequently found mixed in with Mamon phase

ceramics, which were dated to the late Middle Preclassic period. Currently, K'awil phase ceramics are only found at two sites in the Cival region, which are Cival and Holmul (Callaghan and Neivens de Estrada 2016; Neivens 2018). During the early Middle Preclassic period, the site of Holmul experienced its first period of occupation. Around the same time, the land surrounding Cival was first inhabited by approximately two hundred residential complexes (Velasquez Lopez 2011). These residential complexes, hamlets, and small villages were located within a two-to-three-kilometer radius or approximately a half a day's walk from the center of Cival.

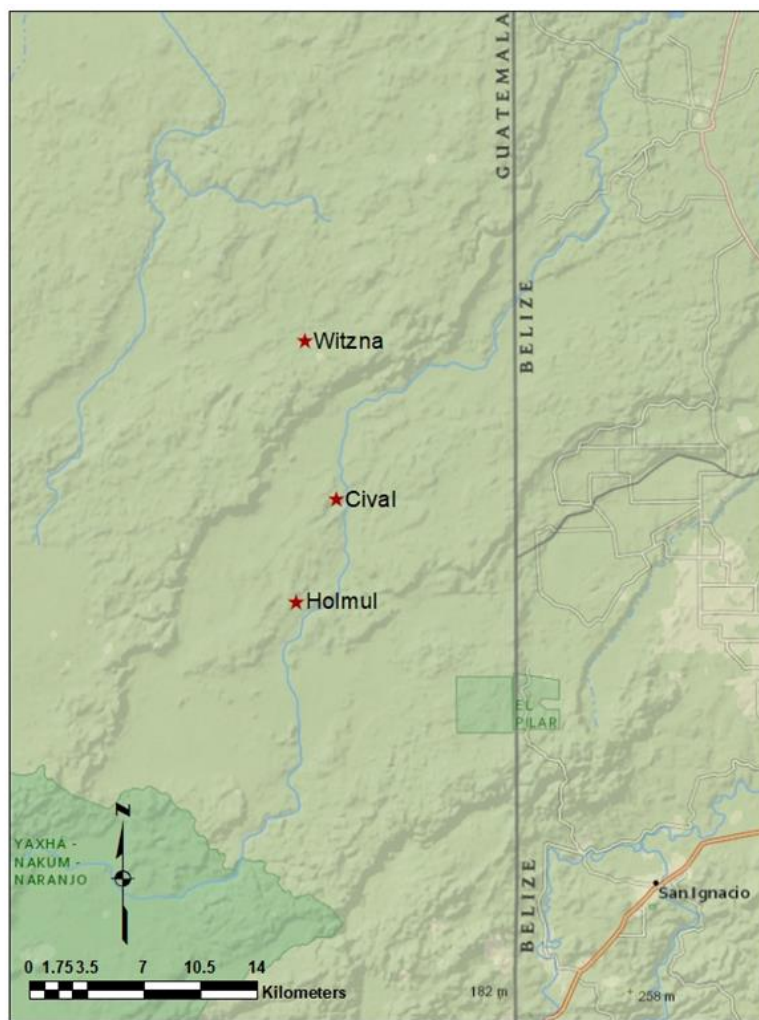


Figure 3.3: GIS image showing the location of the three major sites examined in this dissertation. Map by Kaitlin R. Ahern.

3.5.1 Cival

As mentioned above, Cival was rediscovered in 1984 by Ian Graham. He named the site Cival after the local Maya word for lagoon or swamp because the site is positioned around several sizable civaes. The center of Cival is situated among several hills, multiple large civaes (perennially wet marshes), and two large bajos. It is also within walking distance to the Holmul River (Estrada-Belli 2011). Cival was a large Preclassic period site that was occupied between 800 BCE and 300 CE. It was the regional capital of the area from 300 BCE to 200 CE, and it only declined once the city was attacked around 200 CE (Estrada-Belli 2011; Estrada-Belli and Tokovinine 2016).

During the Middle Preclassic period, the residential complexes surrounding Cival provided the site with a population range between 2,000 and 5,000 individuals (Estrada-Belli 2011:77). A portion of this population eventually settled within or around the ceremonial center of Cival, whereas the other inhabitants remained in the hinterlands. Additionally, a percentage of these residents settled along the banks of the site's civaes (Estrada-Belli 2011; Velasquez Lopez 2011).

Around 800 BCE, Cival experienced its first phase of monumental construction. This early date is based on two sets of radiocarbon dates. The first set of dates was retrieved from the interior of a sealed storage chamber or a chultun located near the center of the site. This bedrock chamber contained the remains of a human skeleton and gave a calibrated AMS radiocarbon date around 840 to 800 BCE (Estrada-Belli 2011). A second radiocarbon date was obtained from pieces of charcoal discovered in the sealed inauguration cache and was calibrated to approximately 790-760 BCE. This cache was part of both the first known ritual activity at Cival and part of the inauguration of the Central E-Group assemblage (Estrada-Belli 2011).

The initial phase of construction at Cival included the massive project of modifying the land to create a level area of 500 meters squared between two hills. The creation of this leveled surface required laborers to fill in the area between these two hills with an average of four to seven meters of material. This fill included boulders, dirt, and smaller rocks (Estrada-Belli 2011). Next, laborers from the neighboring communities constructed two early structures that were located on either side of a large plaza and were arranged along an east-west axis. Both structures were positioned on top of modified hill knolls that were carved into the natural rise in the bedrock (Estrada-Belli 2011; Ahern 2014a, 2014b). Together, these structures and the plaza formed an architectural pattern known as an E-Group assemblage.

The first phase of construction for the E-Group's western pyramid, or Structure 9, consisted of carving the natural limestone bedrock and then coating it in a thin layer of plaster. This altered bedrock rose approximately 1 meter in height from the plaza floor and had several notches carved into it (Estrada-Belli 2014). Before the next major phase of construction, there was a minor addition of a new plaster floor applied to the front of the platform. During its second phase of construction, Structure 9 was transformed into a radial pyramid that likely exceeded 2 to 3 meters in height and had at least six terraces (Estrada-Belli 2014). The E-Group's eastern platform or Structure 7 also began as shaped bedrock and contained several carved steps. By its second major phase of construction, the platform measured approximately 1 to 2 meters in height (Estrada-Belli et al. 2004; Morgan and Bauer 2004). Over time, Structure 7 functioned as a platform that supported three temples.

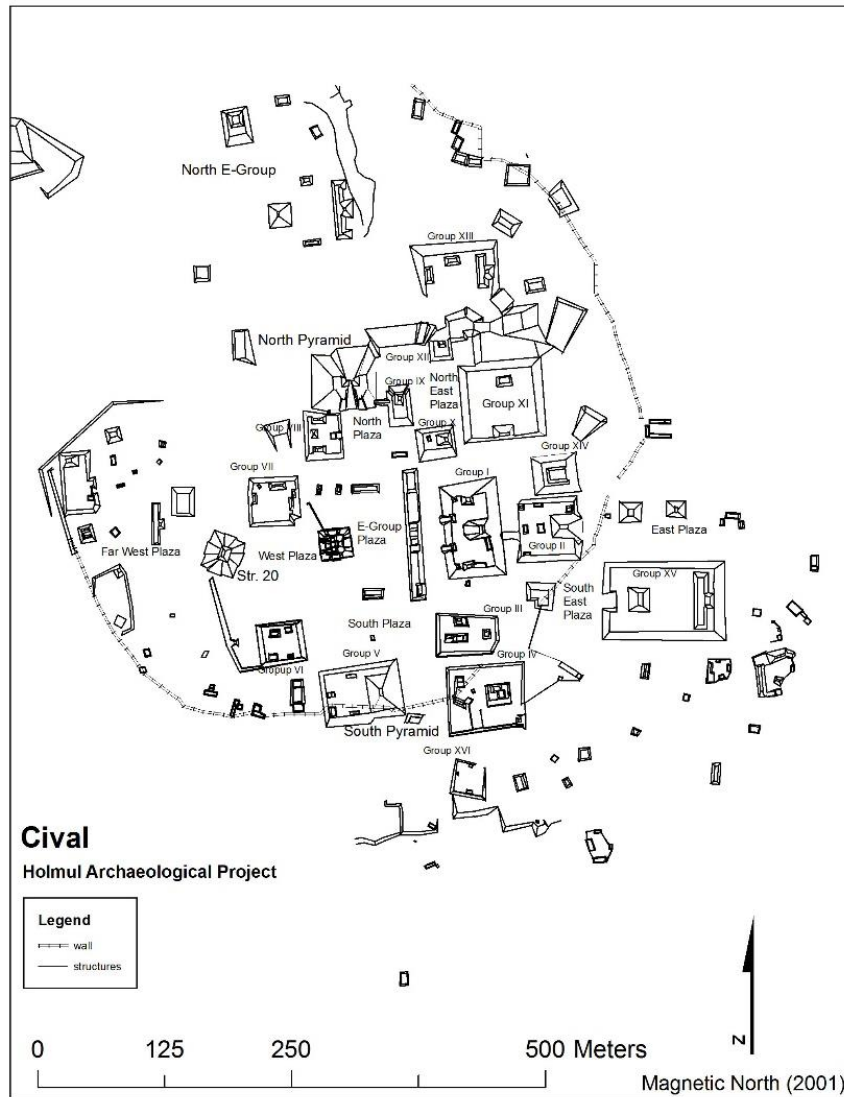


Figure 3.4: Map of the site of Cival. Map by Francisco Estrada-Belli.

Between 800 and 700 BCE, this early E-Group assemblage became the epicenter of Cival, and its central plaza served as a communal gathering point for the members of the neighboring villages, hamlets, and residential complexes. Around 790 to 760 BCE, the villagers carved a cruciform shape in the bedrock immediately in front of Structure 7. This carved bedrock served as the location for the inauguration cache that was first mentioned in chapter 2. The E-Group assemblage remained unchanged for almost 400 years (Estrada-Belli 2011), before undergoing several new phases of construction during the Late Preclassic period. Although the

site grew beyond this complex, the Central E-Group remained the ritual core of the community throughout the history of Cival. Thus, the complex was often remodeled and repaired. Structure 9 or the western radial pyramid had five phases of construction (Ahern and Colindres Díaz 2015; Estrada-Belli et al. 2015), and Structure 7 or the eastern elongated platform underwent six significant phases of remodeling. Both structures experienced periods of minor alteration. Additionally, the plaza floor also experienced six phases of remodeling, where it was raised and replastered. However, the width of the plaza remained the same size throughout all of the phases of construction to the E-Group assemblage (Estrada-Belli et al. 2014; Estrada-Belli et al. 2004).

Cival experienced its next major site expansion around 350 BCE with the construction of Group 1, the North pyramid, the South pyramid, and the West pyramid or Structure 20. These four new pyramids were built on the edge of the site's leveled plaza, and their construction doubled the size of the ceremonial core. Interestingly, these new pyramids were positioned around the Central E-Group assemblage, and each one of them was constructed in one of the primary cardinal directions. The eastern and western pyramids were positioned 308 meters from each other, whereas the northern and southern directional pyramids were separated by 259 meters (Estrada-Belli 2011). Thus, if lines were drawn along the east-west and north-south axes of the directional pyramids, the lines would cross in the center of the primary E-Group assemblage. According to Francisco Estrada-Belli (2011), the positioning of Cival's four largest pyramids in the cardinal directions and the location of the primary E-Group assemblage in the center created a k'an cross pattern (2011), which was an important Maya glyph that consisted of a cross with a circle in its center. Concurrently, three large plazas were constructed to the north, west, and south of the Central E-Group plaza. Between 350 BCE and 100 CE, each of these pyramids experienced up to five phases of construction (Estrada-Belli 2011). Thus, by the Late

Preclassic period, Cival demonstrated clear site orientation and planning with particular emphasis on maintaining alignments with the cardinal directions.

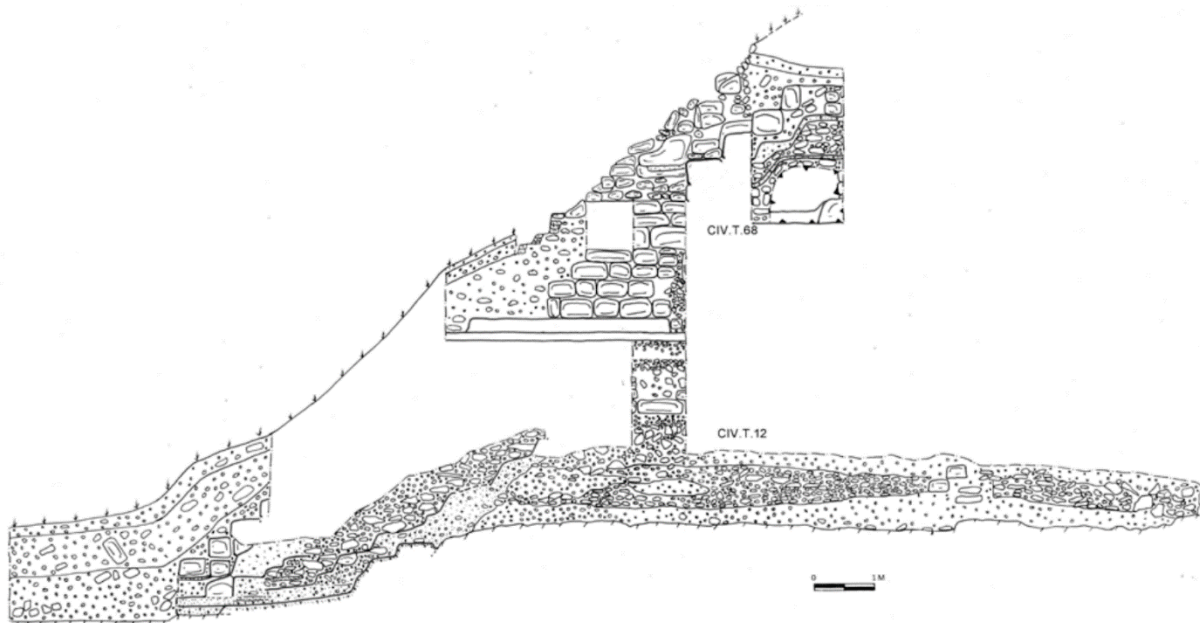


Figure 3.5: Profile of the 2013 excavations on the eastern side of Structure 9. It is an east-west profile of CIV.T.12 and CIV.T.68. Drawings by Kaitlin R. Ahern and Josué Calvo.

Around this time, four additional E-Group assemblages were constructed in the ceremonial center of Cival. The construction of these E-Groups strongly resembled, if not copied, the unique construction process of the Central E-Group assemblage as the topsoil was first stripped away, and then the complex was built directly on the exposed bedrock. The earliest phase of construction for each of these assemblages used marl and stone to mimic the natural slope in the bedrock. During later phases of construction, plaster and cut stones were also used (Estrada-Belli 2004; Estrada-Belli 2014). Additionally, four out of the five E-Groups were constructed in previously unoccupied locations. Only the North E-Group assemblage was built over previous residential structures (Estrada-Belli 2016a). The positioning of these new E-Groups largely followed the cardinal directions as three were built to the west, north, and

southeast of the Central E-Group assemblage. The fourth new E-Group was built to enlarge the Central E-Group complex, as unfortunately, the construction of the triadic group or Group 1 interfered with the viewing of solar alignments from Structure 9. Thus, Structure 20, also known as the West Pyramid, was constructed to replace Structure 9 as the new western radial pyramid. Structure 7 continued to serve as the eastern elongated platform. However, the platform was lengthened to 129 m to preserve the view of solstice from Structure 20 (Estrada-Belli 2016a). This enlargement of the Central E-Group assemblage also resulted in the creation of the site's largest plaza, which was the West Plaza.

Around 300 – 200 BCE, a low platform was placed in the plaza in front of the eastern structure (Structure 7) of the Central E-Group assemblage. Additionally, Stela 2 was erected on this platform, and it contained one of the earliest depictions of a king in the Maya lowlands (Estrada-Belli 2002; Estrada-Belli 2011). The discovery of Stela 2 strongly indicates that the institution of kingship had emerged at Cival by 300 BCE (Estrada-Belli 2006). Later four large timber posts were placed above the cruciform cache and positioned in a cardinal arrangement around Stela 2. Eventually, the monuments and posts were toppled and buried under a new plaza floor (Estrada-Belli 2011).

During the Late Preclassic period, Cival became the hegemonic power in the region (Tomasic 2009). Cival's influence extended as far as the neighboring sites of Chanchich and Holmul, both of which were 6.3 km away from Cival (Estrada-Belli 2016a). The city's influence served to shape architecture and ceremonialism throughout the region (Estrada-Belli 2011). For example, the earliest E-Group in the region was constructed at Cival, and by the Late Preclassic period, the architectural assemblage had spread to eight of the neighboring sites. Despite Cival's

influence, some architectural patterns were not adopted throughout the region, such as monumental triadic groups, which were only discovered at Cival (Estrada-Belli 2016a).

In the years preceding a major unknown conflict, the ruler or elites of Cival began the final phase of construction on various structures. Around the 1st century CE, the Central E-Group assemblage and the monumental triadic group, known as Group 1, experienced the last major phase of construction at Cival (Estrada-Belli 2011). Around 100 CE, the city experienced some form of conflict, which resulted in the residents of the city building a stone wall. The wall formed three-quarters of a circle around the site, and it measured two meters in height with a length of 1.3 kilometers (Estrada-Belli 2011). Additionally, the stone wall likely supported wooden palisades that extended its height by three to four meters and thus supplied additional protection. Interestingly, it only incorporated parts of the city center, and in several instances, the residents incorporated lesser elite structures as makeshift sections of the wall (see Figure 3.4). Francisco Estrada-Belli (2011) proposed that the residents of Cival were attacked while constructing the wall, and thus it was never completed. The Central E-Group assemblage was located in the center of the enclosed area, which indicated that this complex continued to serve as the ceremonial core of the site.

Regardless of this attack, the site remained occupied for roughly another 100 to 200 years. During this period, half of the Central E-Group assemblage, or Structure 7 and the plaza, underwent a small final phase of construction. However, Structure 9 remained untouched (Estrada-Belli 2011, 2014; Ahern and Colindres Díaz 2015). As the population at Cival diminished, the nearby ceremonial center of Holmul was gaining prominence. During this period of decline, some of the biggest and most significant pyramids were ritually buried in rubble, such

as Structure 9 (Estrada-Belli 2011; Ahern and Colindres Díaz 2015). Once Cival was utterly abandoned around 300 CE, the center was never inhabited again.

Cival's decline corresponded to the diminished status of other Preclassic period sites throughout the lowlands, such as El Mirador, Becan, and others. Some of the major theories regarding the decline of Preclassic period sites have emphasized an environmental crisis, such as the constriction and drying up of the water sources (Wahl, Byrne, and Lysanna 2014), followed by a period of conflict. At several Preclassic period sites, such as Cival, there is evidence of fortifications that were erected towards the end of the site's history (Estrada-Belli 2011; Rice and Rice 1981).

3.5.2 Holmul

Holmul, also known as La Riverita, was another ancient Maya center. The site was occupied between 1000 BCE to approximately 1040 CE (Estrada-Belli and Tokovinine 2016), and it contained three major complexes, which are Group I, II, and III. Extensive research at Holmul revealed its dynamic role within the broader region, which consisted of regional hegemony, powerful alliances, political maneuvering, successes, and defeats.

Around 1000 to 850 BCE, an early village or residential group emerged in the vicinity of Group II at Holmul. The village was the location of various feasting events, as early Middle Preclassic period ceramics and faunal remains were used in the construction fill of later monumental structures built in Group II (Neivens de Estrada and Méndez 2009). Nina Neivens (2018:76) proposed that the village was a gathering place for early ritual activity, where both settled villagers and mobile groups came together to share ideologies and create a place. This village was subsequently torn down sometime before 400 BCE.

Monumental architecture first emerged at Holmul around 400 BCE with the scraping of the soil to bedrock near the former village and the construction of a large basal platform, known as Group II, which supported three structures (Neivens de Estrada 2006; Neivens de Estrada and Méndez 2009; Neivens 2018). These temples are known as Building N, B, and F, and they all faced the south. Two additional structures were erected slightly south of Building B, and they faced each other. These new structures were Building C and Building A, and they roughly created a triadic group layout. Towards the end of the Preclassic period, Building N was demolished and buried under the Group II plaza. However, Building B continued to receive further renovations throughout the Classic period (Neivens 2018). Group II served as a place of ritual activity regarding ancestor veneration and royal lineage from 400-350 BCE to 850 CE.

By the Late Preclassic period, Holmul was subordinate to the nearby center of Cival. During this period of Cival's influence, the people of Holmul constructed the site's only E-Group assemblage, and it was built with similar proportions to the Central E-Group at Cival (Estrada-Belli 2011). The distance from the center of the western radial pyramid and eastern elongated platform at both Cival's Central E-Group and Holmul is approximately 86 meters. Francisco Estrada-Belli (2011) proposed that both E-Groups potential shared a similar distance along their north-south axis during the Late Preclassic period. However, later modifications to the E-Group assemblage at Holmul extended the distance of the north-south axis.

The E-Group assemblage at Holmul was positioned near Group I, which was also first constructed during the Late Preclassic period. Group 1 was located on a monumental platform that supported a large temple pyramid, known as Building D, and five additional structures. The entrance to the Group I platform was Building D's central staircase located to the north (Mongelluzzo 2011). The final major ceremonial complex at Holmul was Group III, which also

experienced its first phase of construction during the Late Preclassic period. Group III was composed of two raised platforms known as Court A, and Court B. Court A was dominated by a large temple pyramid, whereas Court B supported the Holmul Palace and a sunken plaza. The entrance to the Holmul Palace and Court B was located on the western side of the raised platform. Court B and potentially, the royal palace was occupied from the Late Preclassic to the Terminal Classic period (Mongelluzzo 2011).

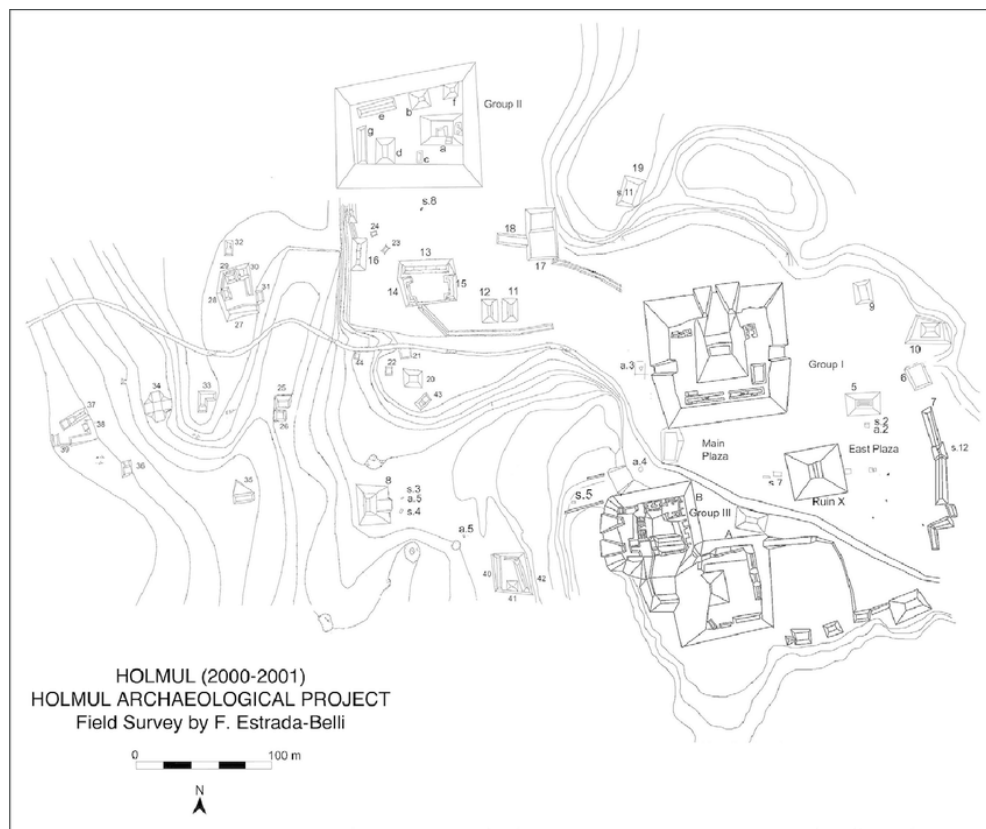


Figure 3.6: Map of Holmul's civic ceremonial center. Map by Francisco Estrada-Belli.

The decline of Cival during the Late Preclassic period was accompanied by increased political activity at Holmul. Between 150 – 300 CE, multiple high-status individuals were buried in Building B, located in Group II. The ancestral imagery depicted on the façade of Building B and the placement of burials indicated that it served as an ancestral shrine (Estrada-Belli 2011)

during this period. Additionally, the weakening of Cival corresponded with the construction of La Sufricaya, which was a small ceremonial center and royal complex constructed 1 kilometer from Holmul's main ceremonial center (Estrada-Belli 2011; Estrada-Belli and Tokovinine 2016). La Sufricaya was first visited by Raymond Merwin in 1911 during his excavations at Holmul (Merwin and Valliant 1932). The minor center contained a mixture of civic and ceremonial architecture, which included a public plaza with a ball court, a funerary pyramid-shrine, and a palace on a multi-tiered platform.

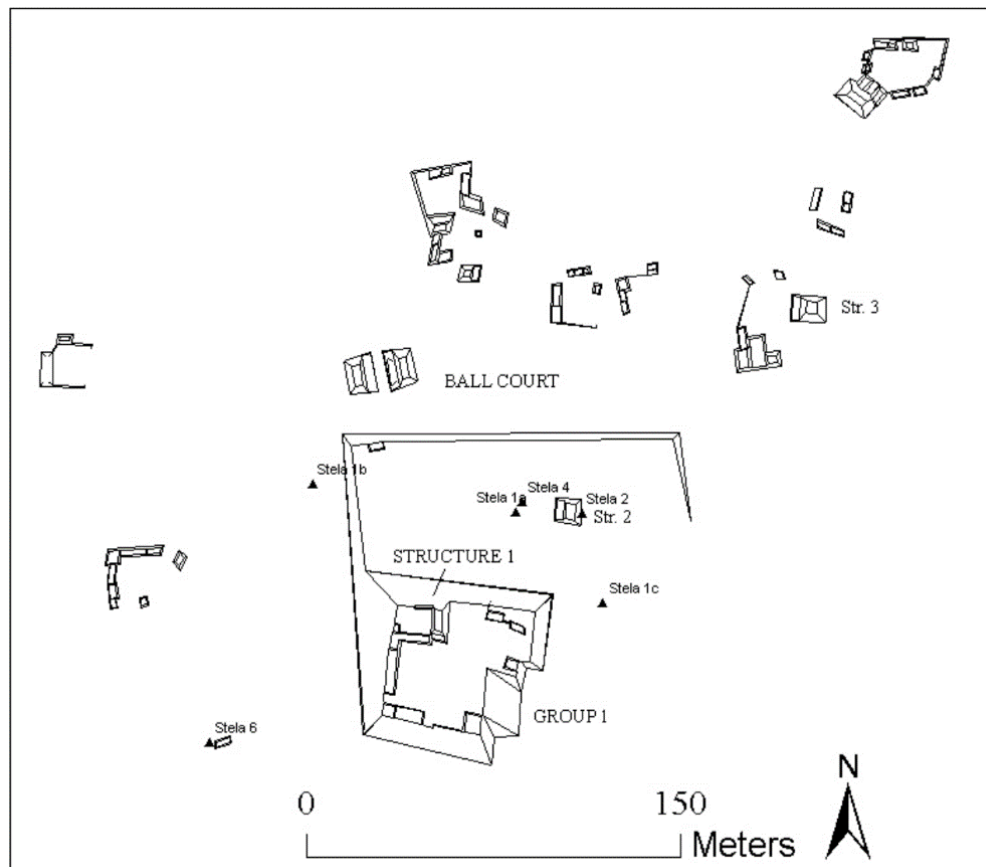


Figure 3.7: Map of La Sufricaya. Map courtesy of Francisco Estrada-Belli.

The inside of the palace was decorated in colorful murals that depicted individuals adorned in Teotihuacan-style warrior clothing and Teotihuacan-style architecture. The murals depicted royal ceremonies and the inauguration of the new palace (Estrada-Belli 2011). Additionally, stelae found at La Sufricaya were discovered to contain dates between 376 and 422 CE. Together the murals and stelae indicated that a local dynasty emerged at La Sufricaya as early as 379 CE, which was a year after the famous Teotihuacan “Entrada” to Tikal in 378 CE. The Teotihuacan “Entrada” was a famous event in ancient Maya history that continues to be debated among scholars (Braswell 2003; Martin and Grube 2008; Tokovinine and Estrada-Belli 2015). There are various interpretations regarding the Teotihuacan “Entrada,” ranging from the belief that the entrada was an invasion into the Maya lowlands (Proskouriakoff 1993) to the idea that the entrada was simply the formation of an alliance between particular Maya polities and Teotihuacan. Nevertheless, Tikal’s interaction with the Teotihuacan “Entrada” resulted in Tikal becoming a hegemonic power in the Maya lowlands.

The proximity of the two dates makes it plausible that this new dynasty was supported by local and foreign forces, like Tikal, that potentially helped Holmul overthrow Cival and establish La Sufricaya (Estrada-Belli 2011). Additionally, this new dynasty might have overthrown the former ruler of Holmul and killed his lineage, as around 378 CE 18 individuals were buried in the main ceremonial center at Holmul (Estrada-Belli 2011:137). This new ruler held office between 379 and 422 CE (Tokovinine and Estrada-Belli 2015; Estrada-Belli and Tokovinine 2016). Around 450-500 BCE, the palace at La Sufricaya was intentionally burnt and filled in during a ritual termination event (Hurst 2009). This ritual termination indicated that Holmul severed its connection with Tikal and La Sufricaya as afterwards, new royal courts were once again constructed in the ceremonial core of Holmul (Estrada-Belli et al. 2009).

Around 593 CE, a frieze was constructed in Building A, which was located in Group II. The frieze mentioned the name of a Holmul ruler who had strong family ties with the ruler of Naranjo. Estrada-Belli and Tokovinine (2016) proposed that a daughter of the Naranjo king married the ruler of Holmul, which served to establish a political alliance between the two polities. Since Naranjo was closely aligned with Calakmul (or the Kaanul dynasty), Holmul also became allied with Calakmul. The frieze also contained the names of five to six previously unknown Holmul rulers. It also established that between 422 and 590 CE, there were five Holmul rulers (Estrada-Belli and Tokovinine 2016). After completing the frieze, the people of Holmul attempted to build the last phase of construction for Building A, but the project was left uncompleted. The construction was likely left unfinished due to Tikal defeating the city of Holmul and capturing its ruler in 748 CE (Estrada-Belli and Tokovinine 2016). Nevertheless, the center of Holmul continued to be occupied until 1040 CE.

3.5.3 *Witzna*

Witzna was an ancient Maya city located 15 kilometers north of Holmul. The site's ceremonial core contained multiple palaces and was positioned 2 km northwest of a lake known as Laguna EkNaab. It was one of the largest urban centers in the region (Fialko 2005). The site was predominately occupied during the Early to Late Classic periods; however, there were at least two structures with Late Preclassic period occupation (Estrada-Belli 2016b). Witzna was first excavated in 2004 by Vilma Fialko and the Petén Archaeological Site Protection Project (Fialko 2005). It was excavated again in 2016 by the Holmul Archaeological Project. During the 2016 season of excavation at Witzna, the Holmul Archaeological Project discovered Stela 2, which contained a date and an emblem glyph. This emblem glyph revealed that Witzna was

called *Bahlam Jol* (or Head of the Jaguar), and the discovery of this glyph indicated that Witzna was an independent dynasty at some point in its history (Estrada-Belli 2016b). However, in 697 CE, Witzna became part of Naranjo's sphere of influence. This event is mentioned on Stela 22 at Naranjo, which states that Witzna (*Bahlam Jol*) was burnt for a second time by the ruler of Naranjo on May 21st 697 CE. Archaeological evidence and a sediment core taken from Laguna EkNaab proved that the entire site of Witzna was destroyed by fire between 650 and 800 CE (Wahl et al. 2019). Nearly 100 years later, the local dynasty at Witzna experienced a brief resurgence in power before its final decline (Estrada-Belli 2016b).

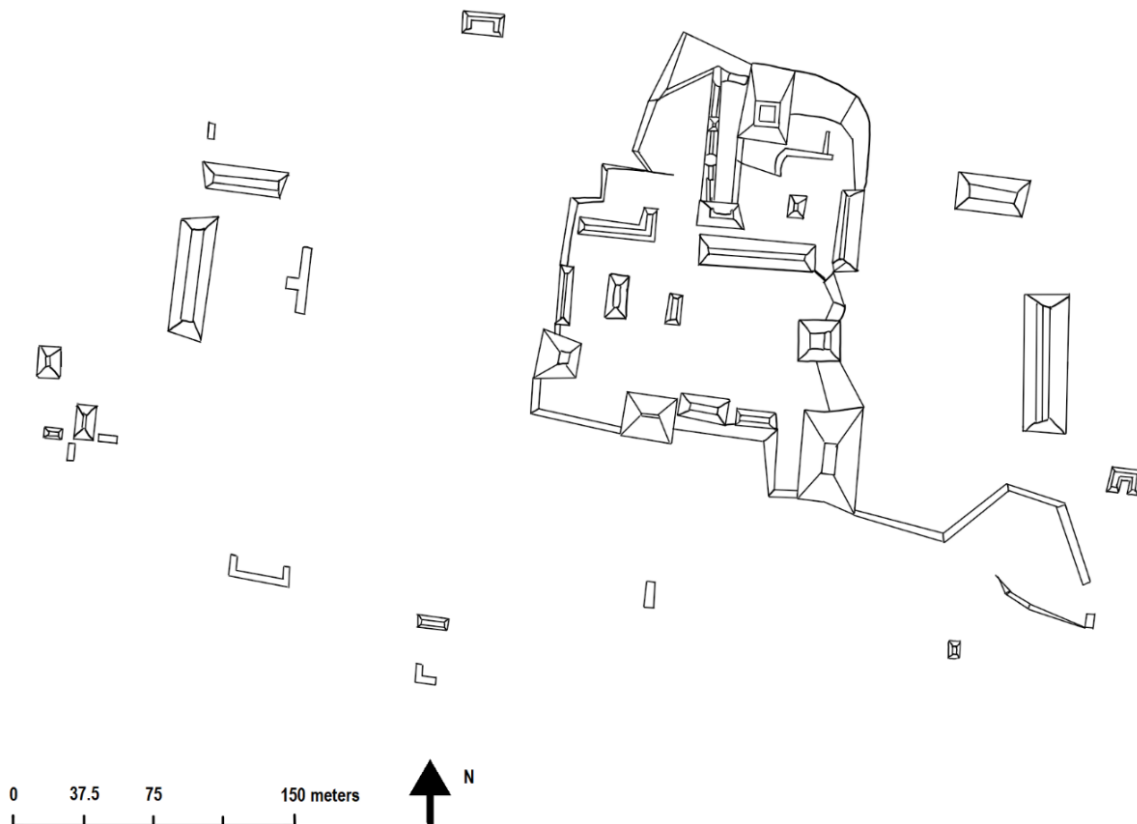


Figure 3.8: Map of the civic ceremonial center at Witzna. Drawing by Kaitlin R. Ahern. (After Francisco Estrada-Belli 2019).

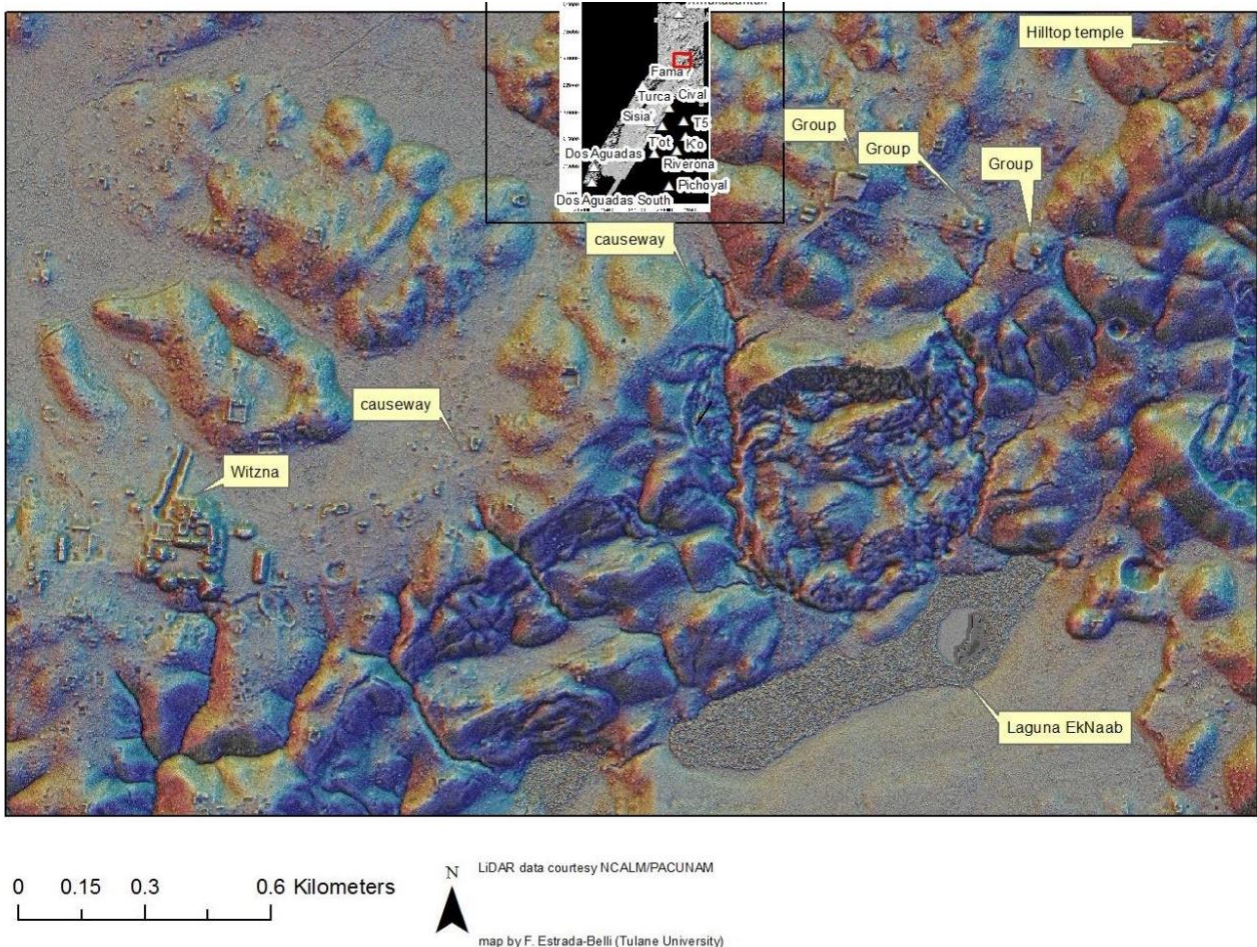


Figure 3.9: LiDAR map from the 2017 report by the Holmul Archaeological Project that shows the site of Witzna. The pyramid labeled the 'Hilltop Group' is the location of the Watchtower. Check out the sizable distance between the city proper and the Watchtower complex. Map by Francisco Estrada-Belli.

Northeast of Witzna's ceremonial core were four smaller structures that are collectively known as East Witzna. Three of these buildings were connected to the ceremonial core by a sacbe, known as the East Witzna Road (Estrada-Belli 2019). The fourth was known as the Watchtower, and unlike the other three sites, there was no causeway linking the Watchtower to the ceremonial core. The Watchtower was also located the furthest from the ceremonial core, and it was the only site in East Witzna that dated to the Late Preclassic period. The closest group to the Watchtower was a pyramid known as Structure 9. This pyramid was potentially constructed

during the Early Classic period, and it contained the burial of a Witzna ruler. During the Late Classic period, a new burial was interred in this pyramid, and two stelae were placed on the western side of the structure (Estrada-Belli 2019; Girón 2019). The remaining two complexes located along the East Witzna Road were occupied during the Late Classic period. These three complexes and the two stelae at Structure 9 were burnt during the Late Classic period, in an event that was likely connected to the act of war that burnt the ceremonial core of Witzna (Estrada-Belli 2019).

3.5.4 Watchtower

The Watchtower (or Atalaya in Spanish) was discovered in 2017 with the use of LiDAR (Estrada-Belli 2017). The Watchtower is a pyramid located on the highest hill (called Gran Cerro de Witzna Este) in the Cival region. This pyramid received the name ‘Watchtower’ because its summit provides an excellent vantage point where a person can view almost all of the sites in the Cival region (Estrada-Belli 2019). This pyramid was part of a hilltop architectural complex that was composed of a pyramid located to the south and a platform to the north. Additionally, the hilltop contained a structure positioned in front of the pyramid, a plaza, and a wall located on the western edge of the complex. The pyramid or the Watchtower faced north and had a height of 18.45 meters. A quarry was located slightly southwest of the pyramid. Laborers also extracted limestone to the south of the pyramid, which resulted in an area resembling a small sunken plaza. In 2018 and 2019, excavations were conducted on the Watchtower and the surrounding architecture (Ahern 2019, 2020), which determined that the Watchtower was occupied during the Late Preclassic to the Early Classic period (Estrada-Belli 2019).

The first phase of architecture for the Watchtower was built upon a layer of smooth black earth that was placed directly upon the bedrock. The first phase consisted of multiple platforms and a potential structure located on the uppermost platform. These platforms lacked a coating of plaster or stucco. The lower platform was built 0.23 meters above bedrock, and it was composed of medium-sized stone slabs that were a mixture of yellow, white, and gray. This platform was aligned to the north, and there was a step built into this stone slab floor. The upper platform was largely earthen, but limestone blocks were placed along the edges of the platform. This platform had an unusual alignment to the northwest. On the top of the earthen platform, there were two rows of stone that possibly served as walls for a masonry structure. Unfortunately, when the ancient Maya decided to construct the second phase of construction for the Watchtower, they largely destroyed this masonry structure and cut the walls down to a single row of stones (Ahern 2020).

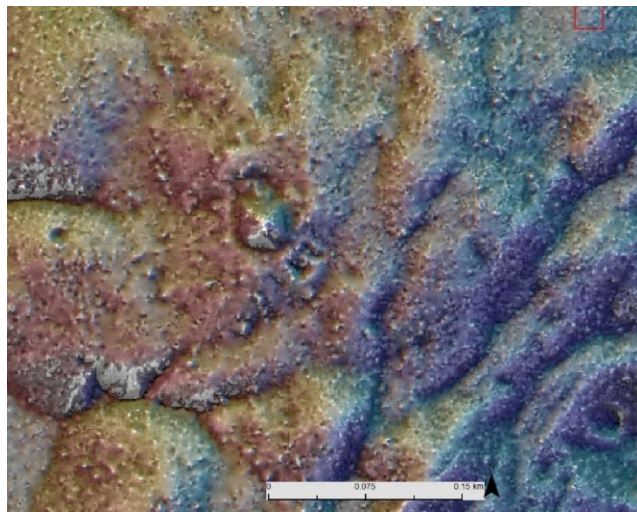


Figure 3.10: LiDAR image of the Watchtower. Image by Francisco Estrada-Belli.

During this second phase of construction, the ancient Maya placed various construction walls in the fill. They also placed a construction floor above the first layer of fill. Both of these

features were used to support the additional layers of fill material required to reach the desired height for the later phases of construction. They also served to protect the earlier architecture.

Another excavation (WIT.T.14) established the construction sequence for the top of the Watchtower. Although there were only three major phases of construction for the Watchtower, there were multiple smaller alternations made to the top of the pyramid. The second phase of construction began with the placement of two layers of fill that was sealed under a construction floor. Above this floor was a thin layer of fill, which served as the base for two different phases of floors. There was also another small phase of construction that resulted in two more layers of floors (Ahern 2019). All of these layers of floors may have each supported a wooden structure at the top of the pyramid.

The final phase of construction significantly modified the top of the pyramid as it resulted in the construction of a permanent structure that was composed of a platform, a connecting staircase, a door jam, and a floor. At a later point, the floor was burnt and replaced with another floor, which was also damaged by fire. Additionally, blocks used for corbel arches were found in the layer of collapse, which means there was once a roof over both the door jam and platform. Eventually, a wall was constructed on top of the platform, and it was positioned along an east-west axis to restrict access to the front or back entrance of the top structure.

The excavation (WIT.T.13) at the base of the Watchtower uncovered the northern face of the pyramid. Intriguingly, there were no staircases that connected the Watchtower to the plaza. Instead, the only discovered staircase ended at the pyramid wall, which was located 2.7 meters above the base of the pyramid and plaza floor. The northern wall of the pyramid was built directly on the bedrock.

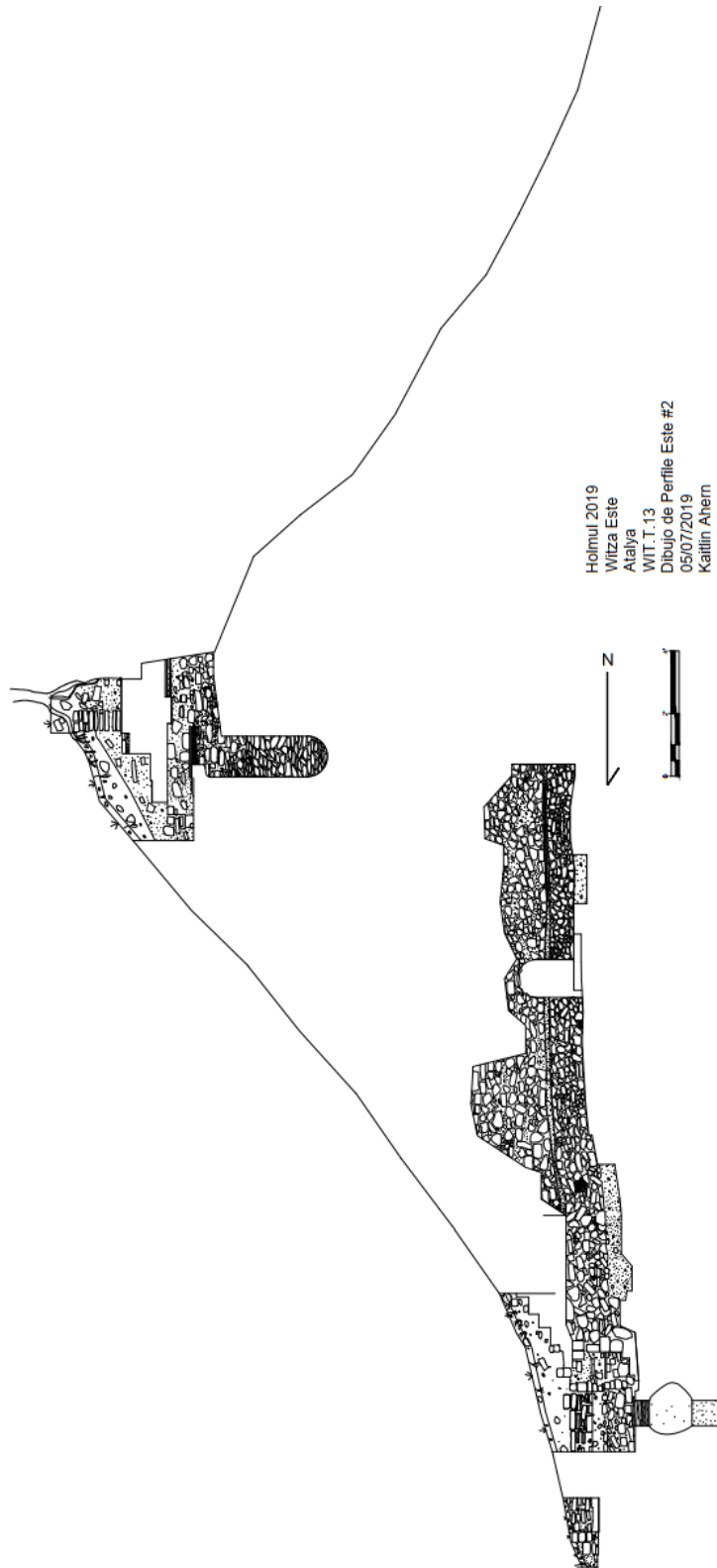


Figure 3.11: East profile of the Watchtower, including the excavations WIT.T.13, WIT.T.14, and WIT.T.16. Drawing by Kaitlin R. Ahern.

After finishing the third and final phase of the Watchtower, the inhabitants constructed a new rectangular masonry structure 0.4 meters from the northern wall of the pyramid. This new structure or Building A was positioned directly on top of the bedrock and was constructed during the Early Classic period. The excavations WIT.T.13, WIT.T.15, and WIT.T.19 contributed immensely to the understanding of this structure (Ahern 2019) and determined that it contained a double enclosure that was composed of terraces and limestone walls. The outer walls measured 6.04 x 7.26 meters. The floor of the structure measured 4.25 x 5.44 meters.

The first phase of construction for Building A included walls, a rustic floor, and two staircases, which were located along the outside of the eastern and western walls. However, neither of the stairs connected with the staircase of the Watchtower. Both sets of stairs led down to a heavily eroded plaza floor. Later, another wall was built on this floor, which resulted in the construction of a new plaza. There was a total of two floors for Building A, and both were heavily burnt.

During the Early Classic period, one of Building A's floors were broken by the inhabitants who wanted to either access a previously constructed chultun or to carve a new chultun into the bedrock. This chultun served as an offering where the ancient Maya placed a human head, teeth, four miniature vessels, two plates, six pieces of obsidian, marine shells, and some broken stone tools. The skull fragment was positioned facing upwards, and thus the individual's teeth were discovered before the top of the skull (Ahern 2019). These teeth consisted of both milk and adult teeth. Since there were no other bones found, the individual was possibly decapitated and then placed into the chultun. After finishing the ritual, the chultun was filled in with marl and covered by a meter of fill. At a later point, a new floor was placed inside the structure.

Additionally, a wall was discovered to the west of the Watchtower complex, and it was constructed during the Late Preclassic period. The wall was composed of a row of stones placed on top of one another and was positioned on soil (Carcuz 2020). To the north of the Watchtower was a potential platform that was constructed around the Late Preclassic period. The platform measured 14.5 meters along its north-south axis, and it had two sets of stairs located on its northern and southern sides. The platform was composed of medium slabs, small stones, and dark brown earth. Excavation into the platform revealed no archaeological material and that the structure was built from stacking small stones into a pile (Carcuz 2020). Although the platform was lackluster and lacked a coating of plaster, it did contain similarities to the earthen and stone slab platforms found in the Watchtower.

The Watchtower complex was only occupied for a short period between the Late Preclassic and Early Classic periods. The discovery of weapons used in warfare across the complex and the significant number of burnt floors indicated that like Witzna and East Witzna, the final phase of occupation for the Watchtower ended with fire and war (Estrada-Belli 2019).

3.6 Discussion

Cival, Holmul, and Witzna were medium to large-sized centers that were located in the same region. Despite their proximity to one another, each site had a distinct trajectory during the Middle and Late Preclassic periods that impacted their construction and use of public and private plazas. The differences between these sites and their plazas are particularly interesting and will be discussed further in chapter 6.

During the Middle Preclassic period, the sites of Cival and Holmul were first occupied by sedentary and semi-nomadic groups. Around 800 BCE, Cival engaged in the first act of

monumental architecture in the region by constructing the first phase of the Central E-Group assemblage. This complex contained a large public plaza that served as a gathering and ceremonial location for the region. Holmul began constructing monumental architecture around 400 BCE. By the Late Preclassic period, Cival had become the hegemonic power in the region, and the city's influence reached as far as the site of Holmul. Additionally, the Watchtower was first occupied during this period.

The end of the Late Preclassic period was accompanied by environmental changes and increased conflict in the Cival region, which led to significant political reorganization. The clearest example of these conflicts was at Cival, as around 100 CE, the city's inhabitants partially constructed a stone wall that surrounded parts of the ceremonial core. This wall was left uncompleted, suggesting that the city was attacked. Afterward, the city of Cival began to decline and was largely abandoned by the beginning of the Early Classic period. At Holmul, there was increased political activity during this period, which resulted in the city becoming the new dominant center in the region.

Witzna and the Watchtower also experienced multiple phases of conflict. Almost every floor found in the various phases of construction for the Watchtower was burnt. Since several of these burnt floors were constructed during the Late Preclassic period, it is plausible that the Watchtower was also caught up in Late Preclassic period conflicts. Despite these changes, only the site of Cival was abandoned by the Early Classic period – as Holmul and Witzna continued to be occupied into the Late Classic period. However, Witzna and East Witzna experienced another period of violence around 697 CE, which resulted in the burning of both locations.

CHAPTER 4

Plazas, Lime Plaster, Methodology

4.1 Introduction

This chapter explores the major methodologies utilized in the investigation of plazas and lime plaster samples at the sites of Cival, Holmul, and Witzna. The first section discusses the excavation methods and technologies utilized during my four field seasons with the Holmul Archaeological Project. These excavations were essential to both the broader investigation of plazas and the acquisition of lime plaster samples. The next three sections discuss the methodologies employed in the examination of public and private plazas in the region, which includes the use of geographical data (Google Earth Pro), proxemics, and plaza capacity studies. Together, these three approaches provide valuable insight into the utilization of plazas by examining the types of interactions that occurred in these socially constructed places. The remaining portion of this chapter focuses on providing a general understanding of the history and production of lime plaster and the methodologies utilized in this investigation of ancient Maya plaster samples. These methods include petrographic and optical microscopy, SEM-EDS, and portable XRF.

4.2 Excavation

Between 2013, 2014, 2018, and 2019, I conducted a total of eight excavations at the sites of Cival and East Witzna as a part of the Holmul Archaeological Project. These excavations followed the procedures of the Holmul Archaeological Project and are briefly discussed in the subsequent paragraphs. The project uses a simple nomenclature for the various excavations

conducted by the project, such as CIV.T.71. The first three letters of this label refer to the name of the site – for example, the abbreviation CIV is used to refer to the site of Cival. The next letter indicates the type of excavation, such as T for *trench* and L for *looter's trench*. Each of these two abbreviations is separated by a period. Finally, there is a set of digits that refer to the excavation number. Thus, the label CIV.T.71 serves as an abbreviation for the 71st trench excavated at Cival.

Table 4.1: Excavations conducted on Structure 9 at Cival.

Year	Site	Structure	Excavations	Excavations led by:
2004	Cival	Structure 9 – Eastern Side and Plaza	CIV.T.12	
2013	Cival	Structure 9 – Eastern Side	CIV.T.12	Kaitlin R. Ahern
	Cival	Structure 9 – Eastern Side		Josué Calvo
2014	Cival	Structure 9 – Northern Side	CIV.T.71	Kaitlin R. Ahern

During the 2013 and 2014 field seasons at Cival, I partook in two excavations on Structure 9, which was the western radial pyramid of the Central E-Group assemblage. The 2013 field season reopened a previous excavation from 2004, called CIV.T.12, with the goal of tunneling into the eastside of the pyramid. This tunnel revealed five distinct phases of architecture and confirmed that the Central E-Group assemblage was the earliest construction in the ceremonial core of Cival. It also determined that the size of the E-Group plaza was preserved across all five phases of construction (Estrada-Belli 2017). In 2014, a new excavation, known as CIV.T.71, was opened on the northern side of Structure 9. This excavation unit was positioned halfway up the pyramid and placed slightly to the left of the pyramid's center to discover

preserved architecture. By the end of the season, three phases of architecture and an eroded mask were discovered (Ahern and Colindres Díaz 2015).

In 2014, the director of the project, Francisco Estrada-Belli, began the transition towards using digital record keeping in the field by having the archaeologists use tablets. This adoption of tablets profoundly impacted the collection of data as it provided a more cohesive and secure method for preserving photos and field notes. A couple of years later, the tablets also replaced the traditional paper drawings used to document the excavations. Therefore, during the 2018 and 2019 field seasons, the app CADTOUCH PRO was utilized to create detailed drawings of the excavations. These images were later edited via AUTOCAD.

Between 2018 and 2019, I excavated at a pyramid known as the Watchtower or *Atalaya* in Spanish and its surrounding plaza. This pyramid was located in East Witzna, which was a group of structures located to the northeast of the ceremonial core of Witzna. The Watchtower complex consisted of a southern pyramid (known as the Watchtower) and a northern platform. It also contained a structure positioned in front of the pyramid, a plaza, and a wall. In 2018, five excavations were opened in the Watchtower complex. Two of the excavations, known as WIT.T.13 and WIT.T.14, provided valuable insight in determining the architectural phases of the Watchtower. The excavations WIT.T.13, WIT.T.15, and WIT.T.19, were conducted to further our understanding of the structure located immediately in front of the Watchtower. Towards the end of the season, a piece of a broken altar was discovered in the plaza, which resulted in a new excavation, known as WIT.T.22, that recovered the additional altar fragments (Ahern 2019). In 2019, the Holmul Archaeological Project returned to the Watchtower to continue a tunnel into the pyramid. This tunnel was a continuation of the excavation WIT.T.13 and led to the discovery of a previous phase of architecture (Ahern 2020). During this field season, five new excavations

were carried out on the northern platform and the wall surrounding the complex (Carcuz 2020). Additional details regarding these excavations are discussed in chapter 5.

Table 4.2: Excavations conducted at the Watchtower complex located in East Witzna.

Year	Site	Structure	Excavations	Excavation led by:
2018	East Witzna	Watchtower	WIT.T.13 and WIT.T.14	Kaitlin R. Ahern
	East Witzna	Building A	WIT.T.13, WIT.T.15, and WIT.T.19	Kaitlin R. Ahern
	East Witzna	Watchtower Plaza	WIT.T.22	Kaitlin R. Ahern
2019	East Witzna	Watchtower	WIT.T.13	Kaitlin R. Ahern
	East Witzna	Walls	WIT.T.23 and WIT.T.24	Sheryl Carcuz Chinchilla
	East Witzna	North Platform	WIT.T.25, WIT.T.26, and WIT.T.27	Sheryl Carcuz Chinchilla

4.3 Plaza Analysis via GIS and Google Earth Pro

This section shifts away from field excavations to the discussion of the methodologies used to examine the spatial qualities of the plazas located across the three sites. Plaza analysis was conducted via maps produced by site surveys carried out by the Holmul Archaeological Project between 2000 and 2014. This data was recorded as spatial or geographical data that was imported to Google Earth Pro to provide a free and easily accessible version of the data. Since Google Earth Pro uses worldwide satellite images, researchers can simply upload geographical data to the program.

The site surveys for Cival and Holmul were obtained by downloading the geographical data from the Holmul Archaeological Project's website. The *measure tool* in Google Earth Pro was used to measure the distance between various structures and determine the total area squared of various plazas found at these sites. Specifically, the north-south and east-west measurements were taken, and when possible, the length was obtained by measuring from the edges of two

structures. To eliminate selection bias, this analysis incorporated almost all public and private plazas in the ceremonial core of Cival and Holmul. Information regarding the size of plazas at Witzna was not as easily accessible as this spatial data was not uploaded to the project's webpage or Google Earth Pro. Instead, this information was obtained through personal communication with Francisco Estrada-Belli. The measurements for the Watchtower plaza were manually obtained during the summer of 2019.

4.4 Proxemics and Estimated Plaza Capacity

The information gathered from the spatial data of these plazas were evaluated through the approaches of proxemics and estimated plaza capacity. In 1996, Jerry Moore developed an interactional model that linked the spatial qualities of plazas with the communicative elements of ritual and proxemics. This approach drew upon Edwin Hall's (1968, 1972) concept of proxemics, which explores "visual and auditory effects and potentials of human interactions defined by specific spatial parameters" (Inomata and Tsukamoto 2014). Proxemics is used to examine the human perception of behavioral patterns regarding proximity to others.

There are three modes of human communication, which are paralinguistic, verbal, and nonverbal (Moore 1996). Paralinguistic communication includes nonverbal vocalizations. Verbal communication includes the use of language, speech, and signs. Nonverbal communication involves the use of body language, gestures, and facial expressions. These three modes vary in importance as the distance increases or decreases between participants. Each mode of communication has a distinct spatial range or distance set, which includes intimate, personal, social distance, and public (Hall 1972). These spatial ranges each contain a threshold point for the type of interpersonal interaction, and these ranges are influenced by individual culture (Hall

1966). Additionally, there are a variety of sensory mechanisms used in the perception or judgment of a distance, and these are visual, tactile-kinesthetic, auditory, heat-radiation, and olfactory cues. The use of these mechanisms can vary based on culture (Hall 1972).

Jerry Moore's (1996) approach provides a guideline for investigating the use of historic and prehistoric plazas as the size of the plaza sets limits on the types of communications that can occur within the space. Proxemics can be used to determine how specific patterns of open space best accommodate the distinct modes of human interaction. Thus, this archaeological approach can provide potential insight into the activities that occurred in these plazas. For example, a small enclosed plaza can indicate a close interpersonal distance or a gathering of a small number of individuals. A large central plaza can indicate that the space accommodates all segments of society who engage in social or public interpersonal distance.

Table 4.1: Distance and perception based on data in Hall 1966 (After Moore 1996).

	Distance in Meters										
	0	1	2	3	4	5	6	7	8	9	10
Informal distance classes	Intimate/Personal	Social			Public						
Oral/Aural	soft voice; whisper	casual or consultative voice			loud voice when talking to group			Full public speaking voice; frozen style			
Detail vision	details of skin, teeth, face visible	fine lines of face fade; wink visible			eye color not discernible; smile vs. scowl visible			difficult to see eyes, subtle expressions			
Scanning vision	whole face visible	upper body; can't count fingers			upper body and gestures			whole body has space around it in visual field			
Peripheral vision	head and shoulder	whole body movement			whole body visible			other people become important in vision			

4.4.1 Estimating Plaza Capacities

Plaza capacity studies emerged from Jerry Moore's (1996) model regarding proxemics and plazas. This approach draws upon the idea that plaza size is associated with the different modes of interactions and activities that occur within the plaza. Archaeologists have estimated plaza capacity by analyzing and calculating the available space and population capacity of major and minor plazas located in a center (Inomata 2006a; Moore 1996; Tsukamoto 2014a, 2014b; Inomata and Tsukamoto 2014). The space in plazas can range from public to restricted elite spaces. Thus, plaza capacity estimates provide a means of categorizing the use of plaza space. This approach is also used to connect plaza construction with the broader site history (Inomata 2006). However, there are particular concerns associated with this approach. Plaza capacities can vary significantly in the cultural design, intended use of the space, and the spatial positioning of individuals, as it is challenging to know how various cultures arranged themselves and what was seen as personal distance and crowding (Hall 1968). Additional factors that affect plazas and open spaces include size, location, and access patterns. Each of these factors can result in the creation of various types of human interaction (Moore 1996).

Due to these shortcomings, Inomata and Tsukamoto (2014) caution that plaza "estimates should be used cautiously and only in heuristic manners" (8). They suggest that connecting plaza capacities with the larger site history of plaza construction can mitigate these concerns as it contextualizes the plazas. Additionally, multiple estimations of population density are used to determine an appropriate population range for the capacity of a plaza. Interesting, many plazas in the Maya lowlands and throughout Mesoamerica can accommodate nearly the whole community (Inomata and Tsukamoto 2014; Murakami 2014; Stuardo, Mejía, and Campiani 2014). Researchers studying the Maya lowlands have frequently used population densities of 0.46 m²

per person and 1 m² per person (Inomata 2006; Tsukamoto 2014a). This study continues with this convention.

In 2006, Takeshi Inomata analyzed the plaza capacity of major and minor plazas at Tikal, Copan, and Aguateca. At Tikal, he combined the history of the site and plaza space by examining alternations to plazas and causeways. He assumed that city plans were geared towards the inclusion of community members in public events. Thus, causeways served as a means of bringing ceremonial processions to multiple public plazas, which allowed more people to witness and engage with these ceremonial and ritual events (Inomata 2006). Additionally, he suggested that small platforms located in public plazas potentially served as a stage for rulers and performers (Inomata 2006).

Kenichiro Tsukamoto (2014a) used estimated plaza capacity to examine the site of El Palmar and discovered a clear spatial distinction between the Late Preclassic and Middle Classic period plazas, as the latter was associated with the increased construction of restricted plazas. This approach also determined that the power of elites increased at El Palmar from the Preclassic to Classic periods (Tsukamoto 2014a). Additionally, he realized that there was almost no spatial distinction between public and private plazas at El Palmar during the Late Preclassic to Early Classic periods. Thus, he proposed that during these periods, the ruling elites were not distinguished from the rest of the population. He also determined that major changes in plaza accessibility during the Middle Classic period were the result of changes in ritual performance that occurred during periods of social and ecological disruption (Tsukamoto 2014a).

Plaza capacity studies were also applied to the ancient Maya sites of Palenque and Chinikihá to investigate the interaction among different-sized cities within the same region during the Late Classic period (Stuardo, Mejía, and Campiani 2014). Due to a large number of

examined sites, the authors listed each site as containing a total plaza area, which facilitated the comparison of these sites. They determined that the inhabitants from the smaller centers likely visited the larger sites to participate in the ceremonial, ritual, and mundane events that occurred in their large public plazas (Stuardo, Mejía, Campiani 2014).

In 2017, Francisco Estrada-Belli conducted a comparison of thirteen E-Groups assemblages and their plazas in the Cival region. Some of the relevant characteristics examined included plaza size (m²) and plaza width. He also provided an estimated population capacity for the Central E-Group plaza at Cival (Estrada-Belli 2017). This analysis differs from Francisco Estrada-Belli's (2017) prior examination, as it focuses on all of the major plazas at Cival, Holmul, and Witzna.

Estimated plaza capacity studies are also conducted on plazas located outside of the Maya lowlands. In 1996, Jerry Moore applied this approach to plazas in the Andean region, where he determined the use of specific types of plazas among the Inka Empire, Chimú state, and the Chiripa, Pucara, and Tiwanaku. These plazas included open, enclosed, and sunken plazas (Moore 1996). In 2014, Tatsuya Murakami used plaza capacity estimates to investigate the size, morphology, and access patterns of plazas and courtyards at Teotihuacan. Estimated plaza capacity was also applied to plazas located in Central Veracruz (Ossa 2014).

This section established the methods of proxemics and estimated plaza capacity as both approaches are critical to the investigation of the practices associated with public, semi-restricted, and restricted plazas at the sites of Cival, Holmul, and Witzna. This chapter now shifts to the discussion of the methodologies used to analyze the 19 lime plaster floor samples acquired from these three sites to identify practices tied to both plaster production and plaza construction.

4.5 A Brief Background of Lime Plaster

The discovery and subsequent adoption of limestone and lime plaster served to revolutionize early human societies, and it continues to have an essential role in today's world. Lime is an indispensable basic material that has fundamentally shaped – and in many cases – built the foundations of ancient and modern civilizations. Limestone is a sedimentary rock that is primarily composed of calcium carbonate (CaCO_3), whereas lime is the calcined or burned form of limestone.

Throughout its history, lime was used for an assortment of purposes, such as in agriculture and construction. This dissertation primarily focuses on its application as lime plaster. Additionally, there is an assortment of terms used to refer to the various mixtures of lime and aggregate, such as plaster, stucco, mortar, and cement. In this dissertation, the word plaster is used as a general term to refer to fired lime products.

4.5.1 Chemistry of Lime Plaster Production

Lime plaster is produced by calcining or heating limestone to 800-900° C, where the calcium carbonate (CaCO_3) dissociates and produces calcium oxide (or quicklime). Once water is added to the CaO (quicklime), it becomes slaked lime, which is a hydrated lime, and its weight is reduced by up to 45%. The slaked lime is then mixed with an excess of water to form a lime putty, which can either be stored for several years or used immediately. The next step generally involves adding aggregate materials to the lime putty, unless the lime plaster is to be applied as a thin layer. The addition of aggregate serves to reduce the cracking and shrinking of the plaster. It is also used to strengthen the lime paste (Murakami 2016) and is used as a bulking agent. The types of aggregate used in the Maya lowlands typically consist of sascab, sand,

detritus, and recycled plaster (Abrams 1996; Hansen et al. 1996). Sascab is a naturally decomposing limestone that is found in limestone outcrops (Littman 1958). It can be challenging to identify sascab, as the term was often used to refer to any powdery material. Thus, multiple substances are locally referred to as sascab despite having a variety of chemical variations (Hansen 2000). Finally, the lime paste is applied to a surface and left to harden through the carbonation process, where it absorbs both oxygen and carbon dioxide (CO_2). This exposure results in the formation of calcium carbonate (CaCO_3), which is chemically identical to limestone.

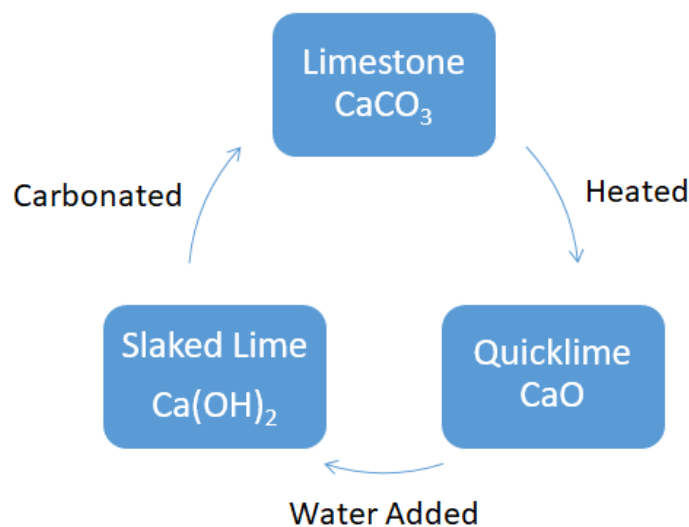
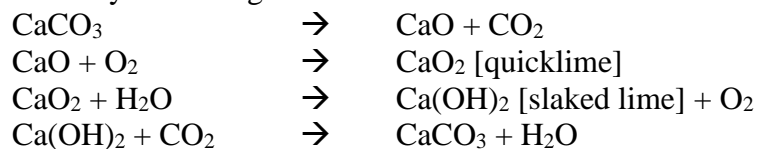


Figure 4.1: Image of a simplified lime cycle for high-calcium lime.

Lime Cycle for High Calcium Lime:



The above is a simple chemical formula for the production of a high calcium lime. Since the Mesoamerican limes commonly come from limestone intermixed with dolomite ($\text{CaMg}(\text{CO}_3)_2$), rather than a high calcium, this formula should serve only as a guide to provide an elementary understanding of this chemical process (Schreiner 2002).

There is an assortment of practices that can complicate the production of lime plaster. In this dissertation, they are loosely grouped into two categories, which are the quality and recipe of lime plaster. The quality of the lime plaster is a result of multiple processes that are heavily affected by the skill of the laborers producing the plaster. First, the overall quality of lime can be measured by its degree of calcination, which is ultimately a result of whether the temperature remained at a constant high heat throughout the calcination process (Murakami 2016). Thus, a temperature lower than 800° to 900° C results in a lower quality lime plaster. Second, the plaster is affected by the aggregates added to the lime putty. The quality of the aggregate is based on the degree of sorting and its size. A high-quality aggregate is well sorted and has smaller sized particles (Hansen 2000).

Third, the quality of the plaster is also affected by the source of the materials used during production. Ethnographic studies on the modern Maya have revealed that wood from certain types of trees are preferred for the calcination process as they can withstand the high temperatures (Russell and Dahlin 2007). Additionally, limestone can contain mineral impurities that negatively affect the final product. Thus, specific sources of limestone produce a higher quality lime than others. The most common impurities in limestone are silica and alumina, followed by iron, phosphorus, and sulfur (Boynton 1980).

The production of lime plaster can also be examined by analyzing the distinct recipes used by plasterers. The recipe of lime plaster is primarily impacted by the different organic and

inorganic materials added during production. It is also affected by the lime to aggregate ratio, which is the amount of aggregate added to the lime putty. The lime to aggregate ratio can range from 1:1 to 1:4. For example, at Copan, experimental plaster was made by combining one-part lime and two-parts aggregate (Abrams and Freter 1996). Investigating lime plaster recipes provides a means of examining a society or comparing multiple cultures. Thus, similar style recipes can potentially suggest interaction. Additionally, the variation in lime plaster recipes can be used to measure centralization in the social and political organization of a city (Murakami 2016). It is also used to indicate the degree of standardization at a site.

Lime plaster can also have hydraulic properties, and when utilized, it results in a more durable plaster. Throughout ancient history, there were two major types of hydraulic lime plasters, which were natural hydraulic limes and pozzolanic limes. Natural hydraulic limes are formed when limestone containing clay impurities is calcined. Pozzolanic limes were developed in the Mediterranean and were the result of adding aggregates that contained silica and alumina compounds to a non-hydraulic lime during the process of slaking (Hansen 2000).

4.5.2 Brief Overview of Old-World Lime Production

Lime plaster was an essential building component to many early societies around the world, and its development was critical to thousands of years of international architectural feats. The earliest known use of lime plaster was in the Neolithic Near East around 12,000 BCE, and it was used as an adhesive to fix a stone blade to a wooden shaft (Kingery, Vandiver, and Prickett 1988). Another early example of lime use was the discovery of a possible lime-burning hearth in Hayonim Cave, which was a Natufian site dating to 10,300 to 9000 BCE. Additionally, this cave potentially contained the earliest example of the production of quicklime (Kingery, Vandiver, and

Prickett 1988). By 7000 – 6500 BCE, lime plaster technology was spreading across the Neolithic Near East and was used in the construction of floors and walls at the sites of Jarmo, Asikli Hüyük in Anatolia, and Jericho (Gourdin and Kingery 1975).

The ancient Egyptians primarily used a gypsum plaster as it was more readily available in the area than limestone. Gypsum also has a lower temperature required for producing plaster as it only needs a firing temperature between around 130° and 170°C. The earliest use of lime plaster in Egypt was between 1400 and 1200 BCE and was discovered at the site of Timna (Gourdin and Kingery 1975).

Lime plaster technology emerged in Neolithic Greece roughly around 5400 BCE. Karkanis and Stratouli (2008) analyzed lime plaster samples from Drakaina Cave in Western Greece and determined that the lime plaster was produced and utilized during the Late Neolithic to the Early Chalcolithic (5400 – 4500 BCE), as it was used to construct at least four layers of floors. They also discovered that clay was added to and fired with the lime plaster, which potentially gave some hydraulic properties to the plaster. It is unknown whether this was an accidental result or if there was some early mastery of hydraulic lime (Karkanis and Stratouli 2008:37). However, it appears that the ancient Greeks eventually discovered the hydraulic properties of lime. At Malia, in Crete, there is evidence that volcanic ash from the island of Santorini was used to create hydraulic cement (Blezard 1998; Villaseñor 2009).

The hydraulic lime discovered by the Greeks and heavily developed by the Romans possessed superior strength over regular lime. It is known that Roman authors produced manuscripts on lime plaster as some of their writing has survived until today. These writings discussed the processes involved in the selection of suitable limestone (Vitruvius) and the burning of lime plaster (Dix 1982).

The Romans used a hydraulic lime from a red or purple volcanic tuff found on and near the Bay of Naples. When there was no volcanic earth, the Romans made use of powdered tiles or ceramics, which produced a similar effect (Blezard 1998). The most extensive use of lime plaster was in the building industry. The Romans developed an authentic concrete around the third century BCE, which consisted of rubble mixed with sand and lime mortar (Hughes and Valek 2003). The development of multiple lime plaster techniques encouraged their use for specific purposes. Thus, lime mortar was used in the construction of walls, and reinforced mixes, like concrete, were used in floor substructures (Dix 1982).

Following the decline of the Roman period, knowledge of lime plaster technology deteriorated, and the use of pozzolanic sands to create hydraulic mortars was largely forgotten in Europe (Hughes and Valek 2003). Generally, inferior quality lime was produced throughout the European Middle Ages (Blezard 1998). By the Renaissance, architects began following the techniques of the classical Greek and Roman buildings (Hughes and Valek 2003).

The ancient Chinese developed an innovative method of producing lime plaster by creating organic-inorganic hybrid mortars. The organic additions included sticky rice, egg white, fish oil, tung oil, juice of vegetable leaves, or animal blood, which were mixed into the mortar (Xiao et al. 2014). The most common hybrid was sticky rice lime mortar, which resulted in a flexible and robust mortar. This Chinese technology was fully developed by the South-North Dynasty around 386-589 CE (Yang et al. 2009), and it was used to construct tombs, buildings, and water source facilities.

During the 18th and 19th centuries in Great Britain, there were numerous advances in the production of cementitious materials. In 1756, John Smeaton was commissioned to construct the Eddystone lighthouse. Through his experimentations into the chemical behavior of various lime

sources, he became the first person to recognize the properties of hydraulic lime (Blezard 1998). James Parker introduced Roman cement in 1795, which, despite its name, was a new invention. By 1824, Joseph Aspdin developed and received a patent for Portland cement; however, his creation was only a hydraulic lime and did not resemble the cement used today. I.C. Johnson built upon previous experimentations and developed a stronger, though slower setting cement (Hughes and Valek 2003). Johnson is often perceived as developing the first Portland cement that bears any resemblance to modern cement (Blezard 1998).

4.6. Mesoamerican and Maya Lime Production

Lime plaster was a precious building material to both ancient Mesoamerica and the ancient Maya. It was an essential building material that enabled monumental construction in the Maya region. One of the primary functions of plaster was as a protective medium (Littmann 1957), which served to protect the limestone structures from heavy rainfall (Abrams 1996). Lime plaster also had a sanitary use as plaster surfaces provided various benefits over dirt, tamped, and bedrock floors, such as greater resistance to helminths (hookworm and ringworm) and insects. Additionally, plastered surfaces provided a more efficient removal system for water drainage (Abrams 1994).

Lime was an equally important material in the Mesoamerican region. The Maya and other groups in Mesoamerica have traditionally used lime for an assortment of functions. For example, lime was traditionally used in the preparation of maize. By soaking maize in lime, the outer shell (or the pericarp) is softened, which results in better digestion of niacin and thus improved nutrient absorption. The softened shell also makes it easier to grind the corn into a flour (MacKinnon and May 1990; Castanzo and Anderson 2004). The ancient Maya also used lime for

sizing bark paper (MacKinnon and May 1990) and for lining storage containers of perishable materials as it repelled pests and served as a preservative drying agent (Barba 2013).

This section discusses the archaeological evidence of early lime plaster, the evidence of lime plaster production sites, and the characterization of lime plasters in Mesoamerica.

4.6.1 Archaeological Evidence

The ancient civilizations of Mesoamerica were highly skilled builders who relied on lime to produce plaster, stucco, mortar, and washcoats. The earliest known architectural use of lime plaster was in the Oaxaca Valley between 1400 and 1150 BCE, where residential and nonresidential buildings were whitened with lime washcoats (Marcus and Flannery 1996). By 1000 BCE, lime plaster was used at the agricultural settlement of Cuello in northern Belize, and it coated two low platforms (Gerhardt 1988). These platforms contained post holes, which suggests they supported a wooden superstructure (Hammond and Gerhart 1990; Gerhart and Hammond 1991). Additionally, lime plaster was used during the Middle Preclassic period (1000-400 BCE) at the site of Nakbé and later El Mirador (Hansen 2000), as well as at Uaxactún, Calakmul (Barba 2013), and Cival (Ahern 2014; Estrada-Belli 2017).

Although there is a surplus of evidence for the early use of lime among the ancient Maya and the Zapotec, there is not a lot of evidence elsewhere. Luis Barba (2013) proposed that this discrepancy was a result of greater difficulties in developing lime plaster in certain areas, especially when there were no limestone outcrops located nearby, such as at Teotihuacan. Nevertheless, archaeological excavations have revealed Preclassic period lime plaster at the site of Chalcatzingo (Grove 1987). Additionally, some of the earliest known lime kilns in Mesoamerica were discovered in the Puebla-Tlaxcala Basin. The majority of these kilns were pit

kilns, and two of them dated to the Early Preclassic to early Middle Preclassic period (Castanzo and Anderson 2004).

4.6.2 Archaeological Evidence of Lime Plaster Production Sites

There is a dearth of information regarding lime plaster production sites among the ancient Maya. One of the major challenges hindering our understanding of lime plaster production is that the densely forested Maya lowlands make it challenging to conduct field surveys. Thus, most lime plaster production sites are discovered through excavation (Castanzo and Anderson 2004). Currently, most of our data on lime plaster industries come from the Yucatán and the site of Copan. However, new survey techniques and remote sensing technology, like LiDAR, will aid in the future identification of pit-kilns and other types of plaster production sites (Seligson, Ortiz Ruiz, and Barba 2018).

There were at least three techniques used by the ancient Maya to manufacture plaster, and these are i) open-air kilns (Russell and Dahlin 2007), ii) semi-enclosed kilns (Abrams and Freter 1996), and iii) pit-kilns (Abrams et al. 2012; Seligson et al. 2017). The majority of lime production industries discovered in the ancient Maya lowlands are pit-kilns, which are kilns built into the ground. Archaeologists have also discovered several possible open-air kilns located throughout the Prehispanic Maya area. As an aside, open-air kilns are also known as caleras (Morris, Charlot, and Morris 1931) and wooden pyres. Since these open-air pyres often leave undetectable signatures in the archaeological record, it is unknown if they were more commonly used than pit-kilns.

Initial information on ancient Maya plaster production was obtained from ethnographic reports from the early 20th century. In 1931, Morris and his colleagues documented local Maya

villagers participating in an open-air firing of limestone in an area around Chichen Itza. The villagers selected this site for its proximity to desired hardwood and access to quality limestone sources (Morris, Charlot, and Morris 1931). Seligson and his colleagues (2018) recently published a comprehensive review of the known burnt lime plaster production sites located throughout the Prehispanic Maya area. They proposed that different subregions of the broader Maya lowlands had different lime production technologies and socioeconomic organization of lime production (Seligson, Ortiz Ruiz, and Barba 2018).

Archaeologists have discovered annular pit-kilns at the sites of Sayil and Kiuic, located in the eastern Puuc region of the Northern Lowlands. These pit-kilns dated to the Late and Terminal Classic periods (Seligson et al. 2017; Seligson, Ortiz Ruiz, and Barba 2018). Additionally, annular pit-kilns dating between the Late Preclassic to the Colonial period were found near the site of Oxkintok, which is located at the northern edge of the Puuc region (Ortiz Ruiz 2015). A high concentration of pit-kilns was discovered at the sites of Ceibos-Kikteil, Conkal, Dzibilchaltun, Rejoyadas, Sacniete, and Tamanche by the Ichkaantijoo Regional Archaeological Project (Seligson, Ortiz Ruiz, and Barba 2018).

Evidence of lime plaster production was also uncovered at the site of Copan, which is located in the southern Maya lowland of Honduras. In the 1980s, archaeologists at Copan uncovered and excavated five subterranean pits or pit-kilns that were dated to the Late Preclassic and Early Classic periods. The pit-kilns discovered at Copan had an elliptical shape and were likely used to burn limestone (Viel 1983); however, these pits potentially had an alternative function (Abrams 1996). By the early 1990s, archaeologists identified a section of a domed or semi-enclosed kiln at Copan that dated back to the Late Classic period. Currently, it is the only

known semi-enclosed or dome lime kiln found in the Maya region (Abrams and Freter 1996; Abrams 1996).

In 2007, seven open-air lime production features were discovered outside of the city walls of the Postclassic site of Mayapan. Russell and Dahlin (2007) expanded their finding by constructing an open-air firing site, which demonstrated that these seven features were sufficient for producing the annual lime production required for Mayapan.

MacKinnon and May (1990) discovered a small coastal lime-making site on the Placencia Lagoon in Belize, and it had a layer of calcium carbonate (CaCO_3) approximately 40 cm below the surface, which contained lumps of cemented lime. Due to its similarities to nearby modern sites of plaster production, they proposed that it was an open-air firing site that was used during the Early Classic period to produce lime from shells. Additionally, there were three Late to Terminal Classic periods sites located on the Placencia Lagoon, and each was discovered to contain a few lumps of cemented lime. Thus, these sites were also potentially used to process lime (MacKinnon and May 1990).

4.6.3 Characterization of Archaeological Lime Plasters

The majority of lime plaster studies in Mesoamerica have focused on identifying the elemental composition, aggregates, and organic additives found in plaster. Edwin Littmann was one of the first researchers to investigate the chemical composition of lime plaster in Mesoamerica. Littmann conducted chemical analysis on plaster samples taken from Comalcalco (1957), Palenque (1959), Uaxactún (1962), Altar de Sacrificios (1972), Teotihuacan (1977), Cuello (1978), and Tikal (1990). He also investigated the techniques required for the

construction of floors (1962; 1967) and examined the composition of sascab (1958), which is the product of weathered limestone.

Edwin Littmann (1957) noticed there were variations in the different layers of lime plaster. A plaster layer can consist of different amounts and sizes of aggregates. Lime plaster layers can also differ in thickness. This dissertation utilized three terms to discuss the application of lime plaster, and these are coarse-plaster, fine-plaster, and washcoat layers. Although coarse-plaster was first described as a lime-aggregate (Littmann 1957), this dissertation adopts the nomenclature used by Heather Hurst (2009) in her earlier examination of lime plaster in the Cival region. The coarse-plaster layer is a mixture of lime and aggregate, and it is used to create an artificial base and level surface (Littmann 1957). The fine-plaster layer is a thin layer applied above the coarse-plaster, and it serves as the final surface of the plaster. Additionally, the thin-plaster layer generally has either a small amount or no additional aggregate mixed in with the lime (Hansen 2000). A wash coat, also known as a lime coat, was a very thin layer of lime that was frequently used to apply a fresh coating of plaster to a surface.

This variation in lime plaster layers was also found at Tenochtitlan. Miriello and his colleagues (2011, 2013) determined that the Tenochtitlan plaster samples contained a layer of *enlucido*, *firme*, or both. *Enlucido* refers to a thin, superficial layer made of lime without aggregate, and the term is equivalent to the fine-plaster layer. *Firme* is a thick, lower layer made of lime and aggregate, and it is comparable to the coarse-plaster layer. The *firme* functioned as a base to apply a layer of *enlucido*. A smooth substrate allowed plasterers to apply a layer of *enlucido* directly to the surface (Miriello et al. 2011; Miriello et al. 2013). Plaster placed on top of an irregular substrate required *firme* to be placed first. The floor samples in Tenochtitlan usually consisted of both layers, whereas samples from walls, balustrades, and staircases

generally consisted of just a layer of enlucido (Miriello et al. 2013). The terms firme and enlucido are also used to describe variations in lime plaster layers at Teopancazco, which was a neighborhood in Teotihuacan (Pecci et al. 2016).

Researchers have identified both the presence of organic and inorganic additives in lime plaster found throughout ancient Mesoamerica. Two well-documented organic additives used in the Maya region were the water extracts of bark and the saps of local trees (Littman 1957; Hansen 2000). In 1960, Edwin Littmann investigated the effects of bark extract in the production of lime plaster by conducting a series of experiments. He determined that bark extracts of tannic acid had a positive effect on the properties of lime plaster as their addition led to less surface cracking, which ultimately stabilized the plaster during the drying process. Eric Hansen (2000) later expanded on this finding by proposing that the charcoal discovered in some of the plaster samples taken from the ancient Maya site of Nakbe was possibly the residue of an organic additive, such as bark extract.

A study conducted at various ancient Maya sites in the Yucatan discovered organic materials mixed with the lime plaster (Magaloni et al. 1995a). Although the researchers were not able to identify the additive contained in the lime plaster, they discovered high levels of glutamic and aspartic acids. Magaloni and her colleagues (1995a) proposed that the incorporation of the organic material enhanced the mechanical resistance of the lime plaster. Diana Magaloni (1996) later determined that the organic material from multiple ancient Maya mural samples likely came from the *Holul* tree.

Plasterers at Teotihuacan also added organic materials to lime plasters, which served to strengthen and stabilize plaster floors. Torres Montes and his colleagues (2005) discovered that both cotton fibers and organic mucilage, extracted from leaves of the cactus plant *Opuntia sp.*,

were added to the lime plaster floor of the Ciudadela at Teotihuacan. Cotton fibers were found in both the stucco and the floor. Although the quality of these cotton fibers is uncertain, their addition to the plaster resulted in a fiber-reinforced composite. The organic mucilage strengthened the adhesion of the plaster particles (Torres Montes et al. 2005). Plasterers at Teotihuacan also added additional raw materials to the aggregate, which were mainly of volcanic origin and included tezontle, pumice, glass shards, and porphyric rhyolites (Miriello et al. 2013; Barca et al. 2013).

Villaseñor and her colleagues (2011) examined how the composition and aggregate of lime plaster at the ancient Maya site of Lamanai shifted over 1,700-years. During the early occupation of the site, the lime plaster was composed of local raw materials, like crushed limestone, sascab, and eventually recycled plaster. By the Late Postclassic and Spanish Colonial periods, plasterers at Lamanai exported volcanic material, which they used as an aggregate in their lime plaster as it provided moderate hydraulicity (Villaseñor et al. 2011). Slightly hydraulic plasters were also found at Calakmul during the Preclassic and Late Classic periods and were formed through mixing lime with volcanic ash (Villaseñor 2009). Plasterers at the ancient Maya site of Rio Bec also mixed pyroclastic material with lime to create slightly hydraulic plasters and possibly even pozzolanic limes (Gillot 2014).

Researchers have also focused on new ways of extracting additional information from lime plaster samples. Hansen and his colleagues (1997) determined and identified multiple textures of lime plaster samples acquired from the site of Nakbe. They used optical microscopy, image analysis petrographic thin-sections, and X-ray diffraction analysis to establish that lime plaster has three types of textures, which are a) chaotic, b) sorted, and c) well-sorted. It was determined that the texture of the lime plaster corresponded to the chronological variants of

architectural forms at Nakbe (Hansen et al. 1997). In a later study, Eric Hansen (2000) discovered that particle shapes, such as angular or sub-angular, in the aggregate can indicate whether fractured limestone or refuse from quarrying were used during plaster production.

An additional avenue of investigations is the limestone provenance studies conducted on lime plaster samples. A 2009 study by Luis Barba and his co-authors determined the provenance of limestone used in Teopancazco, a neighborhood center at Teotihuacan, was from the site of Tula, which was 60 km away. These results were obtained by conducting LA-ICP-MS (Laser Ablation Inductively Coupled Plasma Mass Spectrometry) on white nodules, known as lumps, located inside the ancient mortars and plasters. These lumps were pieces of limestone that were unfired or improperly fired, and thus they retained the chemical composition of the original limestone source (Barba et al. 2009). Thus, LA-ICP-MS was used to measure the trace and rare elements found in the lumps. This approach was also utilized by two different studies to determine the provenance of lime plaster samples acquired from the Templo Mayor and the sacred precinct of Tenochtitlan. Both studies revealed that Tula continued to be the predominant source of limestone in the Valley of Mexico during the Late Postclassic period (Miriello et al. 2011; Miriello et al. 2013).

Cathodoluminescence was recently adopted for lime plaster studies in Mesoamerica, and it was used to examine firing techniques and the degree of calcination in lime plaster samples. Murakami and colleagues (2013) used cathodoluminescence and carbon isotope analysis to determine that Teotihuacan lime plasters are almost devoid of unburnt limestone and instead contain calcined and improperly calcined limestone. They conclude that the differential proportion of incompletely calcined limestone was related to differential firing techniques and the individual skills of lime producers (Murakami 2010; Murakami 2016).

Multiple studies utilized the composition of lime plaster to establish a chronology based on relative dating. In 1992, Magaloni and her co-authors examined lime plaster mural samples with SEM-EDS, Optical Microscopy, and X-Ray Diffraction/ Diffractometry to determine that Teotihuacan had five technical stages of plaster use throughout the site's history. They also used EDS mapping to compare the distribution of silicon and calcium within the samples and to determine technical stages (Magaloni et al. 1992).

Villegas and Vázquez (1995) later used the same methodological approach as Magaloni and colleagues to create a relative dating of the stucco relieves at Palenque, Chiapas, based on the variation in material preparation. They determined that there were four technical periods of plaster development at Palenque by examining the size and distribution of grains found in the calcareous matrix.

Researchers have also investigated the elemental composition of both lime plaster and pigments found in mural samples. These studies have predominately focused on murals found at ancient Maya sites (Magaloni et al. 1995b; Magaloni 1996; Hurst 2009) and Teotihuacan (Littman 1977; Magaloni 1995). Mural and pigment analysis differs from the other technical studies on the chemical composition of lime plaster as they also examine the organic materials used to color the surface of the plaster.

In 2009, Heather Hurst analyzed several ancient Maya mural samples acquired from the sites of Cival, Holmul, and San Bartolo. She examined the chemical composition of both the paint pigment and lime plaster of 24 mural samples from Holmul/La Sufricaya and 14 samples from Cival. Analytical techniques used included x-ray fluorescence spectrometry (XRF), microscopy with cross-section and thin-section analysis using both plain polarizing cross-

polarized light, and petrography (Hurst 2009). These plaster samples and their analytical data are incorporated into this larger dissertation project.

Although the ancient Maya preferred to coat their floors in lime plaster, they also used alternative surfaces for floors, such as bedrock and dirt. Floors composed of compacted sascab or tampered lime were found at Calakmul and Lamanai (Villaseñor 2009) and Uaxactún (Littman 1962). These floors were identified by their lack of burnt lime products. Sascab or tampered floors potentially served as a preparation layer during floor construction and were used to obtain a flat surface (Villaseñor 2009). Hansen (2000:153) suggested that sascab was also used as a layer of fill that was utilized to create a smooth surface by filling in the gaps between rocks. Archaeologists also discovered floors coated in gypsum plasters (Magaloni 1995). At Calakmul, plasters made from unburnt earth and clay were used during the Terminal Classic period (Folan et al. 2001; Villaseñor 2009).

Prior studies have determined that the quality of lime plaster during the Middle Preclassic period varied between sites. At Calakmul, floor samples had good to regular sorting, indicating that they were a standard quality (Villaseñor 2009), whereas at Nakbe plaster production techniques were rudimentary and plaster floors were mostly unprocessed (Hansen 2000). At Holmul, plasterers were producing low quality plaster for their murals (Hurst 2009).

Research at the site of Nakbe determined that plaster technology shifted between the Middle and Late Preclassic periods, which resulted in a higher quality lime plaster (Hansen 2000). The major transitions in the plaster were the addition of new ingredients to the binder and greater variance regarding the aggregate size. There was also improved sorting of the burnt-lime as less unburnt material made it into the plaster (Hansen 2000), which was likely a result of

people screening the lime. Hurst (2009) proposed that Holmul also experienced a similar transition between the Middle and Late Preclassic periods.

4.7 Acquisition of Plaster Samples

During the summer of 2018, the author collected 16 lime plaster floor samples from the archaeological sites of Cival, Holmul, and Witzna. Each sample was taken with a hammer and chisel and measured approximately 3 cm long and 3 cm in width. The samples were carefully wrapped and transported to the project lab in Antigua, Guatemala, where they were subsequently organized and cataloged. While in the laboratory, six additional plaster samples were selected to be analyzed, bringing the total number of samples to 22. Afterwards, the samples were shipped to Buffalo, New York. Due to the condition of the samples, only 19 plaster samples were sent to National Petrographic Service in Rosenberg, Texas, to be turned into polished thin sections. The samples were placed on 1x2 inch slides and were coated with a vacuum impregnation with clear epoxy.

4.8 Research Design, Petrographic, and Chemical Analysis of Lime Plaster

This project explores the role of plaster in ancient Maya plazas by utilizing petrographic analysis and multiple chemical analyses to examine the collected lime plaster samples. The petrographic analysis consists of examining thin-sections via petrographic and optical microscopes. The chemical analysis used in this dissertation consists of two methods, which are portable XRF and SEM-EDS. These methods primarily focus on the identification of the elemental composition and on obtaining the chemical signatures of the plaster samples. Additionally, these two methods provide essential information on the major, minor, and trace

elements of the lime plaster samples. These approaches are used to determine the recipe and quality of the lime plaster. The term recipe refers to the mineral and organic ingredients used to create the plaster. The quality of the plaster is reliant on both the materials used and the skill of the plasterer. Together, the recipe and quality provide an insight into the practices surrounding plaster production.

4.8.1 Petrographic Analysis

The mineralogical and petrographical analysis incorporates petrographic thin section analysis and optical microscopy. Thin section analysis requires a small silver of the sample to be cut and mounted on a glass slide. This analysis often utilizes a polarizing microscope that allows for the identification of the mineralogical constituents of the sample (Bishop et al. 1982). Optical microscopy is a complementary approach to thin-section as it provides an additional method for examining plaster samples under a microscope. It also enables the examination of the fine-level structures or morphology of the rocks and minerals located in plaster and details the layers of each sample. Optical microscopy is conducted with a reflected light microscope and is used to examine all of the samples.

Petrographic analysis is the most frequently used and most helpful approach in lime plaster analysis (Elsen 2006; Villaseñor et al. 2011). Petrographical techniques are used in this project to document the micromorphological and microstratigraphic characteristics of the samples. Additionally, it provides a precise observation of the different stratigraphic layers, which is vital in examining the processes of producing lime plaster. This method also identifies the use of various mineral additions (Elsen 2006) and the inorganic and organic aggregates located in the plaster sample. It can also be used to determine the characteristics of aggregates in

the plaster, such as determining size range, shape, and sorting consistency (Villasenor 2009). All of the plaster samples were examined with a Leitz Orthoplan microscope.

4.8.2 Portable X-Ray Fluorescence Spectrometry (pXRF)

Portable XRF is an instrumental method that relies upon fundamental principles regarding interactions between electron beams and x-rays with samples. In particular, the high-energy X-rays are used to excite the atoms in the material or sample, resulting in the material becoming ionized. This high-energy, short-wavelength frequency can result in the displacement of an inner shell electron, which is replaced by an outer shell electron. Since the inner shell electrons are more strongly bonded than the outer shell electrons, this process leads to the emitting of low energy radiation, known as fluorescent radiation or fluorescence. These fluorescence x-rays can be read to detect the elements present in the sample (Shackley 2011).

Portable XRF is used to determine the multi-elemental composition of the lime plaster samples acquired from the Cival region. This method is often viewed as the preferred chemical approach by conservationists because it allows for non-destructive in-situ analysis of artifacts (Craig et al. 2007). There are also portable versions of the pXRF that enables researchers to take the equipment into the field. Another benefit of pXRF is that it provides a reliable bulk quantitative elemental analysis that can be used to detect minor, major, and trace elements (Villaseñor 2009). Unfortunately, it is only reliable at detecting atomic numbers 19 through 41 (Shackley 2011). It also cannot identify specific mineralogy as XRF provides elemental data, not stoichiometric values. Thus, portable XRF is most useful as a complementary approach to SEM-EDS.

X-ray fluorescence spectra were collected using a Bruker Tracer 5i handheld energy dispersive X-ray spectrometer. The excitation source was a Rhodium (Rh) target X-ray tube operated at 12 kV and 100 uA current. No filter was used. A 3mm collimator was used to irradiate the sample. X-ray signals were detected using Peltier cooled XFlash silicon drift detector (SDD) with a resolution of 125 eV. Spectral interpretation was performed using Artax 7.4 software. Spectra was collected over **30** seconds (live time).

Spectral analysis was performed by collecting an accumulated spectrum and determining the area under the peak for each element identified. The data was exported into excel and normalized to Rh for comparative purposes. This analysis was conducted on thin sections, and thus, it should be noted that the glass slide can cause interference. Spectral analysis was conducted on the following elements, Al, Ar, Ba, Ca, Cl, Cr, Fe, K, Mg, Mn, P, Rh, S, Si. Particular emphasis was placed on calcium (Ca), magnesium (Mg), and silicon (Si).

4.8.3 Scanning Electron Microscopy with energy dispersive spectrometry (SEM-EDS)

SEM-EDS is another instrumental method that examines the interaction between electron beams and x-rays upon samples (Shackley 2011). It differs from pXRF as it uses a beam of electrons to create initial vacancies in the atoms. Detection involves elemental identification by measuring the energy released by the atoms, which is used to quantify the data. Another difference is that electron beams can be focused and steered, which allows the chemical analysis of individual inclusions in the sample. SEM provides higher resolution than optical microscopy (Pollard and Heron 2008), to better examine the micromorphological and microstratigraphic characteristics of the samples, while EDS is used to obtain semi-quantitative elemental compositions. EDS can conduct simultaneous energy measurement and detection by examining

the interaction between x-ray excitation and the sample. Additionally, backscattered electrons are used to observe compositional variation (Villaseñor 2009).

In plaster studies, SEM-EDS is predominately used to determine the characterization and major and minor elemental composition of the sample (Villegas and Vázquez 1995; Hansen 2000; Barba et al. 2008; Villaseñor 2009). It is also used to establish chronological sequences (Magaloni et al. 1992; Hansen et al. 1997). Ultimately, this project uses SEM-EDS as the primary method for determining major and minor elements and as a complementary approach to petrography.

Before using SEM-EDS, each of the samples was first turned into thin-sections before being prepared to withstand vacuum conditions and high beams of electrons. Nonconductive samples, like lime plaster, must first be coated in an ultrathin layer of carbon. The samples need to be electrically conducting as otherwise, the primary electron beam is deflected away from the surface, causing scanning and imaging problems (Pollard and Heron 2008). Finally, the samples were placed inside a vacuum-sealed chamber. The samples were analyzed with a Hitachi SU70 Field Emission Scanning Electron Microscope (FESEM) with Oxford Energy-dispersive X-ray spectrometer (EDS).

4.9 Summary

The methodologies used in this dissertation include excavations, proxemics, estimated plaza capacity, and geographical data, such as Google Earth Pro and ArcGIS. Additionally, this project also utilized petrographic and optical microscopy, SEM-EDS, and portable XRF to examine lime plaster composition and determine the existence of a community of practice regarding plaster production. Each of these methods provided a distinct and insightful means of

examining the available data. The results of these methods are found in the following chapters and appendices.

CHAPTER 5

The Data Chapter – An Examination of Plazas and Plaster

5.1 Introduction

Plazas are places of interaction and encounters that range from public open spaces to intimate and more restricted spaces (Moore 1996; Low 2000; Inomata and Tsukamoto 2014). Additionally, plazas are active spaces that are continually transforming through both physical modifications and altered meanings (Joyce 2009). Throughout the history of Mesoamerica, public plazas have served multiple purposes, ranging from locations for public events, ceremonies, elite-sponsored mass spectacles, and even occasionally as marketplaces (Low 2000; Inomata and Tsukamoto 2014).

The emergence of public plazas during the Preclassic or Formative period in both the Maya lowlands and the broader Mesoamerican region is frequently observed as a critical point in the formation of a community (Inomata and Tsukamoto 2014; Inomata 2014; Inomata et al. 2017; Clark 2004) and may have preceded and facilitated political changes (Inomata 2006; Clark 2004). Although plazas were a focal point of communal life at many Preclassic period Maya settlements, the symbolic values attached to the plazas were shaped by different historical traditions and political situations (Inomata 2014).

During the Middle Preclassic period, many sites in the Maya lowlands, such as Ceibal, Cival, and Tikal, began constructing open public plazas that were developed alongside early E-Group assemblages. By the Late Preclassic period (400 BCE – 250 CE), access to certain civic-ceremonial plazas became more restrictive and exclusionary. This shift was accompanied by the construction of more intimate and restricted plazas. Evidence from Cival and other ancient Maya

centers indicates that the changing accessibility of civic-ceremonial plazas and the construction of restricted plazas was linked to increased sociopolitical complexity, emerging centralization, and the formation of centralized rulership (Estrada-Belli 2006; Tsukamoto 2014a) throughout the central Maya lowlands.

This chapter primarily investigates the transformation of plazas between the Middle and Late Preclassic periods in the Cival region. It also explores the continued development and use of plazas throughout the history of each site. In the following sections, data is presented on Cival, Holmul, and Witzna. This data shows a general trend towards an early emphasis on monumental public plazas and structures, while also showing an uneven development of lime plaster production. After presenting the detailed site data below, I will return to these issues to discuss them in chapter 6.

The first section briefly mentions the results of the excavations at Cival and Witzna, which were conducted with the Holmul Archaeological Project. Afterwards, the spatial measurements and architectural history of these plazas are used to estimate the plaza capacity at each site. Finally, the chapter expands upon plaza history and construction by investigating various lime plaster floor samples acquired from Cival, Holmul, and Witzna. This examination provides insight into the building methods and traditions associated with these plazas. Together, this information helps establish the historical processes associated with these centers and provides insight into the types of practices related to these plazas.

5.2 Excavations

This section draws upon multiple archaeological excavations conducted at the sites of Cival and East Witzna. These excavations were carried out under the Holmul Archaeological

Project, which is directed by Francisco Estrada-Belli. The information obtained through these excavations provides insight into the construction associated with the development and expansion of plazas. Additionally, the material examined in this section leads the way for later discussion of the historical processes tied to the emergence and maintenance of these public and private plazas.

5.2.1 Cival

This project discusses three excavations conducted on Structure 9 at the site of Cival. Structure 9 was located in the heart of Cival's ceremonial center and was a part of the Central E-Group assemblage at Cival. This structure is referred to as a radial pyramid, as it was discovered to have a staircase located on all four sides.

5.2.1a CIV.T.12

CIV.T.12 was an excavation unit positioned on the eastern side of Structure 9. This unit shared the name with a much earlier excavation conducted in 2004, which previously uncovered the plaza located in front of the pyramid. My excavation began with a 2 x 4-meter trench that incorporated both the base of the pyramid and a small section of the previously excavated plaza. This trench was later expanded by 2 x 1.5 m to the south to uncover more of the structure's base. Afterwards, a tunnel was excavated approximately 18 meters into the center of Structure 9 (see Figure 3.5). Another unit was opened higher up on the eastern side of the pyramid and was excavated by Josué Calvo (see Calvo 2014).

The ceramic analysis of CIV.T.12 revealed that the earliest phases of Structure 9 and thus the Central E-Group assemblage were associated with the Pre-Mamon ceramic tradition.

Structure 9 also had five major stages of construction, and there was evidence of masks that once decorated the pyramid. Both excavations revealed that the eastern side of the pyramid had the same outwards dimensions throughout the site's history, as each new phase of Structure 9 was built directly on top of the previous structure (see Figure 3.5). Additionally, both excavations discovered that builders were able to maintain the outward size of the pyramid through the intentional mutilation to the earlier structure. These findings indicated that the Central E-Group plaza had a fixed width, as the construction phases of Structure 9 never disrupted the original plaza size.

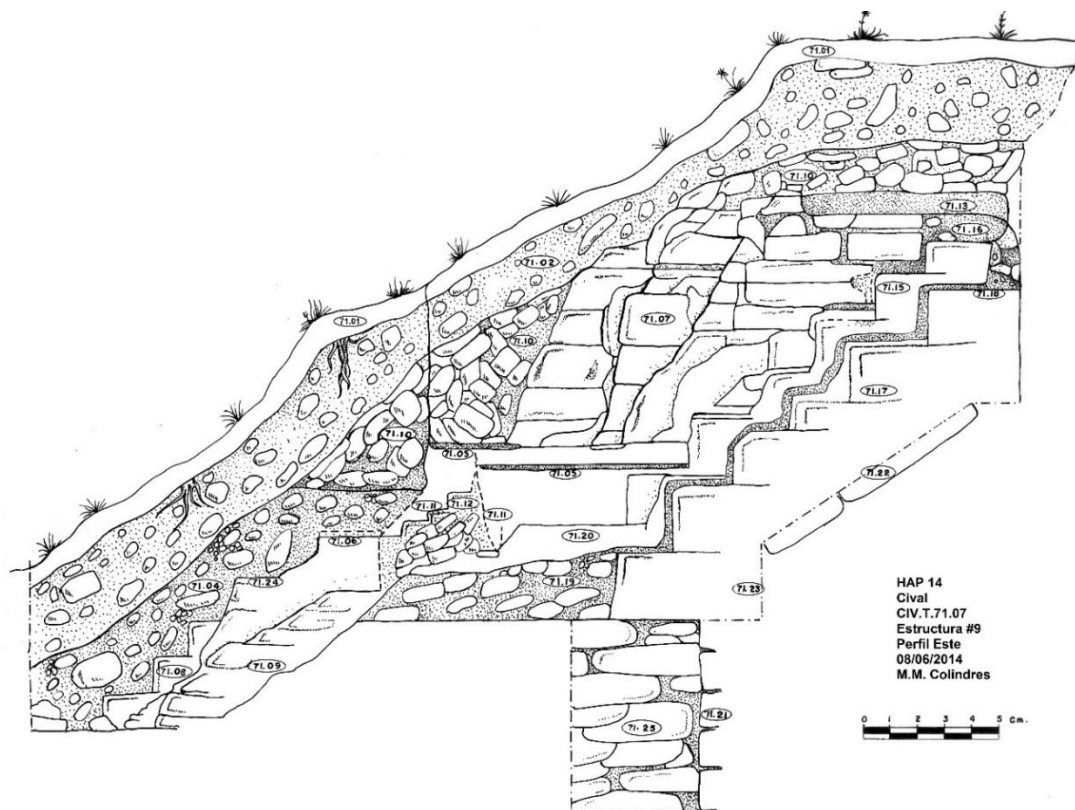


Figure 5.1: East profile of CIV.T.71. Drawing by M.M. Colindres.

5.2.1b CIV.T.71

Another excavation unit, known as CIV.T.71, was opened on the northern side of Structure 9. This new unit was placed halfway up the pyramid, and it began as a 3 by 4-meter

trench. However, the unit was subsequently extended after the discovery of a weathered Chaak mask (Ahern and Colindres Díaz 2015).

The placement of this unit was entirely a consequence of the two previous excavations conducted on the eastern face of Structure 9, as both had discovered evidence of significant mutilation to the earlier phases of construction (Estrada-Belli 2014). Thus, the north side of the structure was selected to identify un mutilated masks and previous phases of architecture. This excavation confirmed that the size of Structure 9 was only restricted on the eastern side of the pyramid, as the northern face experienced multiple outward expansions (See Figure 5.1).

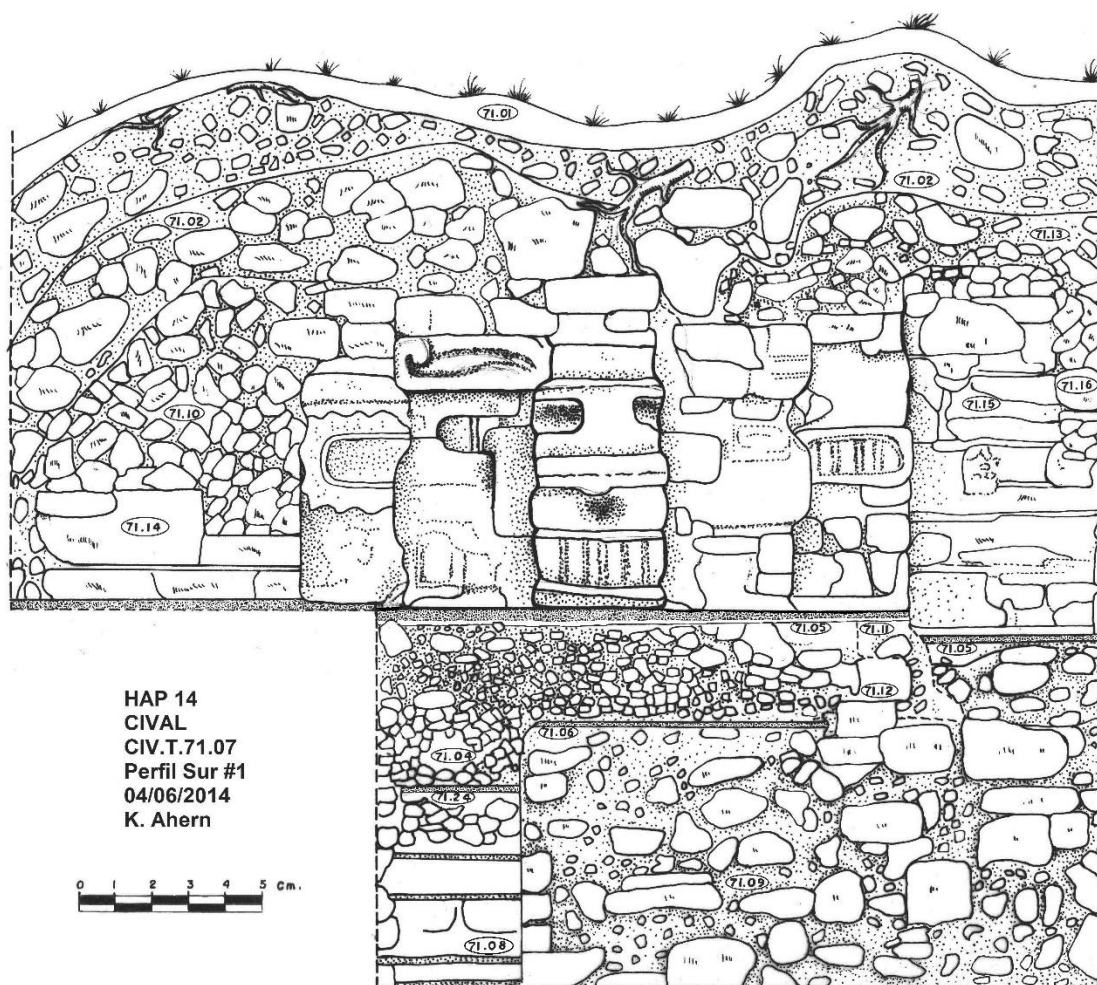


Figure 5.2: South profile of the excavation CIV.T.71 and the Chaak mask. Drawing by Kaitlin R. Ahern.

5.2.1c Summary of Findings at Cival

Ultimately, these excavations at Cival established that the construction and restricted modification of Structure 9, or the western radial pyramid was an intentional and directed action that was conducted to preserve both the width of the Central E-Group plaza and the sacred place. The original east-west axis of the plaza was maintained by builders who prevented future phases of construction from encroaching on the plaza. Thus, each new phase of construction required the destruction or mutilation of the previous architecture as it enabled the development of new adornments, such as masks, to the pyramid. This restricted expansion was also experienced by Structure 7, or the eastern elongated platform, located on the opposite side of the plaza, and it confirmed the intentional maintenance of the plaza width (Estrada-Belli 2017). However, the conservation of the Central E-Group plaza only extended to the preservation of its width along its east-west axis as previous excavations revealed that the plaza floor was slightly raised during each of the plaza's six major phases of construction.

5.2.2 Excavations at the Watchtower, East Witzna

Between 2018 and 2019, there were multiple excavations conducted on both the pyramid known as the Watchtower and the surrounding complex. The Watchtower was first identified in 2017 via LiDAR, and it was positioned on the highest hill in the Cival region. This complex is located in East Witzna, which was a small ritual center that was part of the larger site of Witzna. Although the two sites were separated by several kilometers, they were connected via a sacbe. Additionally, the Watchtower complex was occupied during the Late Preclassic and Early Classic periods.

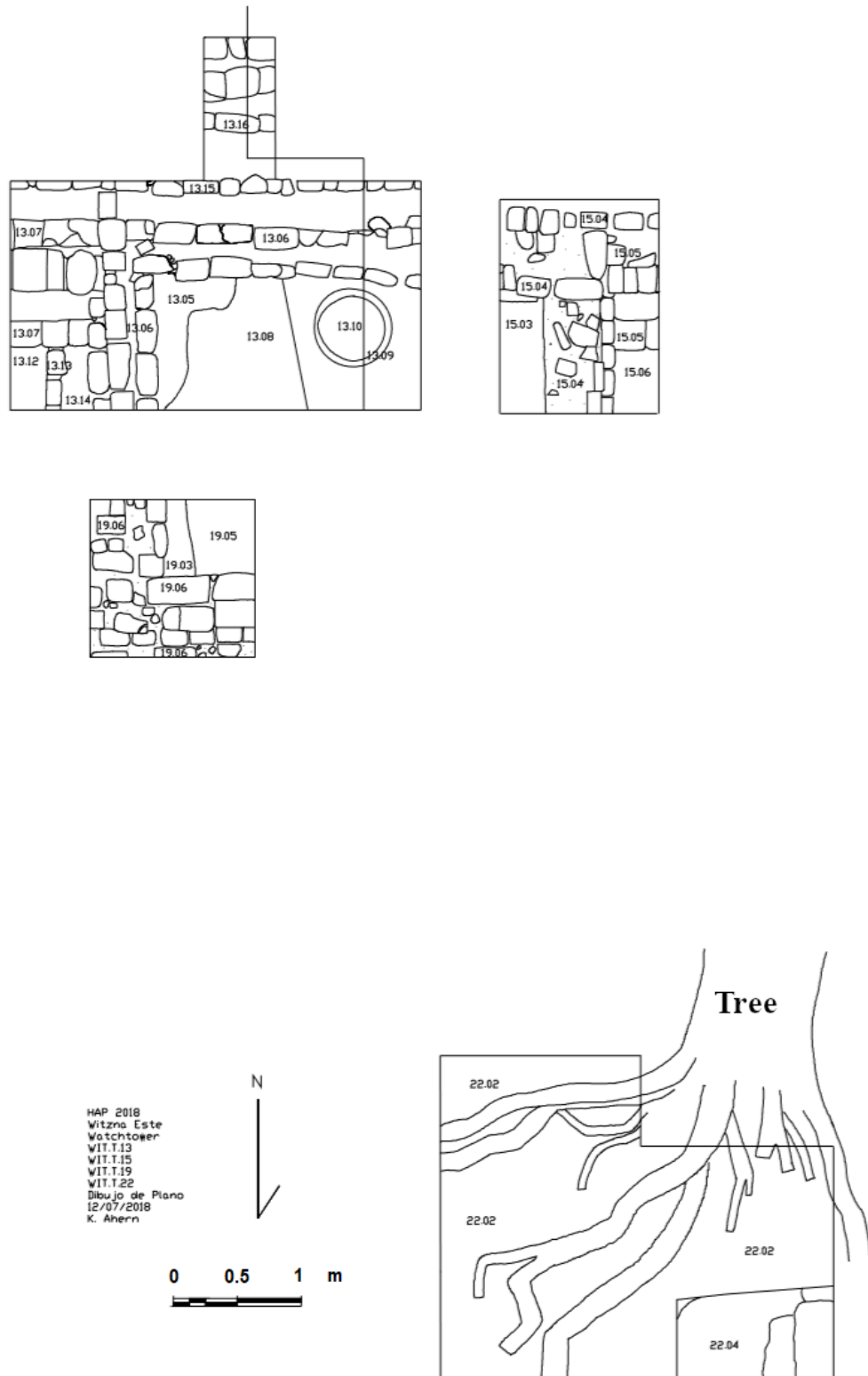


Figure 5.3: Plan view of the excavations WIT.T.13, WIT.T.15, WIT.T.19, and WIT.T.22. Drawing by Kaitlin R. Ahern.

5.2.2a WIT.T.13

The excavation WIT.T.13 was centrally positioned at the bottom of the Watchtower. This spot was chosen as limestone blocks were poking out of the ground. These blocks indicated the presence of architecture close to the surface. Initially, a 2.5 x 3-meter excavation unit was opened, and eventually expanded three times. Additionally, a tunnel was dug to the center of the pyramid to discover earlier phases of construction. During this excavation, another structure was found immediately in front of the Watchtower. This new masonry building was built over a chultun. Although this structure was never officially named, this project refers to it as Building A.

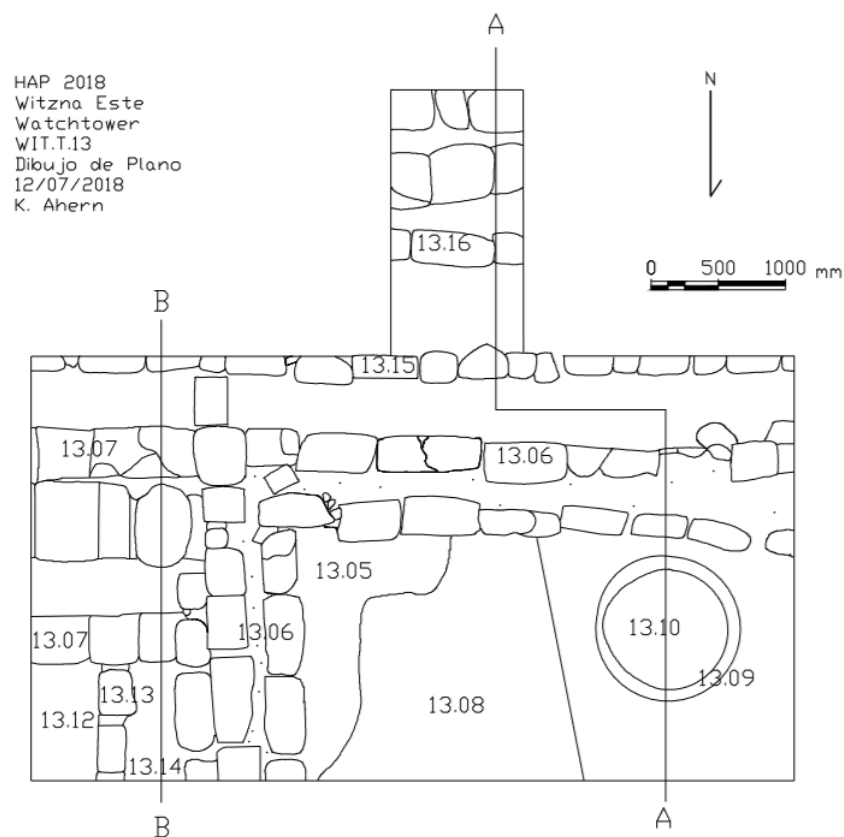


Figure 5.4: Plan view of the excavation WIT.T.13. The A-A and B-B lines refer to cross-sections of the excavations, which are seen in the profile drawings. Drawing by Kaitlin R. Ahern.

The chultun located under Building A contained the top of a human skull, teeth, four complete miniature vessels, two plates, six pieces of obsidian, marine shells, and some broken stone tools. The cranium fragment was positioned facing upwards, which explained why the individual's teeth were discovered before the skull. These teeth consisted of both milk and adult teeth. Ceramic analysis of the vessels determined that the offerings deposited in the chultun dated to the Early Classic period (Arroyave et al. 2019).

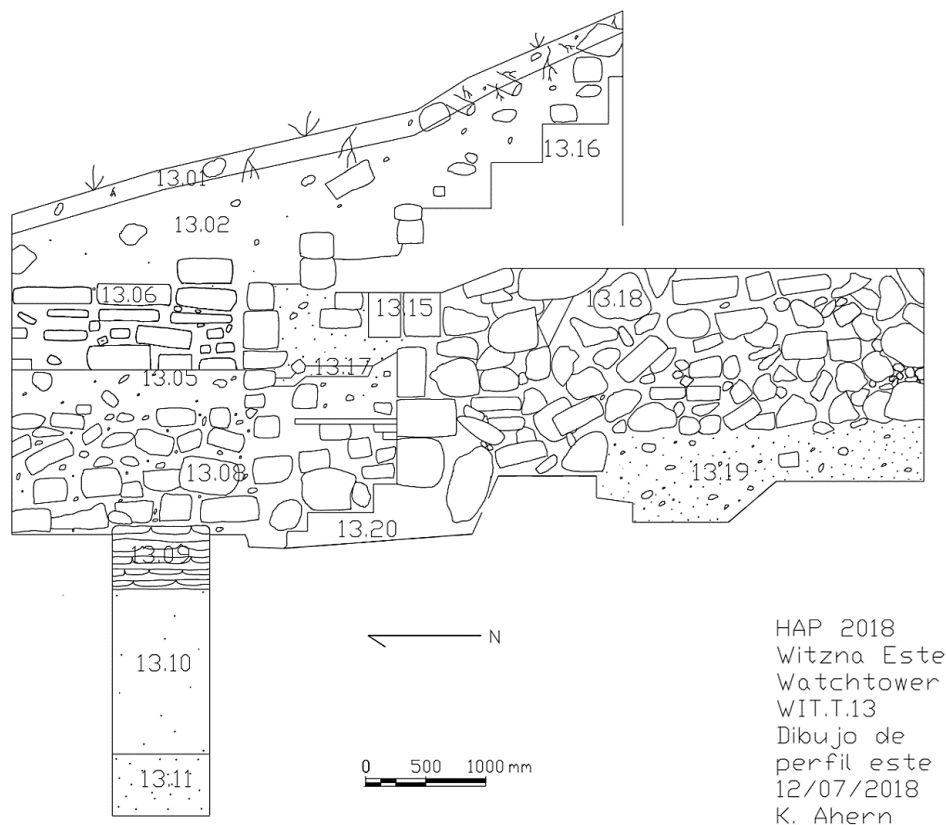


Figure 5.5: Profile view of the cross-section A-A in the excavation WIT.T.13. Drawing by Kaitlin R. Ahern.



Figures 5.6 and 5.7: The first image shows the opening of the chultun and the location of the first miniature vessel. The image to the right is the cranium fragment discovered in the chultun. Photo by Kaitlin R. Ahern.



Figure 5.8: Image of the four miniature vessels. Image courtesy of Francisco Estrada-Belli.



Figure 5.9: Plate discovered in the chultun. Image courtesy of Francisco Estrada-Belli.



Figure 5.10: View of the completely excavated chultun. Photo by Kaitlin R. Ahern.

The tunnel into the center of the Watchtower was excavated across multiple seasons, and when completed, it measured approximately 20 meters in length. This excavation revealed the earliest phase of architecture for the Watchtower, which was a two-tiered platform. The lower level of the platform was composed of a stone slab floor that utilized a mixture of large gray, white, and yellow slabs. The upper level was an earthen platform that was outwardly lined in stone blocks. In addition, the earthen platform was composed of gray soil and lacked any evidence of a plaster coating.

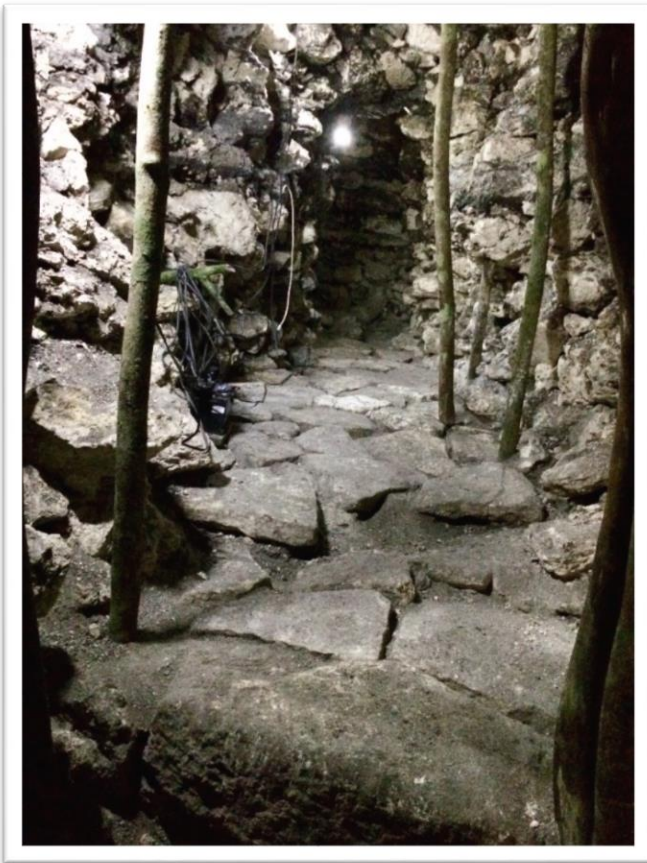


Figure 5.11: Image of the stone slab platform. The first part of the platform is lower than the rest of the floor, as it served as an additional step to the actual height of the platform. Photo by Kaitlin R. Ahern.

There is surprisingly little information available in publications on stone slab platforms and floors. Instead, stone slabs are usually mentioned in the literature as essential components in the lining of ancient Maya tombs (Coe 1956) and for their use as stelae (Stuart 1996). Additionally, stone slab platforms were also used to support residential structures. However, there are only a couple of sources that mention stone slab floors in association with ceremonial buildings. The closest example to the Watchtower platform was discovered at the site of Ceibal, as a stone slab layer was found under a floor in the Central Plaza. This layer was composed of flat to rounded rectangular stones that were densely arranged (Inomata et al. 2017). Although these stones also consisted of the same yellow, white, and gray colors found at the Watchtower,

they were much smaller. Inomata and his colleagues (2017) suggested that this stone layer was part of a floor construction technique where stones were used as a base for a clay or marl floor. This method was discovered a couple of times at Ceibal and also occurred at San Lorenzo (Inomata et al. 2017). Another similar example was found at Cerros, as archaeologists uncovered a low-lying stone platform that was composed of loaf-shaped stones. This platform was discovered at the base of Structure 6 and supported a square monolith with rounded edges (Reese-Taylor 2012b). Unfortunately, the color of these stones was not mentioned. The similarities between the recently discovered platform and the stone slab layers at Ceibal may indicate that the Watchtower platform was the base of a floor. However, the significant size difference of the slabs between the two sites serves to disprove this possibility. Additionally, the stone slab platform did not support a residential structure as there was no evidence of post-molds or a masonry structure. Instead, it is much more likely that the stone slabs were the exterior of the platform, as seen at Cerros.

The two-tiered platform was the first major phase of construction for the Watchtower. During the Late Preclassic period, the platform was covered in several meters of loosely sorted limestone rocks, earth, broken ceramics, and chert tools. This fill was placed by laborers to increase the height of the structure for the next major phase of construction, which was the Watchtower pyramid. Ceramic analysis of this fill determined that this transition from the Watchtower platform to the Watchtower pyramid occurred during the Late Preclassic period (Arroyave 2020).

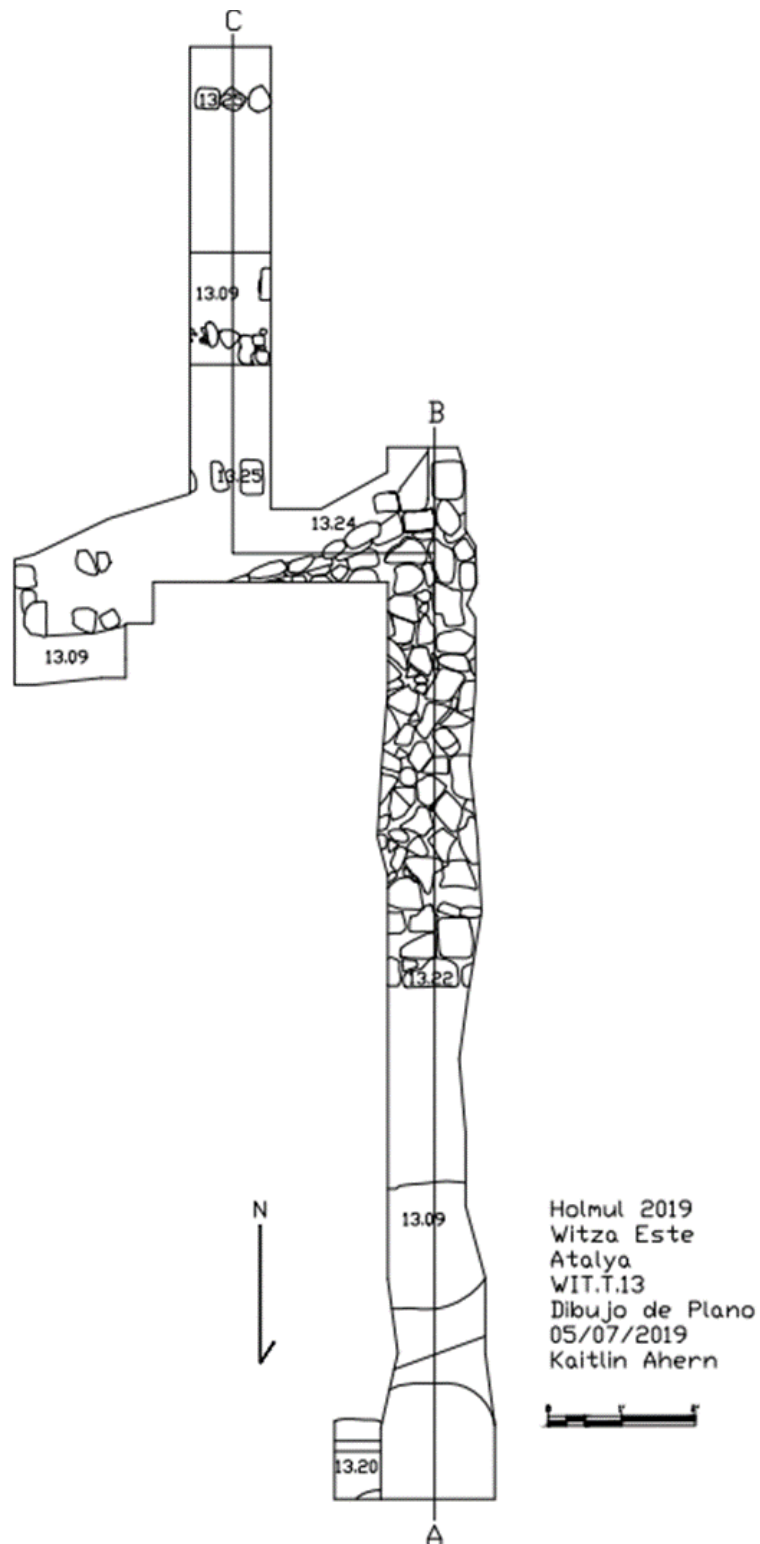


Figure 5.12: Plan view for the WIT.T.13 tunnel and the locations of the A-B and A-C cross-sections. It includes the stone slab platform. Drawing by Kaitlin R. Ahern.

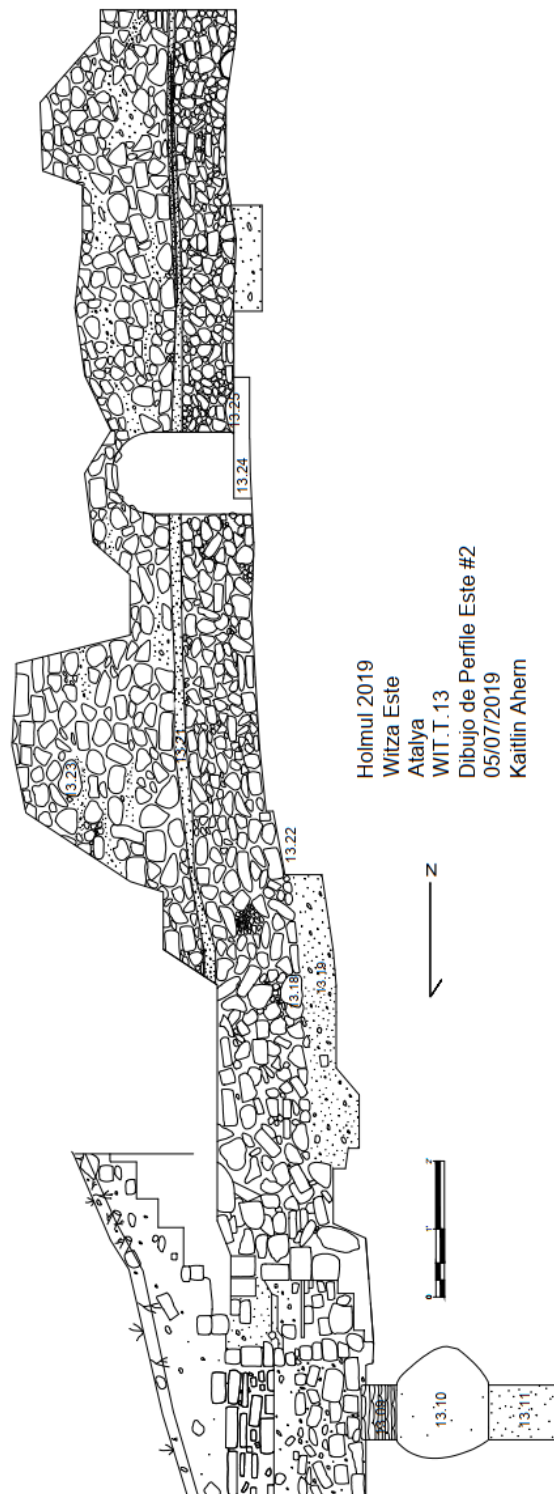


Figure 5.13: East profile of the Watchtower. Drawing by Kaitlin R. Ahern.

5.2.2b WIT.T.14

The excavation (WIT.T.14) was positioned at the top of the Watchtower pyramid, and it incorporated two looters' tunnels that were carved into the southern side of the pyramid (see Figure 5.14). The first looter's tunnel was located at the very top of the Watchtower, and it only uncovered 0.50 m of the floor. The second tunnel was more substantial as it had a length of 4 m and an average height of 1.46 m. Neither tunnel discovered anything beyond architecture. The excavation (WIT.T.14) began as a tunnel, and it was positioned in the first looter's trench. This archaeological tunnel faced northwards and had a width of 0.90 m. It unexpectedly revealed multiple phases of floors that were burned by fire.

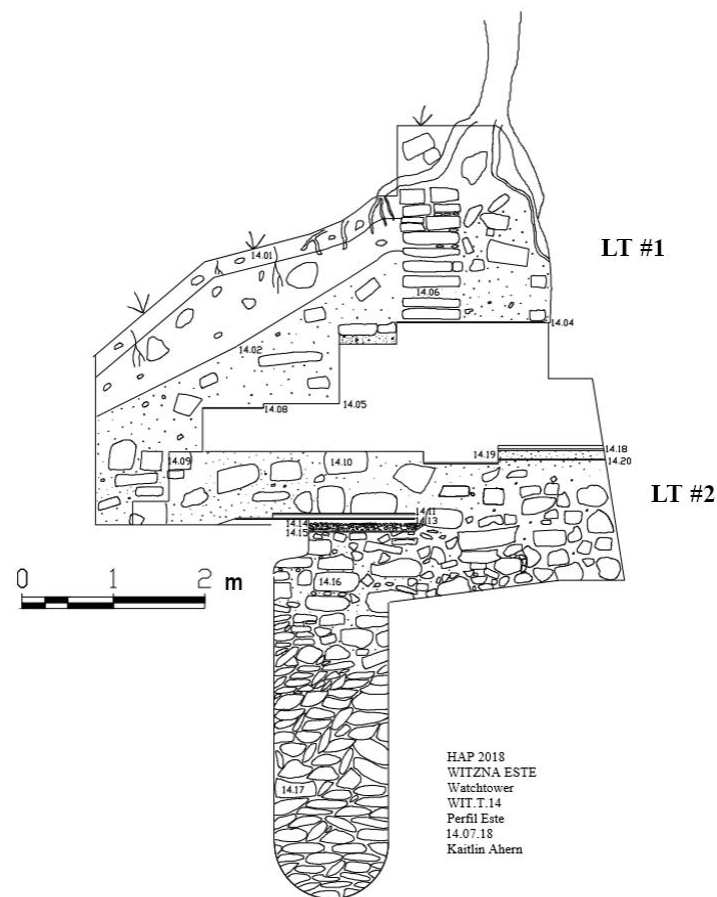


Figure 5.14; East profile view of the excavation WIT.T.14. The location of the two looters' trenches is indicated by LT#1 and LT#2. Drawing by Kaitlin R. Ahern.

5.2.2c WIT.T.15 and WIT.T.19

During the excavation WIT.T.13, Building A was discovered directly in front of the Watchtower. Due to the proximity of the two structures, it was decided to open a new excavation unit 3.10 meters to the west of WIT.T.13. This new unit was known as WIT.T.15, and it was located along the edge of the Watchtower. Additionally, it measured 2 x 3 meters. This excavation sought to determine the measurements of Building A and to search for a staircase leading up the pyramid. This location was chosen as the surface was slightly raised due to a large number of collapsed blocks. This debris was likely the remains of Building A.

WIT.T.19 was an excavation unit opened in the Watchtower plaza, and it was positioned 1.25 m to the north of WIT.T.13. The unit measured 2 x 2 meters. Like the previous excavation, WIT.T.19 was positioned where limestone blocks were poking out of the ground. This excavation was conducted to determine the northern extent of Building A. Ultimately, WIT.T.13, WIT.T.15, and WIT.T.19 established the eastern, western, and northern corners of the building. These excavations also revealed two phases of floors associated with Building A, and both were burnt by fire.

5.2.2d WIT.T.22

An altar fragment was discovered in the northeast section of the plaza and was positioned near a tree. Thus, it was decided to open a new excavation unit, known as WIT.T.22, that measured 5.5 x 4.5 meters. This excavation had the single goal of searching for and uncovering more altar fragments. It also revealed a single plaza floor that was heavily destroyed. Due to the proximity and size of the tree, both the altar and plaza were damaged and fragmented by tree roots. Although no text was discovered on the altar (Stela 5), an approximate date was

determined for the fragment by comparing imagery found at other nearby sites. Specifically, the k'an symbol found on one of the altar fragments matched Late Preclassic period imagery found at San Bartolo (Estrada-Belli 2019).



Figure 5.15 and 5.16: Altar fragments found in the plaza of the Watchtower complex. Photo by Kaitlin R. Ahern.

5.2.2e Summary of Findings at East Witzna

Although not individually discussed in this chapter, there were five additional excavations conducted at this complex, and they were led by Sheryl Carcuz. One of her excavations revealed a Late Preclassic period wall that lined the western side of the hill. Additionally, Sheryl Carcuz uncovered a platform located on the northern edge of the plaza. This platform was constructed during the Late Preclassic period and had stairs situated on its northern and southern sides. An excavation on the northern set of stairs recovered a large number of burnt Late Preclassic period ceramics (Arroyave 2020). Together, these excavations revealed the

northern boundary of the plaza and helped establish the defensive nature of the Watchtower complex.

The excavations conducted at the Watchtower provided all the known information regarding the site and thus were used to better understand the architectural history and modifications of the complex and plaza. The discovery of the cache in the chultun and altar enables the discussion of plaza rituals. Additionally, the burnt floors found on the various structures indicate that sections of the Watchtower complex were burnt multiple times throughout its history.

5.3 Estimated Plaza Capacity

This section draws upon the previously discussed excavation data to begin examining the size and available space in each of the plazas at Cival, Holmul, and Witzna through the use of estimated plaza capacity. As mentioned in the methodology chapter, estimated plaza capacity is an idea rooted in proxemics that states that plaza size correlates with the types of interactions and activities that occur in a plaza. Plaza capacity is obtained through both measuring the size of a plaza and analyzing the history of the site to estimate the population capacity of the plaza (Moore 1996; Inomata and Tsukamoto 2014). There are two commonly used population density estimates in the Maya lowlands for determining the culturally appropriate amount of space required for a person, and these are 0.46 m² per person and 1 m² per person (Inomata 2006; Tsukamoto 2014a). In this section, these two density estimates are used to investigate the plaza capacity and history at the sites of Cival, Holmul, and Witzna.

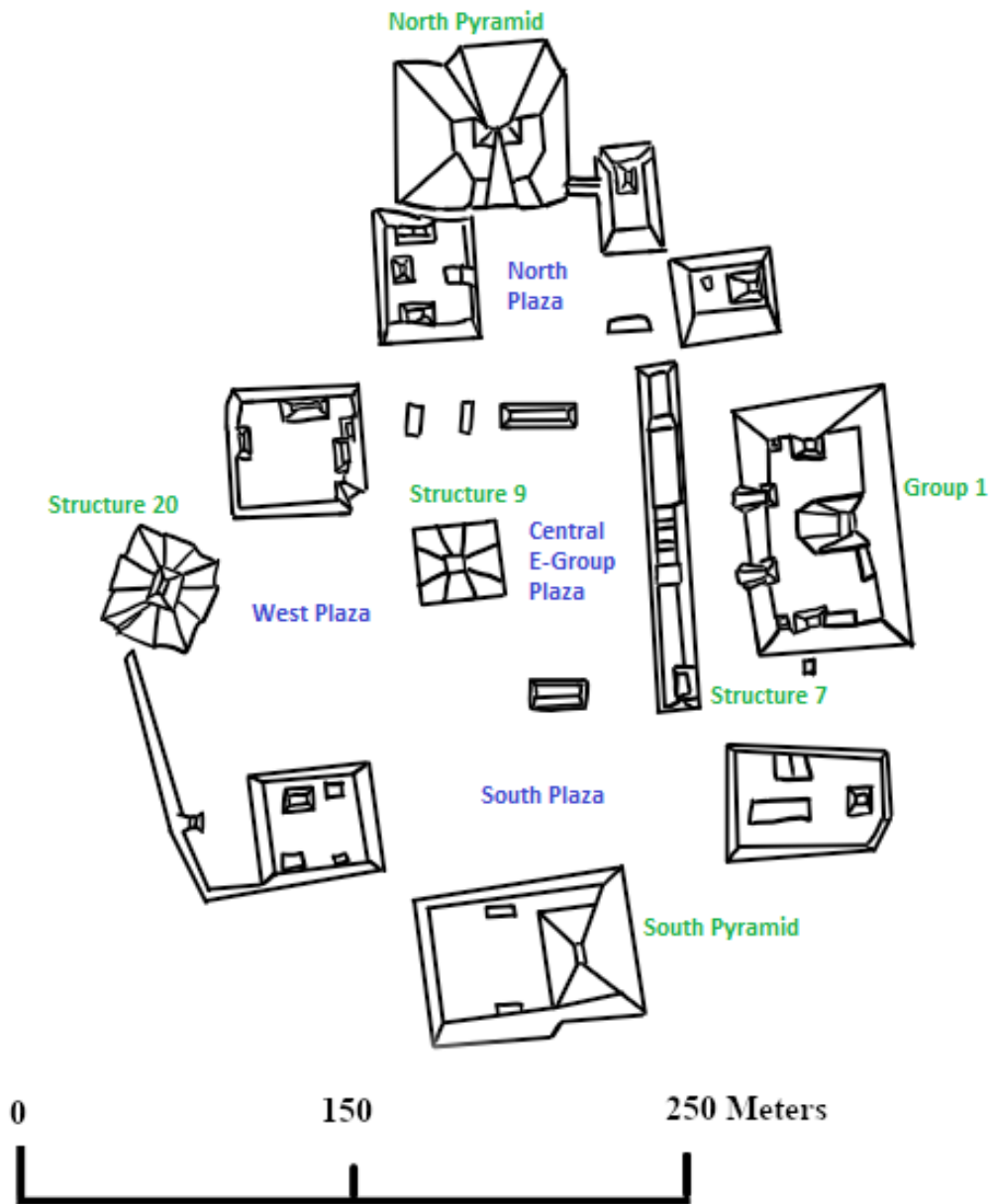


Figure 5.17: A modified image of the inner structures located in Cival's ceremonial core. The green labels represent structures, and the blue labels represent plazas. Drawing by Kaitlin R. Ahern. (After Francisco Estrada-Belli 2014).

5.3.1 Cival

Cival was first occupied during the Middle Preclassic period. By the Late Preclassic period, the city had a well-designed ceremonial center with its major structures aligned along a specific east-west and north-south axis. The first plaza was constructed in the center of the site

around 800 BCE, and it was part of a spatial pattern known as an E-Group assemblage. This spatial pattern consisted of a western radial pyramid, a central public plaza, and an eastern elongated platform that were all aligned along an east-west axis (See Figure 5.17). The Central E-Group plaza was the largest civic-ceremonial plaza erected at Cival during the Middle Preclassic period, and it had an area of 5,000 meters squared (Estrada-Belli 2011).

Cival underwent a significant site expansion around 350 BCE, which resulted in the construction of four new pyramids that were positioned to the north, east, south, and west of the Central E-Group assemblage. This expansion created three new public plazas that were placed to the north, south, and west of the E-Group plaza. To the east was Group I, and it consisted of a steep pyramidal platform that supported a triadic group and a restricted plaza. To the west was the West Plaza and Structure 20, which was a radial pyramid associated with another E-Group assemblage known as the Western E-Group. In the north was the North Pyramid with its North Plaza, and to the south was the South Pyramid and South Plaza. As mentioned in chapter 3, these four new pyramids were likely placed at a deliberate distance from the E-Group plaza. The three new plazas served to create a greater amount of public space at Cival (see Figure 5.17). Interestingly, two out of the three new public plazas were larger than the original E-Group plaza. Additionally, the West Plaza became Cival's largest public plaza with an area of 7,400 meters squared (Estrada-Belli 2017). This quadrupling of public space indicated that public plazas maintained a central role at Cival during the Late Preclassic period and provides insight into how Cival maintained its dominance throughout the region.

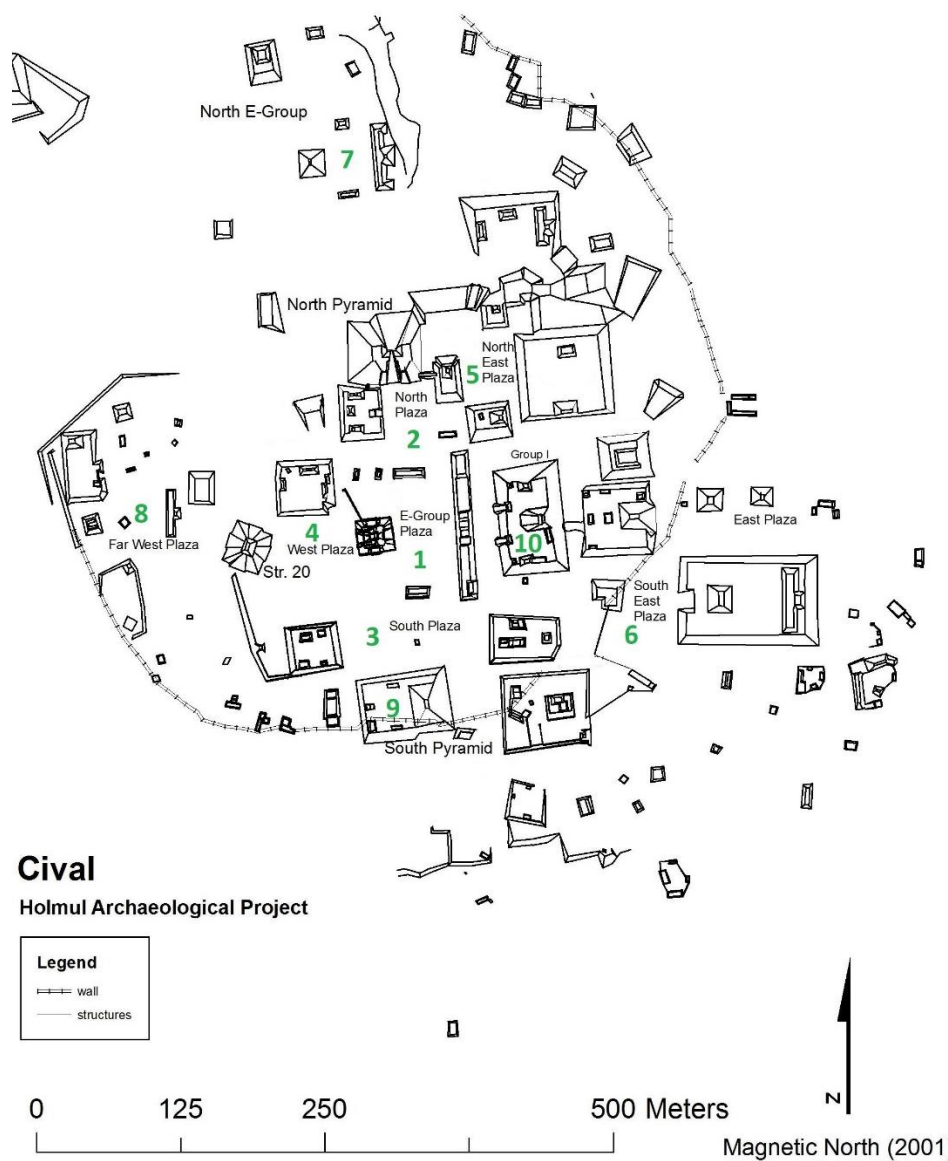


Figure 5.18: Updated map of Cival's ceremonial center that marks the location of certain plazas with green numbers. 1. Central E-Group Plaza, 2. North Plaza, 3. South Plaza, 4. West Plaza, 5. North East Plaza, 6. South East Plaza, 7. North E-Group Plaza, 8. Far West Plaza, 9. South Pyramid Plaza, and 10. Group I plazas. Map by Francisco Estrada-Belli.

The addition of the West Pyramid, or Structure 20, and the triadic group located in Group 1, transformed the Central E-Group and its plaza. The erection of Structure 20 expanded upon the Central E-Group assemblage by replacing Structure 9 as the new western radial pyramid. Structure 7 continued to serve as the eastern elongated platform, but it was lengthened to 129 m

(Estrada-Belli 2016a). Additionally, the Central E-Group plaza became the plaza for two distinct E-Groups assemblages. This Late Preclassic period construction also resulted in the creation of the West Plaza, which was located to the east of Structure 20. Due to the placement of this plaza, it was likely considered a part of the new E-Group assemblage. Thus, this dissertation proposes that the addition of the West Plaza served as an expansion to the Central E-Group plaza, which resulted in a total area of 12,400 meters squared and could accommodate an estimated population between 12,400 and 26,957.

Table 5.1: Sizes and Estimated Capacities of Plazas at Cival.

Plaza	E-W	N-S	Area (m²)	0.46 m²/person	1 m²/person
<i>Central E-Group Plaza</i>	54	92.6	5,000	10,870	5,000
<i>West Plaza</i>	162.2	45.6	7,400	16,087	7,400
<i>South Plaza</i>	105	62	6,510	14,152	6,510
<i>North Plaza</i>	47	74	3,478	7,608	3,500
<i>North East Plaza</i>	48	64	3,017	6,559	3,017
<i>South East E-Group Plaza</i>	43	61	2,623	5,702	2,623
<i>North E-Group Plaza</i>	41	53	2,173	4,724	2,173
<i>Far West E-Group Plaza</i>	30	41	1,230	2,674	1,230
<i>Total Ceremonial Area</i>				68,376	31,453
<i>Group 1 North Plaza</i>	30.5	14.5	442	961	442
<i>Group 1 East Plaza</i>	29	19	551	1,198	551
<i>Group 1 Total Plaza Area</i>			993	2,159	993
<i>South Pyramid Plaza</i>	32	31.5	1,008	2,191	1,008

During the Late Preclassic period, the Central E-Group assemblage and its plaza underwent four to five additional phases of construction. Generally, the two structures and plaza were modified as a single architectural complex, but the final phase of development only

occurred on Structure 7 and the central plaza. Previous excavations on Structure 9 at Cival revealed that the north side of the pyramid became taller and wider with each new phase of construction (Ahern and Colindres Díaz 2015). However, on the east side, the pyramid only increased in height, as the new phases of architecture were laid almost directly upon the earlier structure. This act was deliberate, and it functioned to preserve the original width of the Central E-Group plaza (Estrada-Belli 2014). It also demonstrated that there was ceremonial and ritual importance in maintaining the original size of the plaza. Around 300 – 200 BCE, a low platform was placed in the plaza in front of Structure 7, and it supported a stela depicting a king and several wooden posts. This platform in the Central E-Group plaza possibly served as a stage for performers (Estrada-Belli 2017).

5.3.2. Holmul

5.3.2a Ceremonial Core

The site of Holmul was initially occupied around 1000 BCE, but it was not until 400 BCE that monumental architecture first emerged. The first masonry buildings constructed were Building N, B, and F, and they were located in Group II. These structures were built on a basal platform, which served to restrict access to them and their small plazas. The Group II plazas began as restricted elite spaces, and they maintained their limited access throughout the site's history. This spatial contiguity indicates that the structures and plazas in this group continuously served as a location for elite activities and restricted ceremonies. Around 50 CE, the basal platform was significantly raised, which made access to Group II even more restrictive. The fourth phase of construction for Building N occurred around 150 CE and resulted in the structure being demolished and covered under a plaza floor. This modification created a new and larger

plaza to the west of Building B (Neivens 2018). The new plaza was a restricted elite space that had an approximate area of 988 meters squared.

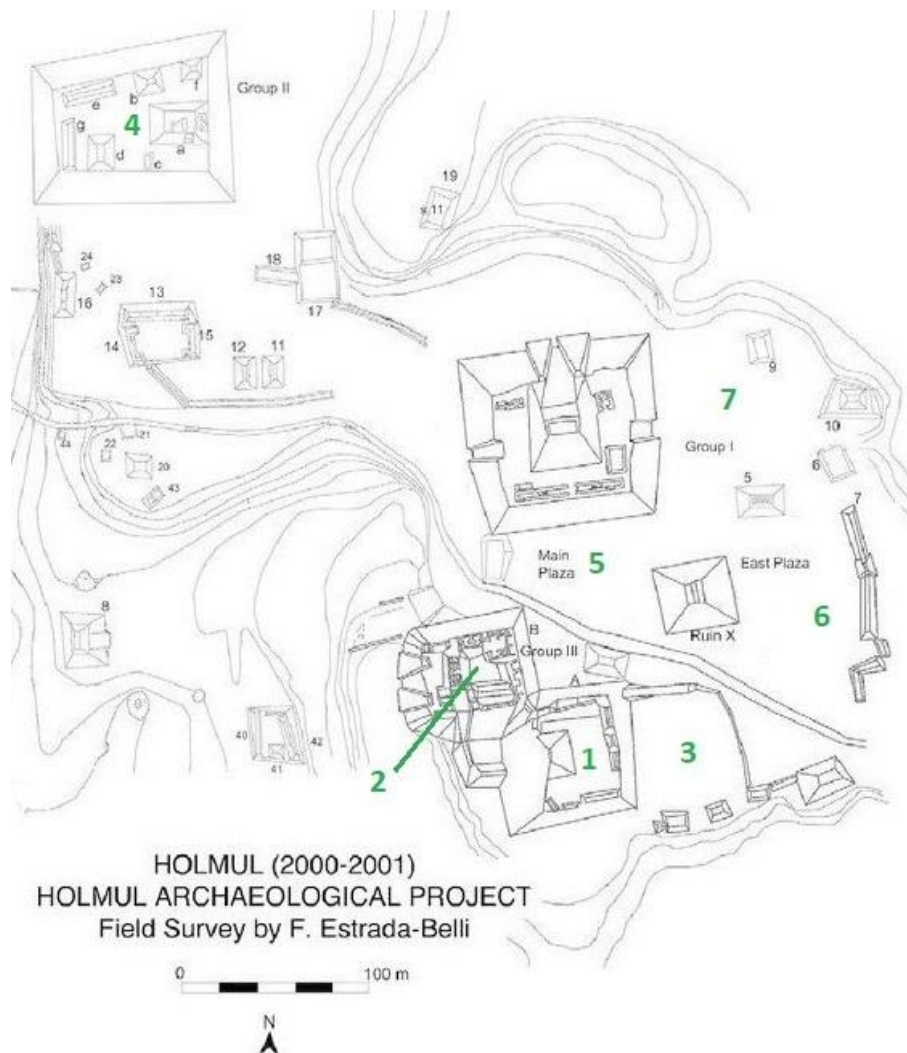


Figure 5.19: Updated map of Holmul's ceremonial core that marks the location of certain plazas with green numbers. 1. Group III Complex A plaza, 2. Group III Complex B plaza, 3. Group III public plaza, 4. Group II plaza, 5. Main Plaza, 6. East Plaza, and 7. North East Plaza. Map by Francisco Estrada-Belli.

During the Late Preclassic period, an E-Group assemblage was constructed southeast of Group I at Holmul. The E-Group plaza, known as the East Plaza, was a large public space, which had an area of 5,800 square meters. To the south of Group I was the Main Plaza. Throughout most of the site's history, these two plazas were the predominant locations for public ritual

activities. Group 1 was located on a massive platform that supported a large temple pyramid, known as Building D, and five additional structures. Group I was accessible through ascending Building D's principal staircase located to the north. Two ancillary structures, Building A and Building B faced south and overlooked the Main Plaza. Intriguingly, people standing in the Main Plaza could view rulers and elite located in and around Buildings A and B (F. Estrada-Belli, personal communication 2013).

Group III was another monumental complex, and it supported Court A and Court B. These royal courts were occupied between the Late Preclassic and Terminal Classic periods (Mongelluzzo 2011). A temple pyramid dominated the plaza at Court A, and it had an approximate area of 637 meters squared. Court B was the location of the Holmul Palace, and its only entrance was the main staircase located to the west. At the center of Court B was a sunken plaza that was surrounded by the rooms and structures in the Holmul Palace (Mongelluzzo 2011). This plaza was the most restricted space at Holmul, as it had an area of 196 meters squared. A public plaza was located at the bottom of Group III, and it measured approximately 3,009 meters squared with an estimated population range between 3,009 and 6,541.

5.3.2b La Sufricaya Complex at Holmul

Three additional plazas were located at La Sufricaya, which was a small ceremonial center and palace complex located approximately 1 kilometer from Holmul's main ceremonial center. As mentioned in chapter 3, La Sufricaya served as a royal complex for the new ruler of Holmul between 379 and 422 CE. This complex became the main center for both the new dynasty and for grand ceremonial events that occurred in its plazas. A few of these events were depicted in the murals located on the palace walls (Estrada-Belli and Tokovinine 2016). After the

death of this new ruler, the royal court and grand ceremonies returned to Group I and III in the site's main ceremonial core.

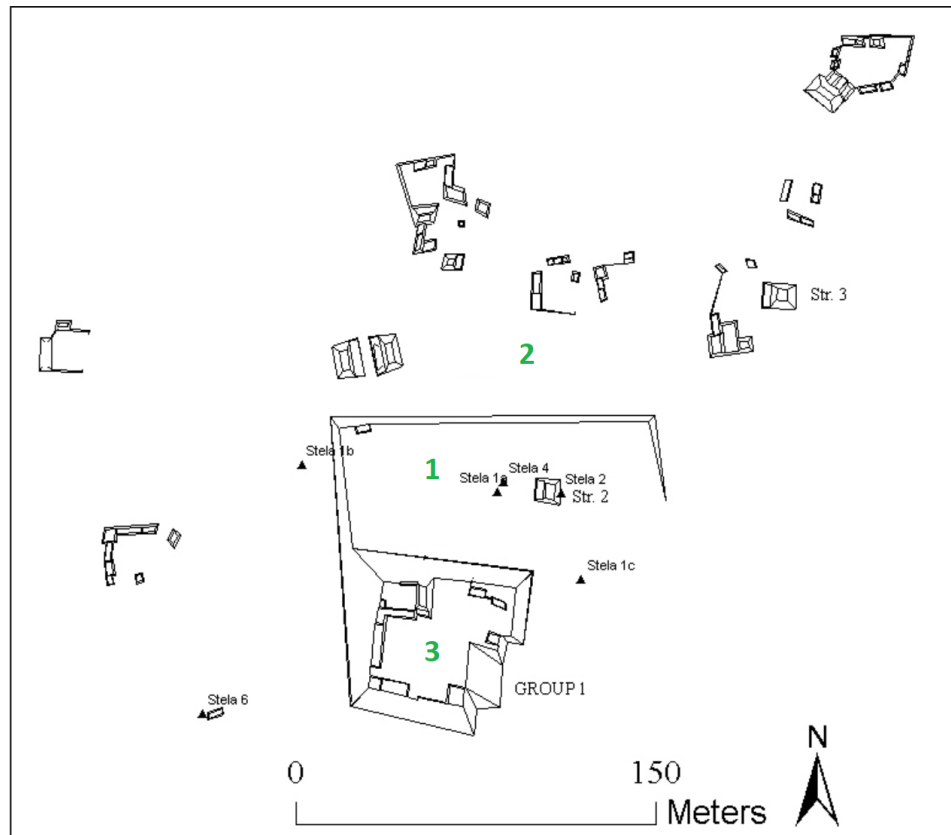


Figure 5.20: Updated map of La Sufricaya. The green numbers refer to the plazas discussed below. 1. South Plaza, 2. North Plaza, and 3. Palace Plaza. Map by Francisco Estrada-Belli.

La Sufricaya contained a sunken ball court, a pyramid, a palace complex, and two plazas referred to as the North and South Plazas (see Figure 5.20). The palace complex was located on a multi-tiered platform that was only accessible by climbing a series of staircases located to the north. The first platform contained the South Plaza, and it served as the only access point to the royal residence, or Group 1, located on the second tier. Additionally, there was an enclosed plaza located in the center of the royal residence (Estrada-Belli 2009; Tokovinine and Estrada-Belli 2015).

The South Plaza was a semi-restricted space that contained a small temple and was only accessible from its northern stairway. It had an area of 7,314 meters squared. This estimate was modified slightly to reflect the total area lost by the positioning of the small temple. The North Plaza was a public space located to the east of the sunken ball court, and it had an estimated area of 1,050 meters squared. This plaza was likely significantly larger when first constructed; however, during the Late Classic period, residential structures were built on the plaza.

Table 5.2: Sizes and Estimated Capacities of Plazas at Holmul.

Plaza	E-W	N-S	Area (m²)	0.46 m²/person	1 m²/person
<i>East Plaza</i>	64	90.3	5,800 *	12,609	5,800
<i>Main Plaza</i>	57	77	4,389	9,541	4,389
<i>North East Plaza (Group I)</i>	98	52	5,096	11,078	5,096
<i>Total Ceremonial Area (Group I)</i>			15,285	33,228	
<i>La Sufricaya- North Plaza</i>	125	42	1,050	2,282	1,050
<i>La Sufricaya- South Plaza</i>			7,314	15,900	7,315
<i>La Sufricaya Enclosed Plaza</i>	36	33	1,188	2,583	1,188
<i>Group III Complex A Plaza</i>	17	37.5	637	1,385	637
<i>Group III Complex B Plaza</i>	14	14	196	426	196
<i>Group III Plaza</i>	51	59	3,009	6,541	3,009
<i>Group II Plaza</i>	19	52	988	2,148	988

5.3.3 Witzna

5.3.3a Ceremonial Core

The site of Witzna was predominately occupied between the Early Classic and Late Classic periods. However, parts of the site were likely inhabited a bit earlier (Estrada-Belli

2016b). Since there were only two seasons of excavations conducted at Witzna, there is limited information regarding the construction history of the plazas. The main acropolis at Witzna was spread across three raised levels and contained a quadrangular palace located on the third level. This palace surrounded a small courtyard that was labeled plaza 4, and it had an area of 578 meters squared. The quadrangular palace underwent at least three phases of construction, with the first possibly occurring in the Early Classic period and two later modifications during the Late Classic period (Fialko 2005). A small number of Late Preclassic period ceramics were found in excavations outside of the palace (Estrada-Belli 2016b), which may indicate an earlier occupation of the center.

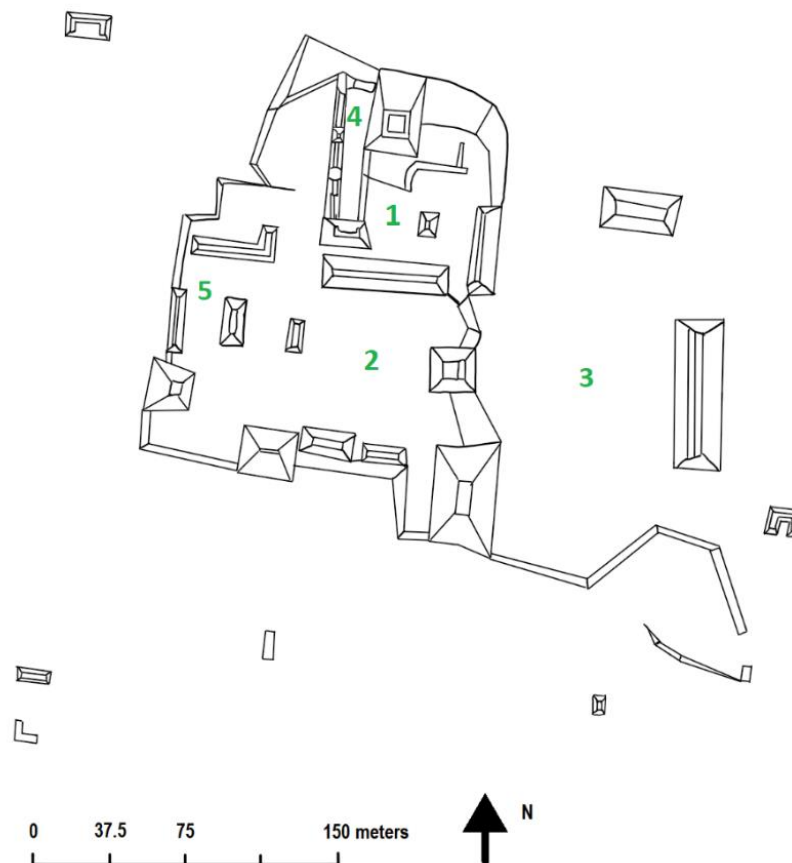


Figure 5.21: This is a map of the ceremonial core of Witzna. The five examined plazas are marked in green. 1. Central Plaza 1, 2. Central Plaza 2, 3. E-Group Plaza, 4. Palace Plaza, and 5. Plaza 5. Drawing by Kaitlin R. Ahern. (After Francisco Estrada-Belli 2019).

Central Plaza 1 was located on the second level of the acropolis and underwent at least three stages of modification and replastering. Access to this plaza was extremely restricted, and activities in the plaza were not viewable from the lower level. The plaza was approximately 1,715 meters squared. However, the total plaza area was a bit smaller as there was a small pyramid located in the middle of this plaza. Central Plaza 2 was located on the lowest level of the acropolis and experienced at least three phases of construction, one of which was a lime plaster floor (Estrada-Belli 2016b). This plaza was 3,548 meters squared. On the edge of the plaza was an offering of ceramics and 18 flint eccentrics that was placed in front of a Late Classic period structure (Perea 2016). The E-Group plaza at Witzna was the largest plaza discovered at these three sites as it measured 10,339 meters squared. Additionally, this plaza had two non-plaster floors and was either first occupied towards the end of the Late Preclassic or during the Early Classic period.

5.3.3b Watchtower

The Watchtower was located on the top of the highest hill in the Cival region, and it was part of an intriguing complex that consisted of a pyramid, known as the Watchtower, a plaza, and a long northern platform (see Figure 5.3). The plaza was bordered along its north and south edges by the Watchtower and the northern platform. The eastern boundary appears unmarked and gradually slopes downwards. Along the western edge of the plaza was a wall (Carcuz 2019) that restricted access to the plaza and complex.

During the Late Preclassic period, the plaza located in front of the Watchtower had an estimated area of 288 meters squared. By the Early Classic period, a structure was built in the plaza, and it was positioned in front of the Watchtower. This structure, or Building A, measured

8 x 6 meters and eliminated 48 meters squared from the total plaza area (Ahern 2019). Thus, Building A served to reduce the plaza size to 240 meters squared, which constricted the small space in the plaza even further. Despite the use of the plaza over a couple of hundred years, the floor was only replastered once. Additionally, the plaza floors were heavily eroded, and thus, it was impossible to determine if they were initially coated in lime plaster, as all that remained of the floors were hard-packed marl (Ahern 2019). The Watchtower complex was abandoned during the Early Classic period.

Table 5.3: Sizes and Estimated Capacities of Plazas at Witzna.

<i>Plaza</i>	<i>E-W</i>	<i>N-S</i>	<i>Area (m²)</i>	<i>0.46 m²/person</i>	<i>1 m²/person</i>
<i>E-Group Plaza</i>	72.3	143	10,339	22,476	10,339
<i>Central Plaza 2</i>	55	64.5	3,548	7,712	3,548
<i>Plaza 5 (including center)</i>	48	83	3,984	8,660	3,984
<i>Central Plaza 1</i>	49	35	1,715	3,728	1,715
<i>Palace Plaza</i>	52.5	11	578	1,255	578
<i>Watchtower, East Witzna</i>			240	522	240

5.4 Plaster Results

Thus far, this chapter has presented data on the spatial organization of these three sites, and the development of plazas and structures through time. Since one of the goals of this research is to understand the communities of practice involved in the production of plazas, this chapter now turns to a discussion of the laboratory analysis of raw materials used in construction, as a way of understanding technology, knowledge transfer, and practice on a smaller timescale. Ultimately, this examination aims to reveal social and cultural mechanisms and the experiences of people at the time of these construction episodes.

Table 5.4: Context for the lime plaster floor samples. LPC refers to the Late Preclassic period. EC refers to the Early Classic, and LC refers to the Late Classic periods.

Name	Context	Site	Period	Date Excavated	Structure	Type
Civ1	Civ.L.01.01	Cival	LPC	2007	Group I, Triadic Group	
Civ2	Civ.T.35.05	Cival	LPC	2007		
Hol1	Hol.T.15.11	Holmul		2001		
Hol2	Hol.T.71.56	Holmul	LPC	2009	Group II, Building N	Floor
Hol3	Hol.T.76.11	Holmul	LPC	2018	Group II, Building N	Platform
Hol4	Hol.T.85.02.A	Holmul	LPC	2014	Group I, Building D	Floor Fill
Hol5	Hol.T.85.02.B	Holmul	LPC	2014	Group I, Building D	Floor Fill
Hol6	Hol.T.102.08	Holmul	LPC	2018	Group I, Building 1	Stairs
Hol7	Hol.T.102.09	Holmul	LPC	2018	Group I, Building 1	Stairs
Hol8	Hol.T.102.17	Holmul	LPC	2018	Group I, Building 1	Floor
Hol9	Suf.T.51.10	Holmul - Sufricaya	EC	2007/2018		
Wit1	Wit.T.01.10.A	Witzna	LC	2004/2016	Palace	Floor
Wit1b	Wit.T.01.10.B	Witzna	LC	2004/2016	Palace	Floor
Wit2	Wit.T.13.17	East Witzna	LPC	2018	Watchtower	Floor
Wit3	Wit.T.14.06	East Witzna	LPC	2018	Watchtower	Floor
Wit4	Wit.T.14.04	East Witzna	LPC	2018	Watchtower	Floor
Wit5	Wit.L.21.01	East Witzna	LC	2018	Structure 9	Floor
Wit6	Wit.L.21.02	East Witzna	LC	2018	Structure 9	Floor
Wit7	Wit.T.11.11	East Witzna	LC	2018	Structure 2	Floor

This project examined 19 lime plaster samples from the ancient Maya sites of Cival, Holmul, and Witzna. Two of the plaster samples were acquired from Cival, nine from Holmul, and eight plaster samples came from Witzna. The majority of these plaster samples were taken

from plaza and platform floors. However, two of the samples (Hol6 and Hol7) were taken from the staircases of two different phases of construction for a platform located in Group I at Holmul. The Cival samples and all but one of the Holmul plaster samples dated to the Late Preclassic period. The Witzna floor samples dated between the Late Preclassic and Late Classic periods.

Although I had fully intended to obtain an equal number of samples from all three sites, I was unable to analyze more than two samples from Cival for various reasons. First, the Holmul Archaeological Project had not excavated at Cival since 2014, and thus, no new samples could be acquired for this project. Second, all but two of the Cival plaster samples in the project's laboratory were painted mural fragments that were previously examined by Caitlin O'Grady and Heather Hurst (2009). Thus, I decided only to analyze the two unexamined floor samples and use Hurst's investigation to contextualize these findings.

As mentioned above, there were prior investigations of lime plaster samples from the sites of Cival and Holmul. These studies generally differ from this examination as they focused on murals, which served as canvases of art that were coated in pigment and stucco. This project examines plaza floors, which were more utilitarian as they served as a protective medium against helminths, insects, and rain (Abrams 1994). Despite their differences in function, both murals and floors were composed of lime plaster. Thus, these investigations into the composition of murals can significantly contribute to the understanding of other lime plaster surfaces, such as floors.

The first mural investigation in the region was conducted in 2003 when Alberto Semeraro analyzed seven samples acquired from the murals at La Sufricaya (Estrada-Belli 2004). In 2009, Heather Hurst completed her dissertation on lowland Maya murals and the techniques and artisans required to create them. Heather Hurst and Caitlin O'Grady examined 70 mural samples

from the sites of Holmul and La Sufricaya, San Bartolo, and Cival. These samples were primarily examined under the microscope, but some underwent further examination with portable XRF (Hurst 2009). Only 36 of these samples are relevant to this study, and these are the 12 samples from Cival and the 24 samples from Holmul and La Sufricaya. The samples from Cival came from a series of murals located in Structure 1, which was the central building in Cival's triadic group. The majority of the samples from Holmul came from the La Sufricaya palace murals, which were constructed during the Early Classic period, but Hurst (2009) also examined a mural located at Group II in the ceremonial core of the site.

In this section, the plaster samples are organized by site, and each of these three subsections includes a brief description of the mineral and chemical composition of the samples. Since the floor samples were from the same region, their chemical composition was very similar. Thus, this section also discusses the unique inclusions discovered in the plaster samples at each site and conducts a basic analysis regarding their possible connection with prior studies. Additionally, Heather Hurst's (2009) conclusions are referenced to better contextualize the findings of the lime plaster samples at Cival and Holmul. The final subsection discusses the commonalities between the lime plaster samples from across the three sites, such as the primary aggregates and the inclusion of organic material.

5.4.1 Cival

As mentioned above, this project only examined two plaster floor samples from Cival. Thus, this section incorporated some of Heather Hurst's (2009) findings to provide a more comprehensive understanding of the site's lime plaster technology. These two-floor samples were produced at an unknown time during the Late Preclassic period and contained micrite

calcite as the primary aggregate. Some of the less common minerals found in these plaster samples included carbon and plagioclase feldspar, which was found in sample Civ2.

Sample Civ1 was significantly less processed than sample Civ2 as it contained multiple pieces of carbon, which indicates that the limestone was poorly burnt during lime plaster production (Hansen 2000). Additionally, Civ1 lacked a clear demarcation between the fine-and coarse-plaster layer. According to Eric Hansen's (2000) findings, there are always two separate layers of plaster, but occasionally, it can be challenging to distinguish between the fine-and coarse-plaster layer. Civ2 was well-sorted and well-processed.

Heather Hurst (2009) mural samples were produced around 200 BCE. She found the Late Preclassic period lime plaster samples from Cival to be well-sorted and well-processed. The samples contained microcrystalline quartz and sub-rounded particles of iron. She also discovered barite in the samples (Hurst 2009), and this finding is discussed in further detail during the examination of lime plaster samples from Holmul.

5.4.2 Holmul

This project examined nine plaster samples from the site of Holmul and all, but one of them date to the Late Preclassic period. The floor samples were predominately obtained from Group I and II at Holmul. The exact date of these samples is unknown, but a temporal range was determined from their stratigraphy.

The majority of the samples contained micrite calcite as the primary aggregate. The second most common aggregate was quartz, which was found in samples Hol2, Hol3, Hol4, Hol5, and Hol6. Some of the less common minerals found in the samples included plagioclase feldspar (samples Hol5, Hol7), zircon (samples Hol1 and Hol7), and alkali feldspar (samples

Hol6 and Hol7). Additionally, two of the samples (sample Hol2 and Hol9) contained chunks of unprocessed micritic limestone that contained peloids (See Figure 5.25). As an aside, peloids are allochemical components, or allochems, which is the term for organized aggregates of carbonate or non-skeletal grains located in limestone (MacKenzie and Adams 1994; Scholle and Ulmer-Scholle 2003).

The Late Preclassic period plaster samples at Holmul generally had a normal sorting and were well-bound, except for samples Hol2 and Hol9, which were composed of poorly sorted matrices. In general, the Holmul samples were not well-processed as carbon particles were found in almost all of the plaster samples, except for Hol1 and Hol4, which suggests that the technology of producing lime plaster was still developing.

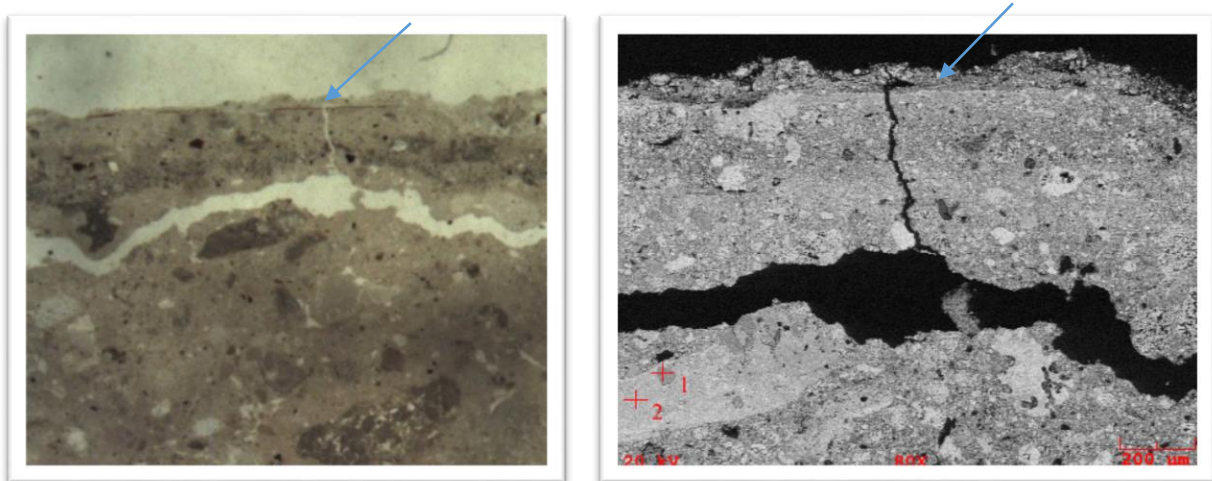


Figure 5.22 and Figure 5.23: Both images show the location of the red line on sample Hol4. Figure 5.22 was an image taken with optical microscopy and has a 2x zoom. Figure 5.23 was taken with SEM-EDS. Both images by Kaitlin R. Ahern.

Three of the samples (sample Hol4, Hol5, and Hol7) were discovered to contain a thin red line located in the fine-plaster layer. These lines were determined to be a layer of red-painted plaster that was subsequently covered over when the surface of the floor was replastered. As

previously mentioned, the ancient Maya often applied additional layers of plaster and washcoats to various surfaces as acts of maintenance. Since these three samples dated to the Late Preclassic, they serve to confirm the presence of painted floors and platforms at Holmul during this period. This discovery may also indicate that the other floor samples examined in this study were also replastered. However, the evidence of this practice was worn away by the heavy use of these floors.

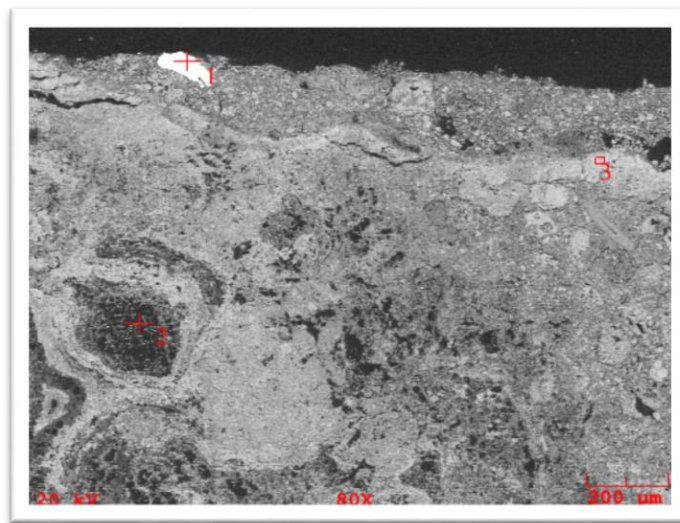


Figure 5.24: Barite located in the thin-plaster layer of sample Hol2. This image was taken with SEM-EDS. Image by Kaitlin R. Ahern.

Additionally, four of the Late Preclassic period Holmul samples (Hol2, Hol6, Hol7, Hol9) contained grains of the mineral barite, which was identified by both optical microscopy and through SEM-EDS. Barite was previously discovered in lime plaster samples acquired from Late Preclassic period murals from the sites of Cival and San Bartolo. These prior investigations had found barite in the fine-plaster layer of various mural samples and an absence of the mineral in the coarse-plaster layer (Hurst 2009). In 2009, Heather Hurst (2009) examined plaster samples from Holmul, but she discovered no barite grains in the Late Preclassic period mural samples. She also did not find any barite in the Early Classic period murals samples acquired from the

minor center of La Sufricaya. Although barite is commonly found in vein fillings in limestone, there is evidence to suggest that there was a practice of adding the mineral to lime plaster. This potential practice and its implications are further discussed in chapter 6.

5.4.3 Witzna

A total of eight plaster samples were examined from Witzna and East Witzna. Three of these samples (samples Wit2, Wit3, and Wit4) were produced during the Late Preclassic period and were associated with the Watchtower located in East Witzna. The remaining five samples dated to the Late Classic period and came from both Witzna and East Witzna. Interestingly, all but one of the samples were burnt.

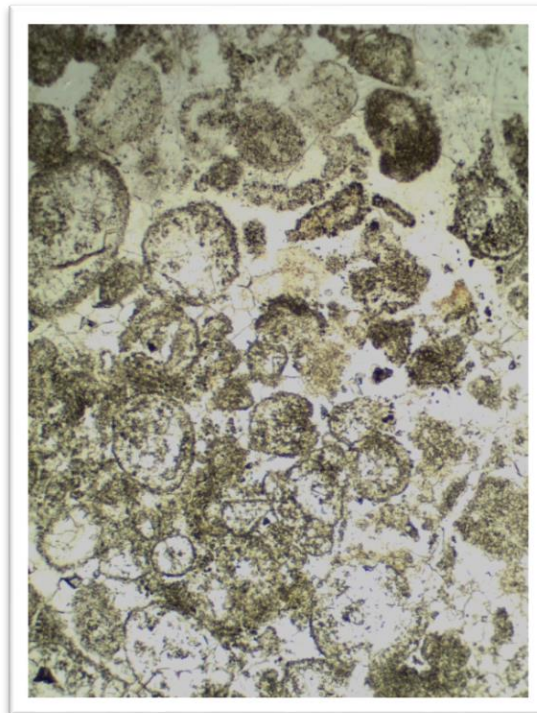


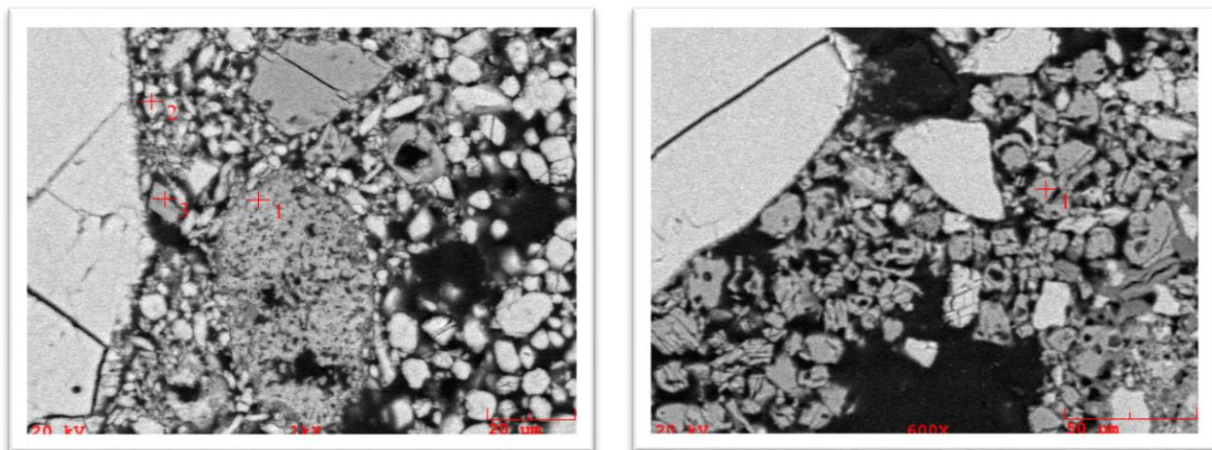
Figure 5.25: Image of peloids in sample Wit3 with a 4x zoom. Image by Kaitlin R. Ahern.

The Watchtower samples (Wit2, Wit3, and Wit4) primarily contained crystalline calcite aggregates. The remaining samples from East Witzna were discovered to have aggregates mostly composed of micritic calcite. Interestingly, the plaster samples (Wit1, Wit1b, and Wit7) from Witzna had a mixture of both calcareous materials. The second most common type of aggregate was quartz, which was found in sample Wit1, Wit1b, Wit2, and Wit6. The coarse-plaster layer of samples Wit2 and Wit3 contained large inclusions of limestone. Additionally, sample Wit3 was composed of large aggregates of carbonate material that contained sascab and peloids surrounded by micrite cement.

These samples also contained plagioclase feldspar (sample Wit4 and Wit6) and carbon (sample Wit3 and Wit5). Some of the less common minerals discovered in these samples were zircon (Wit6) and iron oxide (sample Wit6). The majority of the Late Preclassic and Late Classic period plaster samples were poorly mixed. The best-sorted samples were produced at East Witzna during the Late Classic period and had normal-to-well sorted matrices. Additionally, one of the Late Preclassic period samples from the Watchtower had a matrix that was normally sorted.

The mineral dolomite was discovered in two of the lime plaster floor samples (Wit4 and Wit6). The dolomite grains were located in the matrix of the coarse-plaster layer and were intermixed with calcite (see Figure 5.26). Both of these plaster samples were from East Witzna, but one dated to the Late Preclassic (Wit4) and the other to the Late Classic period (sample Wit6). These dolomite grains were only identified with SEM-EDS. Unfortunately, it is nearly impossible to distinguish dolomite and calcite from one another with an optical microscope unless conducting particular tests that generally involve staining the thin section.

Intriguingly, dolomite was not identified in the remaining samples from East Witzna. There were also no dolomite grains found in the fine-plaster layers of sample Wit4 and Wit6. Thus, it is plausible that these samples were predominately made of calcite and only contained a small percentage of dolomite. Another explanation is that dolomite was intentionally added to the plaster as an aggregate. The most likely explanation is that the local limestone outcrop at East Witzna had some percentage of dolomite. Since there is currently no information available about the chemical composition of the limestone outcrops at East Witzna, additional research should focus on locating potential limestone quarries at the site to identify their chemical composition.



Figures 5.26 and 5.27: The first image is from sample Wit6. In these images, the dolomite grains appear grayer than the calcite. The red 1-3 refers to EDS reports that determined that 1 and 2 are calcite, and 3 is dolomite. The second image (to the right) is from sample Wit4, and it shows significantly more dolomite located in the matrix than sample 18. The red 1 illustrates one of the locations of dolomite. Both images by Kaitlin R. Ahern.

5.4.4 Similarities between the Samples

There were some common characteristics as well as variations in the lime plaster samples acquired from the three centers of Cival, Holmul, and Witzna. These similarities were likely enhanced by the proximity of the sites and the geography of the region. Due to the limited number of samples from Cival, most of the overlapping plaster samples came from Holmul and

Witzna. However, the principal aggregate used in all of the 19 plaster samples were composed of various forms of limestone, such as micrite calcite. This discovery is consistent with previous examinations of lime plaster in the Maya lowlands as these prior studies determined that the most common aggregates in this area were limestone, clay, and sand (Hansen 2000; Littmann 1958). Additionally, portable XRF analysis identified minute levels of barite in all of the plaster samples taken from Cival, Holmul, and Witzna. This discovery strongly indicates that the various sources of bedrock located in this region contained small traces of barite. However, as mentioned above, grains of barite were only discovered in four of the Late Preclassic period samples.

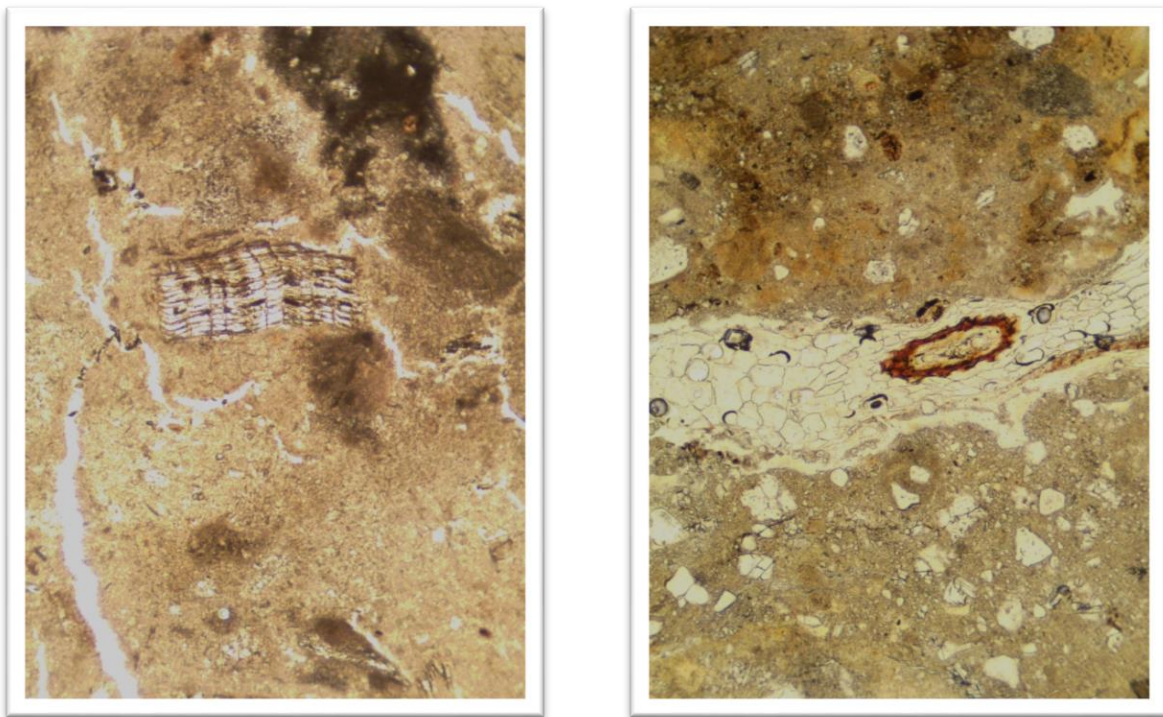


Figure 5.28 and Figure 5.29: The first image shows the organic material discovered in sample Hol3. The second image (to the right) is from sample Wit6. Both images are 10x. Both of the images were taken by Kaitlin R. Ahern.

Organic material was found in four of the plaster samples (Hol3, Hol9, Wit6, and Wit7) obtained from Holmul and East Witzna. As mentioned in chapter 4, the ancient Maya used an assortment of organic and inorganic additives in their production of lime plaster. The plant material found in three of these samples (Hol3, Hol9, and Wit7) were isotropic and were found in carbonate grains. In 2009, Isabel Villaseñor also discovered isotropic plant remains in the carbonate grains used as aggregate in the lime plaster at Calakmul. These grains were determined to be reworked carbonate deposits as similar remains were found in the sascab samples taken from the site and thus, were determined not to be additions to the plaster (Villaseñor 2009). Due to the similarities with the current samples, this dissertation also proposes that the plant remains found in samples Hol3, Hol9, and Wit7 were not additions to the plaster. The final sample (Wit6) had organic material located in a crack separating the fine-and coarse plaster layers. Since this plaster sample was situated only under a couple of centimeters of earth, it is entirely plausible that the organic material was from the remains of roots.

5.5 Summary

This chapter presented all of the data obtained for this project, which included excavations, estimated plaza capacity, and the archaeometric examination of lime plaster samples through optical and petrographic microscopy, SEM-EDS, and pXRF. This data provided insight into both plaza size and capacity and resulted in a better comprehension regarding the quality of the lime plaster samples. In chapter 6, this data is thoroughly examined and utilized to provide a broader understanding of plazas and practice in the Cival region.

CHAPTER 6

Plaza and Plaster Analysis

6.1 Introduction

This chapter discusses the implications of plaza capacity analysis and lime plaster examination at the sites of Cival, Holmul, and Witzna with the intention of better understanding the development and maintenance of public plazas and ceremonial centers. A common feature between all three sites was the early occurrence of E-Groups assemblages and their plazas, which served as the largest public space at each of these centers. Thus, the chapter begins by proposing that E-Group plazas served as essential locations for early public spaces where communities conducted rituals and commemoration. However, before elaborating on the role of these early plazas, it is critical to first discuss the origins of these assemblages and highlight the standardization of the E-Group pattern in both the Cival region and in the Maya lowlands. Afterwards, the next section explores the inferences for each of the three sites by discussing significant findings regarding plaza capacity and lime plaster. The plazas are then examined through the lens of proxemics and are divided into groups based on size. Finally, this chapter compares and contrasts the findings at each site to better understand the unique trajectory that shaped these three centers.

6.2 E-Groups and Public Plazas

Early E-Group assemblages emerged during the Middle Preclassic period from a shared and standardized spatial plan that was created through interregional interaction between multiple Mesoamerican groups (Inomata 2017). This highly standardized spatial plan was referred to as

the Middle Formative Chiapas (MFC) pattern, which consisted of a north-south arrangement of several low platforms and an E-Group assemblage (Agrinier 2000; Lowe 1981; Inomata et al. 2013). Takeshi Inomata (2017) proposed that the original emphasis on the north-south axis in the MFC revolved around aligning structural viewpoints with the location of mountains to the north. The MFC pattern was developed across an interactive Mesoamerican sphere that included the Pacific Coast, Chiapas, the Gulf Coast, and the Maya lowlands. A few of the archaeological sites that are recognized as having the MFC pattern include Mirador, Tzutzuculi, La Libertad, and San Isidro (Agrinier 2000; Inomata et al. 2013).

Additionally, there was another variant of the MFC, which is the MFU, or the Middle Formative Usumacinta pattern. This new architectural pattern was recently discovered in the Maya lowlands at a series of neighboring sites located along the Usumacinta River in Mexico. The earliest example of this MFC variant was constructed around 1000 BCE at the newly excavated site of Aguada Fenix (Inomata and Triadan 2018). Unfortunately, there is limited information on both the MFU and on Aguada Fenix, as nothing has currently been published.

The first and potentially only MFC assemblage emerged in the Maya lowlands around 1000-900 BCE at the site of Ceibal (Inomata 2017). Around 800 BCE, the site of Cival became the earliest known ancient Maya site to disregard all of the other aspects of the MFC except for the E-Group assemblage. This modification to the MFC pattern resulted in the widespread adoption of E-Group assemblages across the Maya lowland (Inomata 2017). Over time, new traditions and additional variations of the E-Group pattern were adopted, such as the Cenote-style E-Group and the Uaxactún-style E-Group assemblage. Both of these variants contained a distinct arrangement of the three structures located along the eastern elongated platform (Chase and Chase 1995, 2017). The eastern triadic assemblages in Belize may also be a variation of the

E-Group assemblage, or it may be a distinct complex with a local origin (Awe, Hoggarth, and Aimers 2017). All of these variations of the E-Group included a public plaza.

E-Groups assemblages were not a static tradition but changed extensively throughout the Preclassic and even Classic periods. Thus, their function, symbolism, and structural components changed throughout time and across sites (Aveni, Dowd, and Vining 2003). They also served as multifunctional spaces (Doyle 2012). Takeshi Inomata (2017) proposed that until 700 BCE, the construction of the MFC pattern and E-Group assemblages at sites in the Maya lowlands likely symbolized participation in a broader cultural practice that connected them across the larger region of Mesoamerica. After this period, E-Groups assemblages may have represented a tie to the past (Inomata 2017) or obtained new and localized meanings.

Traditionally, E-Group assemblages were believed to be static solar observatories where during special astronomical events, such as equinoxes and solstices, one could stand on the western radial pyramid and observe the sun rising over one of three structures located on the eastern elongated platform (Blom 1924; Ricketson 1928). The first example of an E-Group assemblage functioning as a solar observatory was discovered at Uaxactún (Blom 1924; Ricketson 1928). However, over time, researchers realized that these architectural assemblages were much more complicated. There are at least six possible functions for E-Groups ranging from solar observatories with astronomical alignments (Aveni 1975; Aveni and Hartung 1989) and use in geomancy systems (Coggins 1980) to locations for agricultural ritual (Awe, Hoggarth, and Aimers 2017). Due to the widespread temporal and spatial distribution of E-Group assemblages, each of these theories can be applied to multiple E-Group complexes located across the Maya lowlands. These explanations were primarily developed to determine the use of the final architectural phases of E-Groups, which resulted in the limited discourse surrounding the

early applications for these assemblages. Thus, this section focuses on the earliest role of these E-Groups assemblages and views their plazas as public ceremonial locations.

During the early Middle Preclassic period, the Maya lowlands were inhabited by multiple groups and communities with differing levels of mobility and sedentism. There was only a small range of communities that had formal ceremonial complexes of substantial size (Inomata et al. 2015), which included early public plazas and a small number of E-Group assemblages. These centers were constructed by sedentary and mobile groups from the surrounding region – who ultimately participated in public ceremonies in these plazas. The local engagement in these public ceremonies served to socially integrate diverse groups of people into a broader community around these early city centers (Inomata et al. 2015), such as seen at Ceibal. A similar process also occurred at the site of Cival (Estrada-Belli 2016a) and on a smaller scale at Holmul (Neivens 2018).

Specific E-Group assemblages served as ceremonial, religious, and political centers throughout the Middle and Late Preclassic periods. Laporte and Fialko (1990) proposed that some E-Groups and their plazas, such as at Mundo Perdido in Tikal, served as locations where political, funerary, and ceremonial displays and rituals were performed in a publicly accessible area or plaza. Additionally, they suggested that Tikal's E-Group assemblage was utilized to express the legitimization of the site's rulers and that it served as a public stage, which was used to explain the structural order of the universe (Laporte and Fialko 1990).

As mentioned in chapter 3, elaborate caches were found along the east-west axis of the E-Group assemblages at the centers of Ceibal and Cival. During the Middle Preclassic period, greenstone caches were placed at Ceibal and Cival. Towards the end of the Middle Preclassic period, there was a shift from greenstone caches to sacrificial burials, ceramics, and obsidian

offerings, which further reinforced the continued ritual and political importance of these plazas. By the Late Preclassic and Early Classic period, E-Group plazas also became locations for erecting stelae (Estrada-Belli 2017; Aimers and Rice 2006), which highlighted their continued ritual importance. Stelae were also found in the E-Group plazas at the three centers of Cival, Holmul, and Witzna.

The large number of offerings, caches, and burials located in the various E-Group plazas were likely symbolic of the ritual and eventual political purposes of these complexes. The variety of offerings insinuates that these locations and the structures built beside them were places that contained great spiritual, ritual, and political significance. Chase and Chase (1995) proposed that the symbolic importance of these E-Group assemblages resulted in their designation as social focal points, which functioned as locations where elites and rulers bid for political power. Thus, these centers were subjected to displays of various rituals through attempts to secure prestige by both rulers and elites.

6.3 Cival

During the early Middle Preclassic period, Cival was actively involved in interregional interaction with the broader Mesoamerican region as it adopted selective elements of the MFC, such as the E-Group assemblage and the depositing of greenstone or jadeite into cruciform caches. However, the site also rejected other components of the Middle Formative Chiapas pattern, like the structures located on the north-south axis. Additionally, Cival was potentially the first site in the Maya lowlands to construct just the E-Group portion of the MFC. Thus, Cival was an active participant in the widespread adoption of the E-Group assemblage throughout the Maya lowlands.

However, it remains unclear why Cival and other Middle Preclassic period sites, such as Tikal, only adopted the E-Group portion of the MFC. Inomata (2017) provided a couple of potential explanations regarding local traditions and perceptions of space. First, Inomata mentioned the ancient and modern Maya preference for the east-west alignment. Thus, he proposed that the ancient Maya rejected the north-south axis of the MFC because it was not a valuable directionality in the Maya lowlands (Inomata 2017). Instead, the ancient Maya prioritized the east-west axis found in the E-Group assemblage, as it followed the path of the sun. Second, he suggested that the configuration of the E-Group assemblage better aligned with preexisting local concepts of space, such as an early emphasis on large public plazas (Inomata 2017). Both of these factors likely contributed to the selective adoption of the E-Group component of the MFC.

The first E-Group assemblage at Cival was the Central E-Group complex. This E-Group was possibly the first example in the Maya lowlands, where the population prioritized the maintenance of the initial plaza size throughout its constructive history. The E-Group assemblage known as Mundo Perdido at Tikal was also reported to have preserved its original plaza space (Laporte and Fialko 1995). This phenomenon is also found in other parts of Mesoamerica, as archaeologists recently discovered the intentional preservation of plaza size in the plaza located in front of the Pyramid of the Moon (Sugiyama and Cabrera 2007; Murakami 2014).

During the Late Preclassic period (350 BCE – 0 CE), twelve additional E-Groups assemblages were developed in the Cival region, and each underwent the same initial construction process as the Central E-Group, as the new architectural complexes were built directly on or into the bedrock. Additionally, each of these new E-Groups assemblages had a fixed plaza width, which meant that the initial size of the plaza was largely maintained

throughout the site's history (Estrada-Belli 2017). Four of these new E-Groups assemblages were constructed at Cival, thus making it the only known site to contain five E-Group complexes. The remaining eight E-Groups were built at secondary centers in the Cival region, such as Holmul and Dos Aguadas. Recently, all thirteen E-Groups in the Cival region were determined to align with various astronomical events, such as the equinoxes and solstices. Thus, they most likely served as solar observatories during the Late Preclassic period. Francisco Estrada-Belli (2017) also discovered that some of these E-Groups had overlapping sightlines with nine hills located to the east of Cival. Interestingly, the E-Group assemblage at Dos Aguadas had a sightline on the Watchtower. However, it was the only site to align with the Watchtower hill (F. Estrada-Belli, personal communication, 2018). Due to the similarities in the form, alignment, and initial construction of these thirteen E-Groups, it appeared that these secondary centers were politically and ritually connected to Cival (Estrada-Belli 2017).

Francisco Estrada-Belli (2017) proposed that during the Middle Preclassic period in the Cival region, the Central E-Group assemblage and its plaza was constructed by the semi-nomadic groups and populations located throughout the area. He suggested that during the Late Preclassic period, there were regionally hosted ceremonies and potentially even a rotation among the largest E-Group assemblages for hosting ritual events (Estrada-Belli 2017). According to a rough population estimate, Cival likely had a population range between 2,000 and 5,000 individuals during the Middle Preclassic period (Estrada-Belli 2011). During this period, the Central E-Group plaza could accommodate between 5,000 and 10,000 people. Thus, there was ample room in the plaza for sedentary and semi-nomadic people from across the region to come together and participate in extensive ceremonial rituals at Cival.

During the peak of the Late Preclassic period, approximately 10,000 people were living in the vicinity of Cival (Estrada-Belli 2016a). As the city only required a public plaza with the capacity for 10,000 people, the Central E-Group plaza was the ideal size to accommodate the site's population. However, by the Late Preclassic period, Cival's ceremonial core consisted of the Central E-Group plaza and the North, South, and West Plazas, which together could accommodate an estimated 48,717 people. Since there was an apparent abundance of space in these public plazas, Cival continued to host participants from the neighboring sites in the region. Additionally, certain public plazas in the ceremonial center were likely associated with specific ritual activities and events.

At Cival, the construction of Group I, or the triadic group, during the Late Preclassic period marked the development of private, elite space at the site. The emergence of kings at Cival accompanied this shift in plaza type. Despite the introduction of private, elite space, the amount of public space also increased during this transition, as seen with the expansion of the Central E-Group plaza via the construction of the Western E-Group. The emergence of new public plazas indicated that the people of Cival placed a strong emphasis on open places that could accommodate both the local and regional population. Additionally, the population capacity of these public plazas strongly supports the assertion that during the Late Preclassic period, Cival had become the main ceremonial and political center in the region (Estrada-Belli 2011, 2016). Cival's prominent position also shaped architecture and ceremonialism throughout the region.

6.4 Holmul

The site layout of Holmul is strikingly different from Cival. During the Middle Preclassic period, the people of Cival cleared and leveled a 500 m by 500 m area to build the center's

ceremonial core (Estrada-Belli 2011). This monumental undertaking permitted considerably more site planning and the construction of large public plazas. Cival had plenty of open space available for its population and the neighboring sites, such as Holmul, especially during the Late Preclassic period. At Holmul, the inhabitants only began leveling selective areas of the site around the start of the Late Preclassic period, such as seen in Group II, and this resulted in a lack of level areas to construct large public plazas during the Classic period. Additionally, the ceremonial core of Holmul lacked a defined open or public plaza until the Late Preclassic period and the construction of several public plazas in Group I. After the Preclassic period, no new public plazas were constructed in the ceremonial core of Holmul.

Although the largest plazas at Holmul appeared sizable, they were comparatively smaller than the other Classic period sites previously examined via plaza capacity studies (Inomata 2006; Tsukamoto 2014a, 2014b). For example, the largest public plaza at El Palmar had an area of 14,135 meters squared (Tsukamoto 2014a). At Copan, the largest public plaza was 12,747 meters squared, and at Aguateca, it was 11,456 meters squared. The largest single plaza at Tikal was the area in front of Temple VI, which was 25,963 meters squared (Inomata 2006). Although there are larger plazas at Tikal, they were not mentioned here as they incorporated adjacent space to the plaza, such as causeways. Even though Holmul lacked a public plaza that measured over 10,000 square meters, the site had several medium-sized plazas that surrounded the main structure in Group I. These plazas included the E-Group Plaza, the Main Plaza, and the North East Plaza. The combined population capacity of these plazas ranged approximately between 15,285 people to 33,228 people with a total area of 15,285 meters squared. Holmul's largest plaza was located at the nearby ceremonial center of La Sufricaya, which had a total area of 7,314 meters squared.

To better understand the unique characteristics of Holmul's public places, it is essential to examine the period in which the major plazas at Holmul were constructed. Public plazas built during the Middle and Late Preclassic periods tend to be smaller than plazas first constructed during the Classic period. The earliest plaza at Tikal was erected during the Middle Preclassic period in Tikal's E-Group assemblage, which is known as Mundo Perdido. During the Late Preclassic and Early Classic periods at Tikal, the Great Plaza and the adjacent East and West plazas were constructed. The Great Plaza measured 8,506 m², and the East Plaza measured 6,969 meters squared (Inomata 2006). Takeshi Inomata's (2006) calculations for the West Plaza at Tikal incorporated the large area in front of Temple III as part of the estimate, which gave it a total area of 22,918 meters squared. However, if you only examine the area of the West Plaza, it appears to have a total area that was similar to the other Late Preclassic period plazas. At El Palmar, the Central Plaza was also constructed during the Late Preclassic period, and it had a size of 6,674 meters squared (Tsukamoto 2014a). Thus, three of the four Preclassic period plazas analyzed during previously estimated plaza capacity studies are comparable in size (Inomata 2006) to the plazas built at Cival and Holmul during the same period. The Preclassic period public plazas examined in the dissertation all range in size between 4,000 to 8,500 meters squared. The low estimate of this range is based on the size of the Main Plaza at Holmul, which is 4,389 meters squared. The higher estimate is based on the size of the Great Plaza at Tikal, which measures 8,506 meters squared (Inomata 2006). This proposed range of Preclassic period public plazas sizes may differ from plazas constructed during the Classic period due to the lower population estimates commonly associated with the Preclassic. Additionally, it is plausible that these medium-sized plazas were also a more suitable size to accommodate the surrounding community during the Preclassic period.

Table 6.1: This table depicts the Late Preclassic period plaza measures from Tikal and El Palmar.

Site	Plaza	Size	Source
<i>Tikal</i>	Great Plaza	8,506 m ²	Inomata 2006
<i>Tikal</i>	East Plaza	6,969 m ²	Inomata 2006
<i>El Palmar</i>	Central Plaza	6,674 m ²	Tsukamoto 2014a

During the Classic period, there were no new public plazas constructed in the ceremonial core of Holmul. This stagnation was plausibly a result of Cival's early hegemony in the region. Since Cival had ample space in its Central E-Group plaza, it is feasible that during the Middle Preclassic period, the villagers located in the vicinity of Group II at Holmul traveled to Cival to engage in certain types of ceremonial events. By the Late Preclassic period, Cival was the dominant site in the region and had significantly expanded the number of public plazas in its center. Although Holmul constructed multiple public plazas during the Late Preclassic period, residents likely continued to travel to Cival for specific events. Thus, early access to Cival's plazas potentially restricted the need for Holmul to construct additional public plazas that could eventually accommodate the influx of residents from nearby communities.

Holmul became the dominant site in the region during the Early Classic period. Around 379 CE, the seat of power shifted from Holmul to La Sufricaya, which was a small ceremonial and political center located only 1 km outside of the site's core. This dynastic change and the introduction of a new ruler were accompanied by the construction of two medium-sized plazas and a palace complex located on a multi-tiered platform. The development of these new plazas was part of an active political strategy to create a new place or center where local and surrounding communities could participate in ritual and ceremonial events and engage in the formation of new social memories (Tokovinine and Estrada-Belli 2015). The South Plaza was a semi-restricted plaza that was constructed on the lower level of the La Sufricaya palace complex

and was only accessible to the public by a single staircase located on its northern edge. Despite its restricted status, the South Plaza was also the largest plaza constructed at Holmul as it had a total area of 7,314 meters squared and could accommodate approximately 7,315 to 15,900 people. It is plausible that this plaza was exclusively used by a large number of elites to participate in ceremonial and ritual events (Tokovinine and Estrada-Belli 2015). However, the sheer size of the plaza seems to indicate that certain commoners were occasionally allowed to participate in activities conducted in the South Plaza. Ultimately, the ruler of La Sufricaya was unable to establish a new dynasty. After his death, the center was abandoned, and the ceremonial core of Holmul once again became the center of political power.

Despite this transition back to the site's core, no new public plazas were constructed at Holmul. As mentioned above, it is plausible that the physical landscape and lack of previously leveled land in the site's core limited Holmul's ability to engage in the costly task of constructing new public plazas. It is also possible that during the Classic period, Holmul continued to not need new or larger plazas because of the continued use of the preexisting plazas. Finally, since Holmul was a medium-to-large center, it is reasonable that the site's plazas were sufficiently sized to accommodate the residents and surrounding communities who gathered for public ceremonies or ritual events.

6.4.1 Plaster Analysis - Community and Plaster

This subsection discusses the lime plaster floor samples examined at Holmul. In particular, it provides insight into how the acts involved in large-scale planning and construction impacted both the cohesion of a community and the maintenance and transformation of traditions. As discussed in the previous chapter, the mineral barite was found in four of the

Holmul lime plaster samples. Barite was also found in lime plaster samples acquired from the sites of Cival and San Bartolo. In 2009, Heather Hurst tentatively proposed that certain Late Preclassic period Maya sites were participating in a practice of fine-plaster production where local workers intentionally incorporated barite when preparing a plaster surface for mural painting. This claim was tentative as Hurst, and her colleague O’Grady had only discovered the inclusion of barite through handheld XRF and thus were unable to individually locate the mineral in their samples (Hurst 2009).

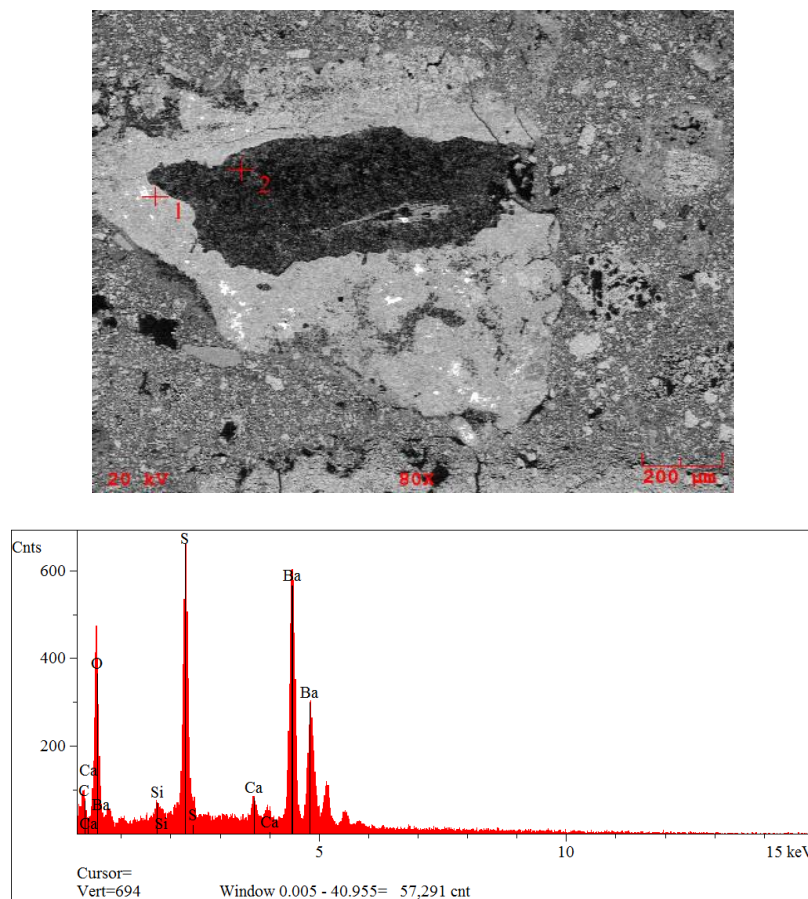


Figure 6.1. and Figure 6.2: The top image is barite located in a chunk of aggregate in sample Hol7. The lower image is the result of EDS analysis of the barite. Both images by Kaitlin R. Ahern.

This current investigation strengthened Heather Hurst's (1998) claim regarding barite and lime plaster through the application of SEM-EDS, as it was able to identify various barite inclusions and conduct an individualized chemical analysis on these grains. It also determined that the barite was mixed into the lime plaster at Holmul. However, these findings also modify elements of Hurst's theory. For example, the Holmul plaster samples examined in this dissertation date to the Late Preclassic period, but they were acquired from floors, rather than from murals. Thus, this project determined that barite was occasionally used for more mundane purposes than just in mural preparation. Additionally, there were two different forms of barite discovered in these floor samples, as two of the samples (Hol2 and Hol8) were found as individual grains, while the remaining two samples (Hol6 and Hol7) were located inside a chunk of sascab. Out of the four samples, only sample Hol2 and Hol6 had barite situated in the fine-plaster layer.

There are two potential explanations for the inclusion of barite in the various lime plaster samples from Holmul, which are that the barite was either an unintentional or intentional addition to the lime plaster. Barite is a naturally occurring mineral that is frequently found in vein-fillings and concretions in limestone. Additionally, the weathering of limestone can result in large barite deposits that accumulate at the top of the bedrock. Thus, it is possible that the addition of barite to the lime plaster at Holmul was simply coincidental. However, the consistent discovery of barite in the fine-plaster layer seems to question this assertion.

The second explanation elaborates upon Hurst's theory that the incorporation of barite into the fine-plaster layer was an active choice. To better understand the validity of this explanation, it is essential to quickly mention the results of ethnographic studies on modern Maya lime plasterers as they demonstrate that the limestone chunks used in plaster production

are carefully chosen to produce the highest quality material (Schreiner 2002). In general, modern Maya plasterers prefer to use the whitest limestone available in plaster production as it has the least amount of impurities (Russell and Dahlin 2007). Although it is almost impossible to find pure limestone, certain impurities are more harmful than others, such as iron. Additionally, limestone impurities can affect both the physical features of the lime and the color of the end product (Hansen 2000). Therefore, it is very likely that the ancient Maya at Holmul were also actively using limestone with the least amount of impurities.

Although the mineral barite is white, it is heavier than limestone, and thus, the local workers likely identified it as an impurity. However, for some unknown reason, barite was eventually added to the lime plaster. This second explanation proposes that the local workers were deliberately selecting pieces of heavily weathered barite to incorporate into the production of lime plaster and the subsequent creation of a fine-plaster layer. This active selection possibly stemmed from a local tradition or belief that claimed that barite improved the quality of the plaster. It is also possible that the location of the weathered barite had a symbolic significance. Either way, future research should investigate if the inclusion of barite has any physical effect on the quality of lime plaster.

6.4.2 Emergence of Barite Tradition

The Holmul plaster samples explored in this dissertation varied considerably from the mural samples previously analyzed at the site. In 2009, Hurst investigated Late Preclassic period murals samples in Building B at Holmul and determined that the matrix was poorly sorted and that the overall composition of the samples was extremely heterogeneous. Additionally, a high quantity of carbon was found in the samples, which suggests that during plaster production, the

limestone was poorly burnt. These differences are most likely the result of a temporal range separating the samples, as the mural samples from Building B were roughly dated to 370 BCE, which was around the transition from the Middle to Late Preclassic period. Around this time, Holmul was partaking in a series of monumental constructions and was interacting with the regional center of Cival.

Thus, the shift from the poorly produced mural samples to the newly examined floor samples indicated a change in practice regarding the methods of plaster production at Holmul. One of these new practices was the use of barite in the fine-plaster layer. This new tradition was quickly experimented with as one of the oldest floor samples (Hol2) examined in this dissertation had a poor to normal sorted matrix and contained barite in the fine-plaster layer. Although there is no precise date associated with sample Hol2, the floor was located in Building N, which was in Group II. Another early sample (Hol8) was well-sorted and contained barite in the coarse-plaster layer. This floor was part of one of the earliest architecture phases for Building 1, located in Group 1. These early floors indicate that barite was introduced into the lime plaster during the transition from a poorly processed to a higher quality plaster. This shift potentially reflected a newly strengthened focus on monuments that led those far above the social level of the plasterer, such as architects and artists, to come into symbolic competition with each other.

Unfortunately, it remains unknown when Cival first began to incorporate barite into the lime plaster production as all of the examined floor samples dated to the end of the Late Preclassic period. However, around 200 BCE, barite was used in the production of mural samples at Cival (Hurst 2009). Due to the limited temporal range of the Cival samples, it is beyond the scope of this dissertation to determine whether Cival or Holmul were the first to

introduce these new practices into the region. Instead, future plaster analysis must examine an assortment of plaster samples from Cival.

6.5 Witzna

Witzna was composed of a large ceremonial core that was closely associated with the nearby cluster of pyramids known as East Witzna. The area surrounding Witzna was first occupied during the Late Preclassic period at the Watchtower complex located in East Witzna. Despite this nearby occupation, the site of Witzna did not experience any monumental construction until the Early Classic period. During the Early Classic period, a raised and monumental platform was constructed across a large area that became the ceremonial center of Witzna. This platform supported a three-tiered acropolis that included a royal palace. It also contained several restricted and public plazas that underwent multiple phases of construction.

To the east of the acropolis was the E-Group plaza, which was both the largest public plaza at Witzna and the largest plaza in the region. The E-Group plaza was most likely constructed during the Early Classic period and measured 10,339 meters squared. The plaza accommodated between 10,339 and 22,476 people. However, there is evidence suggesting that the eastern structure of the E-Group assemblage potentially experienced its first phase of construction during the Late Preclassic period. Since E-Group assemblages are generally constructed as a single unit, the public plaza may also date to the Late Preclassic period. The 2016 field season of the Holmul Archaeological Project also discovered Late Preclassic period ceramics around the acropolis at Witzna (Estrada-Belli 2016b), which may suggest an earlier occupation.

To the west of the acropolis was a series of structures and a small public plaza with undefined borders. Three structures bordered the north, east, and west edges of this plaza, but there was no architecture marking its southern limit. Due to the limited amount of research conducted at Witzna, there is no excavation data on this plaza. Thus, the plaza was not included in this dissertation or in the total amount of ceremonial space at the site. The public plazas located in the acropolis were slightly more restricted and smaller than the E-Group plaza. Nevertheless, the public plazas at Witzna had at least a total combined area of 17,871 meters squared, which was approximately 2,586 m² more than Holmul. As previously mentioned, Witzna was one of the larger urban centers in the region (Fialko 2005), and it was similar in size to Holmul. Thus, it is reasonable that they have a similar amount of public space.

Witzna had a royal plaza, also known as Plaza 4, in the acropolis located at the center of the site. This plaza was the most restricted place in the ceremonial core as it was surrounded by the quadrangular palace, which was located on the highest level of the acropolis. The royal palace at Witzna was just as restricted as the Complex B palace at Holmul. However, Witzna's royal plaza was almost triple the size of the one at Holmul as it measured 578 meters squared and accommodated approximately 578 to 1,255 people. Although this population range appears quite high for a palace, the quadrangular plaza at Witzna only had a width of 11 m, which likely restricted the number of people the plaza could comfortably accommodate. Additionally, the placement of this plaza inside a palace indicated that it functioned as a private space for the ruler, their family, and potentially other high-ranking individuals to engage in everyday activities and private rituals.

Central Plaza 1 was a restricted plaza located on the second level of the acropolis, and it served as the only access point for entry into the palace. This plaza was also quite restricted as it

was only accessible through narrow passageways from the first or main level of the acropolis. Central Plaza 1 had an approximate area of 1,715 meters squared and accommodated between 1,715 and 3,728 people. However, the actual area and population estimates were slightly smaller due to the pyramid or temple located in the center of this plaza. The size, restricted access, and proximity to the palace strongly indicate that this plaza was a location for the elite members of the society to meet with the ruler and engage in private rituals.

6.5.1 East Witzna and the Watchtower

The Watchtower was located several kilometers to the east of Witzna. The remote location of the Watchtower highlights the restricted access to its plaza. The defensive properties of the complex also illustrate the strategic value of the Watchtower. For example, the staircase for the Watchtower ended a couple of meters above the plaza (Ahern 2019), which limited access to the pyramid. Additionally, the isolated nature of the Watchtower complex and the incredible views obtained by standing at the top of the pyramid indicates that it was either a lookout point that had defensive military functions or a ritual location (F. Estrada-Belli, personal communication 2018). The former option appears significantly more likely due to the evidence of several violent events that occurred in the plaza during the Early Classic period. A clear example was the broken altar found in the plaza. There were also complete and fragmented lances discovered in proximity to the altar (Estrada-Belli 2019; Ahern 2019). Both of these examples indicate potential violence carried out in the plaza.

Finally, the complex was likely inhabited at times, as domestic ceramics were found around the northern platform (Carcuz 2019) and in the fill of the Watchtower (Ahern 2019, 2020).

Recent excavations at the Watchtower complex revealed the earliest phase of construction for the pyramid. The Watchtower and its plaza were first built during the Late Preclassic period on a smooth black soil that was positioned directly on the bedrock (Ahern 2020). Afterwards, a two-tier platform was placed on the black soil. The first part of the platform was a stone slab floor that extended for 6.45 meters. The second platform was composed of black earth covered in a layer of marl. At the center of the Watchtower were two rows of stone that likely supported a masonry structure (Ahern 2020). Additionally, excavations revealed a second stone platform located to the north of the Watchtower, and it potentially supported perishable or masonry structures.

Due to the restricted access to the Watchtower, this complex served as a domestic or ritual location for elites. Towards the end of the Late Preclassic period, the Watchtower underwent a new phase of construction that removed the masonry structure. In addition, the platforms were filled in with stone to support the construction of the Watchtower pyramid. A small pot was placed in front of the stone slab platform. The significant modification of the Watchtower indicated a change in the function of the complex. By the Early Classic period, a new masonry structure, or Building A, was constructed in the plaza, and it further restricted the already small plaza (Ahern 2019). Additionally, a ritual sacrifice of a child's skull was placed in a chultun located in the plaza. This chultun was carved from the bedrock and was positioned immediately in front of the Watchtower along the plaza's north-south axis (Estrada-Belli 2019; Ahern 2019). During this period, the Watchtower complex became established as a restricted and important outpost with definitive ties to Witzna. This connection was highlighted with the Early Classic period construction of Structure 9 in East Witzna as this pyramid later became the location for a royal burial and the placement of stelae (Girón 2019). As previously mentioned,

the occupation of the Watchtower complex ended in an act of violence that resulted in the ritual burning of the plaza and surrounding architecture.

6.5.2 Plaster Analysis

This subsection shifts from the discussion of plazas to the examination of lime plaster samples acquired from the site of Witzna. The Late Preclassic period plaster samples at the Watchtower, and the Late Classic samples from the palace at Witzna were poorly mixed as they contained large aggregates in the matrix. The most well-processed of the samples came from East Witzna during the Late Classic period, which had normal to well-sorted matrices. The disparity in the Late Classic period plaster samples potentially indicated political fragmentation that preceded the Naranjo attack. However, it was also possible that particular plaza floors at Witzna were hastily reconstructed after Naranjo first attacked and burnt the site. Thus, some of the plazas and possibly samples Wit1 and Wit1b were burnt in Naranjo's second attack. Intriguingly, all of the lime plaster samples, excluding sample Wit2, showed evidence of violent burnings that occurred across the site.

6.6 Proxemics

Thus far, this chapter has focused on analyzing data by examining the results in relation to their specific site context. This section moves away from this trend by using proxemics to compare the aggregated data on plazas from all three sites. Proxemics is used to define and classify three main types of Preclassic period plazas found in the Petén, and these are small restrictive plazas, semi-restricted plazas, and public plazas (Tsukamoto 2014). The section begins by discussing these three types of ancient Maya plazas and investigating how the data fits

within these categories. Afterwards, each type of plaza is discussed regarding their potential uses.

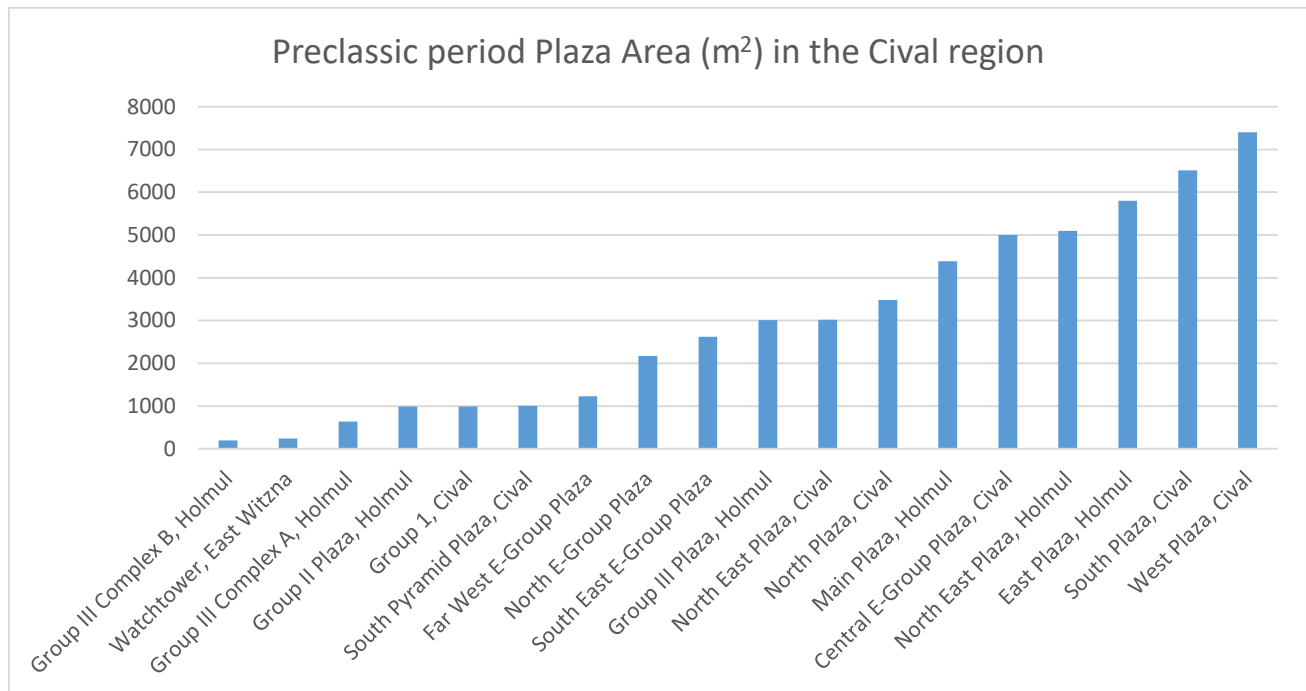


Figure 6.3: Chart of plaza area for Preclassic period plazas at Cival, Holmul, and Witzna.

This project examined the data from 22 Preclassic period plazas from Cival, Holmul, and Witzna, and three previously examined plazas from El Palmar and Tikal. These plazas were sorted into the categories of either restricted, semi-restricted, or public plazas by comparing their total area and general accessibility. This examination determined a loose correlation between the type of plaza and its total area among public plazas, which seem to range in size between 4,000-8,500 meters squared. However, this association is almost nonexistent with restricted and semi-restricted plazas as the physical area of these plazas occasionally overlapped with the other categories' estimated ranges. Although there was no strong correlation between plaza size and type among these 25 plazas, it is plausible that a more extensive data set would provide different results. Additionally, it is valuable to note that unless excavations are conducted on each of these

plazas, it is impossible to accurately know the sizes of these Preclassic plazas as they were potentially expanded or altered during the Classic period. Thus, further investigation and larger sample sizes are needed to determine if there is any strong correlation between plaza size and type.

Small restrictive plazas were suitable for close-range communication and were generally located on raised platforms or pyramids. These plazas were spaces for the elite in society and served as a location for more intimate interactions and small ritual ceremonies. The two most restricted and intimate plazas in the Cival region during the Preclassic period were the Watchtower and the Complex B plaza located in Group III at Holmul. These two plazas were positioned in very defensible locations with limited entry points. The Watchtower complex was constructed on the highest hill in the region (Estrada-Belli 2019; Ahern 2019) and was only accessible along its west side. The plaza was a location of warfare and sacrificial rituals, and it measured 240 meters squared. The restrictive elements of the plaza indicated that it was a private space for a limited number of high-ranking individuals, such as elites and warriors.

The Complex B plaza was constructed inside the royal palace at Holmul, which was positioned on the top of a raised platform located in Group III. This platform had a single staircase located on its western side. The plaza was a sunken court that was only accessible by first entering the royal palace (Mongelluzzo 2011). It measured 196 meters squared. The small size of the plaza and its restricted access indicated that the plaza was a location for intimate experiences and close interactions between the ruler, his family, and high-ranking elites. This plaza and complex were occupied throughout the site's history; thus, it likely became more restricted over time with the encroachment of the royal palace.

Semi-restricted plazas were slightly segregated spaces that served to restrict contact between different segments of society. These plazas were the location of smaller events that restricted participation to elites and higher-ranking social classes. Access to this type of plaza was generally more restricted due to the smaller number of openings and more narrow entrances. Additionally, these plazas were typically found on either leveled ground or on the lowest level of a raised platform.

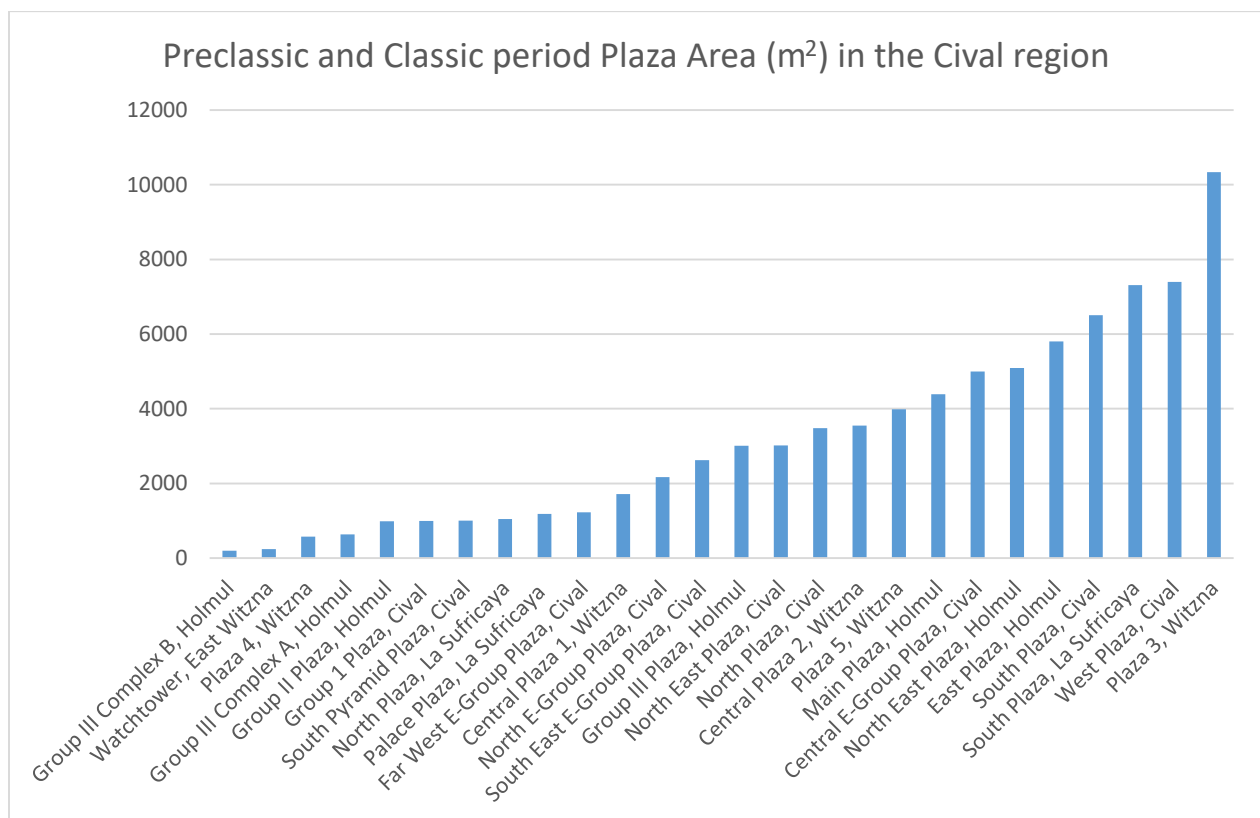


Figure 6.4: Chart of the plaza area for all the plazas examined at Cival, Holmul, and Witzna.

The final grouping of plazas are public plazas that served as open places and accommodated substantial portions of the community. These plazas generally had multiple points of entry, which increased the accessibility to these public spaces. Ceremonial and ritual events conducted in these plazas brought together different segments of society, which permitted

the public to occupy the same space as elites. Large open plazas were suitable for communication at a public distance as loud voices were necessary to convey information across space. There was a range of distances experienced by the population. For example, there was a public distance between an orator and the participants, and a social or personal distance between the participants. The term orator refers to any individuals conversing with the participants from a distance during some form of public event. An orator may include a ruler, a religious practitioner, or a group of performers. Additionally, some sites, like Cival and Tikal, had small platforms located in one or multiple plazas that served as stages where these orators potentially engaged with the audience (Estrada-Belli 2017; Inomata 2006).

6.7 Discussion

During the Middle Preclassic period, public plazas found in E-Group assemblages served as early centers for community formation as the construction and participation in these complexes brought together mobile and sedentary groups of people. These formative plazas were vital to the growth of the site, as the ritual, ceremonial, and eventually, political roles of the plazas served to unify the community. Additionally, the accessibility of these plazas was an essential component of the E-Group assemblage.

Preclassic period public plazas are generally smaller than those constructed during the Classic period and typically range in size between 4,000 to 8,500 meters squared. The difference in size between Preclassic and Classic period public plazas was likely a consequence of the desire for more space to accommodate larger populations. Proxemics were used to examine three different types of plazas constructed during the Preclassic period, which were public plazas, semi-restricted plazas, and restricted plazas.

The centers of Cival, Holmul, and Witzna each had a unique history that affected the development of its plazas. Cival's early occupation and construction during the Middle Preclassic period resulted in a centrally positioned plaza surrounded by leveled land. This center had an extraordinary amount of public space, which strongly supports the evidence that Cival was an important regional center during the Late Preclassic period. As Cival developed, it had both multiple public plazas and continuous plazas. A continuous plaza refers to multiple plazas that connect with each other. Holmul also had a continuous public plaza located in Group I, which was initially constructed during the Late Preclassic period. Although Holmul became the dominant site in the region during the Classic period, its physical size and the lack of previously leveled land limited the expansion of new public plazas.

Witzna was inhabited during the Early and Late Classic periods, which meant that it was the shortest occupied of the three sites. Regardless, it had the single largest public plaza in the region. This plaza and a series of smaller public plazas were constructed during the Early Classic period. The Watchtower and its plaza were initially constructed in the Late Preclassic period and were located in the nearby area of East Witzna. This plaza was one of the most restricted places in the region, and it was likely a place to conduct religious and war-related rituals. Additionally, this plaza was particularly distinctive as it was located in one of the first known military outposts and watchtower discovered in the Maya lowlands.

CHAPTER 7

Plazas as Monumental Foundations: Summaries and Conclusions

7.1 Introduction

This final chapter weaves together the plaza findings at the three sites of Cival, Holmul, and Witzna and conceptualizes them through the theories of practice, structuration, place, social memory, and communities of practice. Structuration is used to examine the role of practice in the creation, maintenance, and transformation of these plazas. The theories of place and social memory are examined to investigate why these plazas continued to be maintained and occupied across hundreds of years. This examination into social memory places particular emphasis on caching and the placement of stelae as these ritual and political acts demonstrated the creation of sacred locations and sites of memory associated with these plazas. Communities of practice is also utilized to understand the similar and likely shared technology required for producing specific E-Group assemblages and lime plaster production across Cival and Holmul. The final two sections of this chapter include a summary of the conclusions and explores future avenues of research.

7.2 Practice and Plazas

This dissertation investigates the plazas at Cival, Holmul, and Witzna through the theories of structuration and historical processualism. Structuration is used to examine how practices reproduce, modify, and transform the structure. Additionally, this project also explores how practices occasionally result in the transformation of society, which can lead to intended and unintended consequences (Giddens 1984). The theory of historical processualism is utilized to explore each site's unique trajectory to understand how it was molded by the actions, practices,

and traditions of its inhabitants (Pauketat 2001). This analysis involves the investigation of the historical processes that shaped the development of these sites and the use of public and restricted plazas. Finally, proximate explanations are utilized to examine how plaza space emerged and was transformed at these three sites (Pauketat 2000).

The construction of formal public plazas in the Maya lowlands during the Middle and Late Preclassic periods served to create locations where diverse groups of people came together and participated in public ceremonies (Inomata et al. 2015). These plazas transformed society with the introduction of greater inequality, new social interactions, and the formation of community. Local participation and engagement in the practices associated with these public plazas served to create, reproduce, and transform these early centers (Inomata and Tsukamoto 2014). Additionally, it was through the construction and later participation in public events held in these plazas that “the residents created and experienced social relations with other community members, shared common experiences and narratives, and negotiated individual and collective identities” (Inomata 2014:27). This phenomenon of early public plazas as centers of community formation occurred at the sites of Ceibal (Inomata 2014) and Cival (Estrada-Belli 2017).

The construction of these Middle Preclassic period monumental plazas and complexes resulted in intended and unintended consequences that altered the trajectory of certain mobile groups located across the central Maya lowlands. These consequences emerged through the types of labor, practices, and organization required to achieve these massive building projects and resulted in a restructuring of society. The individuals and groups that participated in this construction had limited or no understanding of the potential repercussions. Additionally, the communal gathering in these plazas and the conducting of ceremonial and commemorative rituals served to push people in these centers towards greater social stratification as engagement

in these repetitive practices encouraged the negotiation of new social relations. Public participation in these plazas also led to increased interaction among groups with varying levels of sedentism (Inomata et al. 2015).

Another unintended consequence of these early locales of community formation was the adoption of permanent residences. This transition first occurred at Ceibal, where mobile populations began to adopt a more sedentary lifestyle following the construction of the E-Group plaza (Inomata et al. 2015). This shift in mobility was also experienced at Cival, but the adoption of sedentism appears to have occurred quicker in the Cival region (Estrada-Belli 2017). Over time, elites likely obtained specific roles in these public ceremonies (Inomata 2014). However, the full effects of these collaborative construction projects and community engagement in ceremonial rituals fully emerged during the Late Preclassic period, with the introduction of restricted plazas and the appearance of rulers (Estrada-Belli 2006).

As previously mentioned, Holmul also experienced a similar form of community formation through public participation in plazas, but on a more gradual scale. During the early Middle Preclassic period, a small village was established at Holmul and was located in the vicinity of the eventual Group II (Neivens 2018). This village was an early hub for ritual activity and feasting events that drew together both sedentary and mobile groups and resulted in the creation of community. The public participation in these ritual and ceremonial events ultimately resulted in the monumental construction of both restricted platforms and public plazas during the Late Preclassic period (Neivens 2018; Neivens de Estrada and Méndez 2009).

7.2.1 Plaza Development

Middle Preclassic period plaza construction was essential to the sites of Ceibal and Cival, as the construction volume required to build these plazas surpassed later construction at these centers (Inomata 2014; Estrada-Belli 2011). Takeshi Inomata (2014) proposed that certain Middle Preclassic period Maya centers, such as Ceibal, Cival, and Cahal Pech, prioritized the construction of public plazas over pyramidal structures. Additionally, there were sites, like Tikal, that prioritized the more visible pyramidal structures (Inomata 2014). At Holmul, early builders prioritized the construction of three monumental raised platforms, known as Group I, II, and III. The remaining space was turned into a continuous plaza that surrounded Group I.

Public plazas continued to be crucial to the development and maintenance of Holmul and Witzna during the Early Classic period. One of the first projects constructed at Witzna was a large public plaza that likely accommodated much of the site's early population. As mentioned in a previous chapter, it is plausible that the E-Group plaza at Witzna was first constructed during the Late Preclassic period and thus potentially preceded the development of the adjacent acropolis. Nevertheless, this plaza demonstrated the importance of public plazas and community formation in the development of Witzna. Additionally, the creation of a new dynasty at the minor ceremonial center of La Sufricaya resulted in the construction of a new public plaza built in the vicinity of Holmul. This plaza was developed to provide a new public place close to the palace of the new ruler. It also served as a location to maintain the local community and as a place for the negotiation of new social relations under the new ruler.

7.3 Place, Social Memory, and Plazas

Ancient Maya plazas also served as locales of place and social memory. These theoretical concepts are used to investigate caches, stelae, and sites of memory encountered at Cival, Holmul, and Witzna. Sacred places emerged through active practices, rituals, and interaction with space and landscape. They also developed through ritual deposits and offerings of material artifacts as active social participation imbued the constructed place with life, memory, and meaning (Brown and Garber 2008). Additionally, places can contain multiple meanings to various individuals and communities (Low and Lawrence-Zúñiga 2003; Rodman 1992).

The ancient Maya perceived hills as important ritual features in the landscape. Consequently, there are a large number of Middle Preclassic period settlements, ceremonial centers, and plazas located on the top of hills (Awe 1992; Estrada-Belli et al. 2014; Hansen et al. 2008), as they served as ideal sacred places (Grove and Gillespie 2009). As an aside, Cival, Holmul, and the Watchtower were all built on hilltops. The formation of Cival's ceremonial core is particularly interesting, as a local community of builders worked to artificially level the sunken area between two hills, which involved filling in individual sections by several meters (Estrada-Belli 2011). Thus, these laborers actively partook in a monumental act of place-making through the alteration of two sacred hills.

The public plazas constructed on these hills acted to provide a continuity of traditions, memories, beliefs, and of a shared collective past (Schudson 1997). Social memories were frequently created, shaped, and transformed through commemorative rituals, ceremonies, and political events conducted in these plazas (Connerton 1989). The participation in these events by the general population resulted in people establishing strong emotional ties to these places (Inomata 2014). Additionally, the construction, alteration, and re-plastering of plazas served as

ritual activities that were inherently connected to commemoration and the remembrance of past people and events. These plaza modifications also served to promote legitimate claims to the sacred place and to the ancestors and deities that inhabited it. Thus, these plazas functioned as prominent centers where the local inhabitants selected what was transformed into social memory and what could be purposefully forgotten.

7.3.1 Caches and Stelae

Public ceremonies accompanied the construction and physical alteration of plazas, and some of these ritual events left behind physical evidence, such as the caches and stelae placed in these plazas (Inomata 2014). The interment of caches was a ritual activity that served to create a place and solidify and alter social memory. Since ritual offerings were subsequently covered by a new floor or phase of architecture, caches were physically invisible, and thus, only existed in the memory of the community. Occasionally, the physical placement of these deposits was remembered across hundreds of years. At the site of Minanha in Belize, three ritual deposits were placed on the same vertical axis, and each offering was temporally separated by a range of 425 – 750 years (Schwake and Iannone 2010). A similar event occurred in the Central E-Group plaza at Cival with the interment of the cruciform cache as a couple of hundred years later another offering was placed on the same vertical axis. An additional four ritual deposits were consecrated around this vertical axis during the site's history (Morgan and Bauer 2004; Estrada-Belli 2011). These four caches were positioned adjacently to the cruciform cache and were generally offset by approximately a meter (Morgan and Bauer 2004). Both of these examples illustrated the intergenerational nature of social memory.

Table 7.1: This table lists the caches and stelae discussed in this dissertation.

Site	Plaza	Caches, Stelae, and Altars	Information	References
Cival	Central E-Group	Six caches placed in front of the eastern structure	The first ritual deposit was the cruciform cache with greenstone celts and was interred during the Middle Preclassic period. Some of these caches contained blank stelae.	(Morgan and Bauer 2004; Estrada-Belli 2005; Estrada-Belli et al. 2003).
	Central E-Group	Stela	Stela 2. It contained the carving of a potential ruler. Late Preclassic.	(Estrada-Belli 2011).
	North Plaza	Chultun with burial	Radiocarbon date around 800 BCE. Contained pottery and human remains.	(Estrada-Belli 2008).
Holmul	E-Group	Altar cache	Late Classic period.	(Estrada-Belli 2008).
	E-Group	Two stelae and a fragmented altar	Stela 1, Stela 25. Late Classic period.	(Estrada-Belli 2008).
Witzna	Watchtower	Altar	Stylistically dated to the Late Preclassic period.	(Ahern 2019; Estrada-Belli 2019).
	Watchtower	Cache/burial found in chultun.	Human cranial, teeth, and ceramic vessels were deposited in the chultun during the Early Classic.	(Ahern 2019).
	Watchtower	Cache	A bowl dating to the Late Preclassic period. It was placed in front of the stone slab platform.	(Ahern 2020).
	Plaza 1	Cache	Obsidian eccentrics that dated to the Late Classic period.	(Perea 2016).
	E-Group	Two stelae	No caches found below them.	(Estrada-Belli 2017).

During the Middle Preclassic period, the public participated in ceremonial and ritual events in public plazas, such as the burial of caches. Since these offerings were undetectable, the locations of these ritual deposits were passed on through oral tradition. Thus, the site and the specific ritual practices associated with the placement of these caches were potentially part of a ‘secret knowledge’ that elites and eventually religious specialists kept hidden to legitimize their roles. By the Early Classic period, the knowledge associated with ritual deposits was held by a small class of elites that served as religious practitioners. Additionally, the placement of caches became restrictive to members of the elite and ruling family, who placed these deposits in pyramids (Inomata 2014).

Stelae are limestone slabs that were generally erected in ancient Maya plazas and occasionally contained portraits of individual rulers and accompanying text that was sculpted into the stone (Stuart 2010). These stone monuments were similar to caches as their placement in plazas also served as material evidence of ceremonies and commemorative activities.

Additionally, caches were occasionally interred below stelae. As previously mentioned in previous chapters, the earliest examples of stone monuments in the Maya lowlands were blank stelae. By the Late Preclassic period, there was an established tradition of erecting carved stelae in plazas. This practice truly began to flourish during the Early and Late Classic periods as carved stone monuments are found throughout the ancient Maya region.

The shift to placing carved stelae in plazas demonstrated a transition towards visible markers of social memory. The two forms of expression depicted on stelae allowed political messages to be understood by both the elite and the illiterate general population. The text on these stelae served as record-keeping, which aided in the preservation of selective memory, whereas, the portraits depicted on the monuments functioned to embody the ruler (See Stuart

2010). The modification, destruction, and occasional interment of stelae into caches can provide insight into intentional alteration or manipulation of memory and the construction of new political narratives. For example, the destruction of a stone monument served to erase both a ruler and a part of the site's history (Gillespie 2010).

Blank and carved stelae were found at each of the three sites investigated in this dissertation. Due to natural and human-made processes, these stone monuments were discovered in various states of preservation. Additionally, stelae were found in the E-Group plazas at each of the three sites. The carved monument in the Central E-Group plaza at Cival was constructed during the Late Preclassic period, whereas the stelae in Holmul's E-Group assemblage dated to the Late Classic. There is no date associated with the stelae in the E-Group plaza at Witzna. It is also unknown whether earlier carved stone monuments were placed in the Holmul and Witzna E-Group plazas or interred in caches.

The placement of stelae on the surface of the plaza served to create a rigid social memory that was consistently viewable to those engaging in ceremonial and ritual activities in the plaza. Caches, on the other hand, were associated with a more flexible social memory as after their interment into the public plaza, they were mostly invisible, except for in the memories of the community. The location of Preclassic period caches and stelae in plazas demonstrated that these locales were foci of community interest and essential places for ceremonial ritual and commemoration. Additionally, the memory associated with ritual caches and stelae located in public plazas stems from the remembrance of past activities and the anticipation of future events (Inomata 2014).

Private plazas were also crucial to the formation of community and the creation of social bonds. The Watchtower plaza was a small private plaza that began as a potential residential site

and, over time, became an outlook point. Despite the small size of the plaza, material remains indicate that elites or specialists, such as warriors, were partaking in small ceremonies that created and maintained specialized communities in the area surrounding the Watchtower. Recent excavations in 2018 and 2019 revealed evidence of three ritual events conducted in this plaza (Ahern 2019, 2020). During the first major modification of the Watchtower, a small cache containing a single pot was placed in front of the earlier structure. This discovery indicated the existence of a ritual event in the private plaza that ended with the placement of the cache. The next ritual event was the depositing of several ceramic vessels and the skull of a child sacrifice that was placed in the chultun (Ahern 2019). It remains unknown whether the chultun was constructed before or contemporaneously with the ritual interment. If the chultun was carved before the placement of the cache, then the memory of its location resulted in the precise rediscovery of the chultun from under a masonry building. Regardless, this interment further established the plaza as a ritual location. Finally, an altar was placed in the plaza.

7.3.2 Sites of Memory

Ancient Maya plazas also served as sites of memory that reinforced the cohesion of the community (Borgstede 2010) through repetitive commemorative activities. This subsection explores the concept of sites of memory by drawing upon the findings of public, semi-restricted, and restricted plazas in the Cival region. An example of these public plazas is found in E-Group assemblages, which were one of the earliest examples of public architecture in the central Maya lowlands. These E-Group plazas served as essential hubs of memory, as highlighted by the extensive ceremonies and ritual events conducted in them. The general importance of the E-Group plazas in the Cival region is demonstrated through the strict preservation of the original

plaza width for each of the thirteen assemblages, as this act of conservation served to maintain these sacred places.

The E-Group plazas at Cival, Holmul, and Witzna were important sites of memory as indicated by the material remains discovered in these plazas, such as ritual caches and stelae. These artifacts demonstrated a rich tradition of commemoration and ceremonial events that occurred in these locales. Due to the extensive amount of research conducted on the Central E-Group plaza at Cival, it is possible to explore the processes associated with the transformation of this space into a site of memory. As previously discussed, the construction and later public engagement in the monumental Central Plaza and its accompanying E-Group assemblage at Cival resulted in early community formation (Estrada-Belli 2017a) and the creation of a sacred place.

Community interactions and public participation in ceremonies and ritual events in the Central Plaza enabled the creation, modification, and transformation of memory. These ritual events included the depositing of caches and the placement of stelae. Although the ceremonies preceding these specific acts were open to the public, the actual interment of these caches was restricted to a smaller segment of the community, such as elites and religious practitioners. The first ritual deposit interred in the Central E-Group plaza was the cruciform cache (Estrada-Belli 2006, 2011). It was subsequently followed by at least five additional plaza offerings and the placement of a stela (Estrada-Belli et al. 2003; Morgan and Bauer 2004). Additionally, the plaza was frequently maintained through replastering and the construction of new plaza floors. Thus, the evidence of ritual activities and the maintenance of the plaza strongly indicate that it served as a site of memory. Towards the end of the Late Preclassic period, the entire site of Cival was abandoned, and the Central E-Group plaza was forgotten by those who left the city. However, the

E-Group plazas at Holmul and Witzna continued to function as sites of memory into the Late Classic period, as stelae continued to be placed in these plazas.

The Watchtower plaza also served as a site of memory. As previously mentioned, the emblem glyph for Witzna was Bahlam Jol or ‘head of the jaguar’ (Wahl et al. 2019; Estrada-Belli 2016b). Since the Watchtower complex was occupied before Witzna and was located on the highest hill in the region, this place was likely the symbolic location for the ‘head of the jaguar’ (F. Estrada-Belli, personal communication 2019). The placement of the Watchtower complex on this hill indicated its inherent sacred qualities that enabled its transformation into a prominent place. Additionally, the ritual and ceremonial acts conducted in its plaza demonstrated that people participated in the shaping, remembering, and forgetting of social memory. Thus, the Watchtower and adjacent plaza served as a sacred place and site of memory during the Late Preclassic and Early Classic periods. The importance of this potential site of memory led to the development of East Witzna, which was located in the proximity of the Watchtower complex.

Due to the restricted location and the size of the plaza, only a select number of individuals participated in the ceremonies and ritual events associated with the Watchtower complex. During the late Early Classic period, the entire complex was burnt in a ritual termination event that ended the Watchtower’s role as both an outlook and as a hub of memory. However, the structures in East Witzna and the ceremonial core of Witzna continued to be occupied through the Late Classic period. Thus, the Watchtower continued to serve as a visual marker of memory to those living throughout the region.

7.4 Communities of Practice

The labor involved in the physical construction and maintenance of these plazas informs us about the additional practices associated with these places, such as the involvement of a community of practice for the construction and maintenance of these plazas. A communities of practice-based approach views learning as a social process where a community of practitioners builds and shares practices and general knowledge related to a shared interest. It is most commonly used in archaeology to examine ceramics (Blair 2015). However, this theoretical approach is also used to understand the elements of standardization in architectural complexes and lime plaster production. In addition, this approach is used to examine specific practices associated with architecture and lime plaster production.

7.4.1 Community of Practice and E-Groups in the Cival region

There are thirteen E-Group assemblages located across the Cival region, not including Witzna, that displayed elements of standardization. In 2017, Francisco Estrada-Belli conducted a comparative analysis of the E-Group assemblages in the Cival region and discovered some intriguing similarities. Each of the thirteen E-Groups was constructed by stripping the topsoil and building directly on the bedrock. They were also all constructed of “stone and mortar faced by cut stones and stucco” (Estrada-Belli 2017). Additionally, all of the E-Groups had a fixed plaza width, and all but one of the E-Group assemblages had little variability in the width of these plazas. Francisco Estrada-Belli (2017) proposed that a similar width was possibly an indicator of the region’s use of standardized units of measurement. Although there is currently no physical evidence of plaza measuring tools, James Doyle (2017) has suggested that the ancient Maya

potentially cut cords into standardized lengths to assist in agriculture. Thus, these cords were potentially used for other things, like measuring plaza widths (Estrada-Belli 2017).

This example also reveals the diversity that can occur in a community of practice that involves monumental construction that ranges across a substantial area. Despite the striking similarities between these thirteen E-Group assemblages, there were some apparent differences between them as they had an ample range in plaza length and astronomical orientation. These differences likely occurred because of local beliefs and land restrictions that influenced the individual construction of these complexes. Additionally, some of these differences were intentional as certain E-Group assemblages had overlapping sightlines with specific astronomical alignments and with various hilltops located to the east of Cival (Estrada-Belli 2017).

The similar methods for constructing these E-Group assemblages and the maintenance of a fixed plaza width suggest some level of shared practice among a community of practitioners. These communities formed as people quarried for stone, transported limestone, figured out solutions to problems, and went through the various stages of production with one another. As previously mentioned, the original E-Group assemblage was constructed at Cival during the Middle Preclassic period. The remaining twelve E-Groups were erected during the Late Preclassic period and were located throughout the Cival region. Since Cival was the dominant site in the Late Preclassic period, it was plausible that E-Group practitioners or specialists from Cival were sent to build or train others to construct these assemblages throughout the region. This ‘community of practice’ contained a very specialized group of practitioners that potentially included only a few members who supervised the construction process. The community also only lasted across an approximately 100-year period.

7.4.2 Communities of Practice and Barite

Another example of a community of practice was the barite discovered in the Late Preclassic period plaster samples at Holmul. Heather Hurst (2009) previously determined the correlation of barite at both Cival and San Bartolo. Although she does not mention a connection to a community of practice, her idea of a regional and temporal practice can easily be perceived through a community of practice-based approach. The mineral barite was found in lime plaster samples acquired from Cival, Holmul, and San Bartolo. This shared practice of incorporating barite into the fine-plaster layer indicated the existence of a ‘community of practice’ regarding lime plaster production.

The community of practice associated with lime plaster was much more extensive and less specialized than the construction of E-Group assemblages as it extended beyond the Cival region to the site of San Bartolo. It also involved the production of an essential building component for constructing and maintaining architecture and plazas. Thus, the community incorporated a more significant number of practitioners who interacted with one another at greater distances. Due to the range of this practice, each of the three centers likely contained a site-specific community of practice that was composed of lime plaster specialists who occasionally shared and exchanged ideas with other communities throughout the region. Finally, the practices associated with the incorporation of barite in lime plaster and the building of the E-Groups and their plazas involved the formation of a ‘community of practice’ that was held together by a shared interest in a skill. These communities were a locale where unskilled practitioners became skilled through active participation in the community and by engaging with fellow practitioners in the group.

7.5 Conclusions

Plazas serve to connect groups of people to a center through active engagement with community events like public ceremonies, commemoration, and other ritual activities held in these plazas. This community interaction results in the formation of place, community, and local identity. Individual and communal interactions in these plazas serve to continuously create, reshape, and transform society and social memory. Additionally, active community engagement with the ceremonies and ritual activities in these ancient Maya plazas and sites of memory served to anchor people to specific centers. Thus, throughout a site's history, its rulers continued to build and maintain public plazas because it kept people attached to the polity. Community engagement also resulted in the development of communities of practice. The similarities of practices utilized in the construction of E-Groups assemblages and plaster production at Cival and Holmul illustrate clear examples of communities of practice. These shared practices also demonstrate the strong connection between Cival and Holmul during the Late Preclassic period. Since Witzna was not constructed until the Early Classic period, Cival had no direct influence on the site.

Each of the three sites had a distinct trajectory regarding the construction and maintenance of public plazas. Cival was heavily invested in public plaza construction and subsequently in the public ceremonies and ritual events held in these plazas. The significant number of public plazas at Cival strengthens the claim that the site was a regional center and could accommodate participants from the neighboring settlements. The site of Holmul had a restricted number of public plazas because of the center's early emphasis on raised platforms and pyramidal structures rather than plazas. During the Early Classic period, there was a sudden dynastic shift at Holmul that resulted in the construction of an acropolis and several plazas at the

minor center of La Sufricaya (Tokovinine and Estrada-Belli 2015). The positioning of these new plazas was a deliberate act to create a new sacred place that served to solidify community formation around the new ruler. Witzna was constructed in the Early Classic period, and the center only had one public plaza, which was part of an E-Group assemblage. However, the site prioritized the construction of a large acropolis that contained multiple smaller semi-restricted and restricted plazas.

Additionally, restricted plazas also brought individuals together through ceremonies and ritual activities. One of the most restricted plazas in the region was located in the Watchtower complex, and it served as a place to conduct religious and war-related rituals. The domestic ceramics and evidence of ritual events discovered in the complex indicate that it was a vital plaza in the maintenance of a local community. The location of the plaza on top of the highest hill in the region also demonstrates that it was a sacred place and site of memory. Ultimately, each of the plazas examined in this dissertation reflects the sociopolitical conditions exhibited during their time of construction.

7.6 Future Directions

This dissertation confirmed the inclusion of barite in the lime plaster at Holmul; however, there is still plenty of research to be conducted regarding this discovery. The primary limitation of this current investigation was the small sample size, as this project only examined lime plaster samples at Holmul that dated to the Late Preclassic period and were acquired from floors.

Heather Hurst's (2009) investigation also had similar restrictions as she primarily examined Late Preclassic period mural samples at Cival, Holmul, and San Bartolo. Thus, future inquiries should incorporate a wide variety of lime plaster samples from each of these sites and other nearby

centers. Additionally, the limestone outcrops and quarries at San Bartolo, Cival, and Holmul must be examined to determine whether barite occurs naturally in the bedrock at these sites. These future investigations will provide insight into the practices involved in the adoption of this tradition.

Public plazas had an essential role in ancient Maya society as they served as a central place for community interaction and formation. Additionally, plazas were locations of ceremonies, commemoration, and ritual events, as seen by the caches and stelae found in these places. Therefore, plazas are as crucial to understanding these ancient Maya cities as the monumental architecture surrounding them. Future studies must focus upon the further examination of public and restricted plazas located throughout the Maya lowlands. The next phase of this project includes the examination of the remaining plazas in the Cival region to obtain a more detailed understanding of estimated plaza capacities throughout the larger area. This investigation will occur over the summer, and it will provide additional valuable insight into the spatial arrangement of plazas in the Cival region.

Appendix A: Thin Section and SEM-EDS Images

This appendix incorporates the results and images acquired through the analysis of 19 lime plaster samples via Optical Microscopy and SEM-EDS. I fully intended to include more images of the lime plaster samples, but unfortunately, the university closures associated with COVID-19 prevented me from doing so.

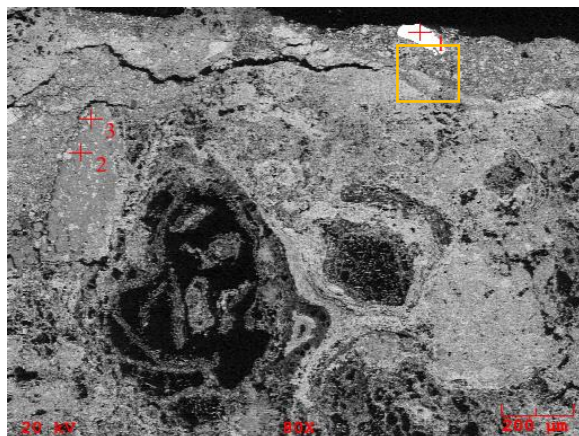
Appendix A is divided into the following sections:

- Appendix A.1: Characteristics of the Lime Plaster Samples
- Appendix A.2: Images taken with SEM-EDS
- Appendix A.3: Thin Sections under Optical Microscope

Appendix A.1: Characteristics of the Lime Plaster Samples

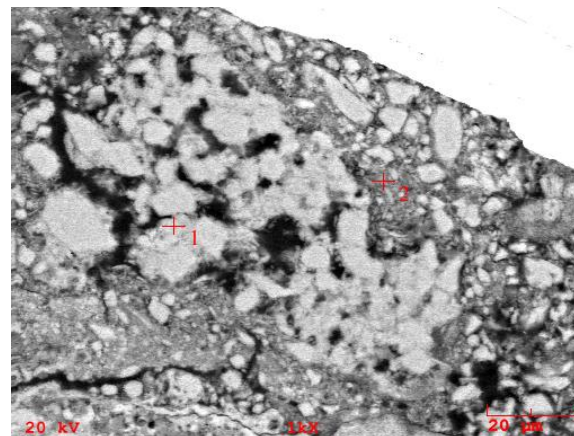
Name	Period	Sorting	Clear fine-plaster layer	Floor Thickness	Carbon/Charcoal	Organic Material	Surface Burnt	Observations
Civ1	LPC	Good			X			The Fine-plaster layer was missing or completely eroded.
Civ2	LPC	Well	Y	1 mm				
Hol1		Good						
Hol2	LPC	Good	Y	0.5 mm	X			
Hol3	LPC	Well			X	X		
Hol4	LPC	Well	Y	> 0.5 mm				
Hol5	LPC	Well	Y	0.5 mm	X			
Hol6	LPC	Good/poor	Y	0.5 mm	X			
Hol7	LPC	Well	Y	0.5	X			
Hol8	LPC	Good	Y	1 mm	X			
Hol9	EC					X		No fine-plaster layer.
Wit1	LC	Poor		0.5 mm			Y	
Wit1b	LC	Poor			X		Y	
Wit2	LPC	Poor						Marl or sascab floor.
Wit3	LPC	Poor			X			Large (and coarse) pieces of limestone found in the sample. Marl or sascab floor.
Wit4	LPC	Good	Y	3-4 mm				Evidence of dolomite mixed with calcite in the coarse-plaster layer.
Wit5	LC	Well/Good					Y	
Wit6	LC	Good	Y	2 mm		X	Y	Evidence of dolomite mixed with calcite in the coarse-plaster floor.
Wit7	LC	Poor	Y	1 mm		X	Y	

Appendix A.2: Images taken with SEM-EDS



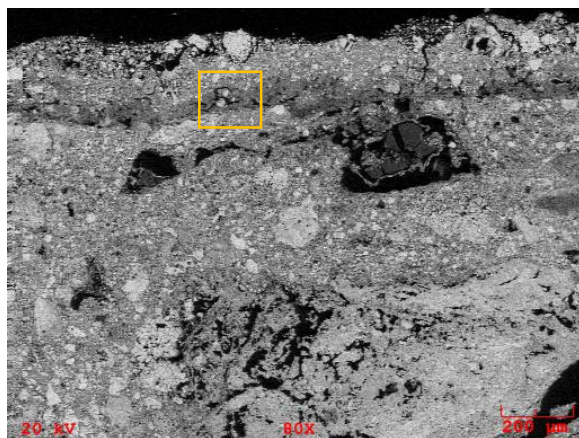
Hol2.
80x

The stark
white
particle is
barite.

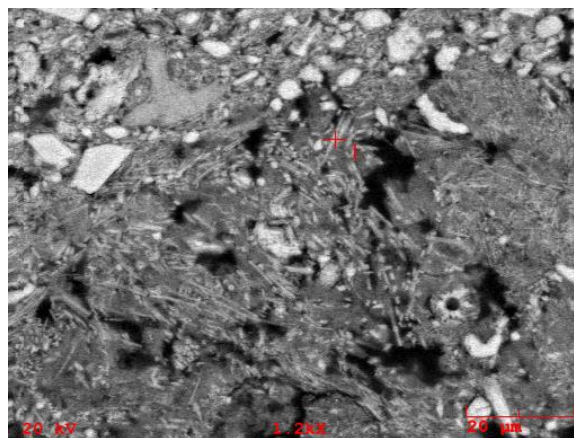


Hol2.
1000x

This set of images focuses on the fine-plaster layer of sample Hol2. Images by Kaitlin R. Ahern.

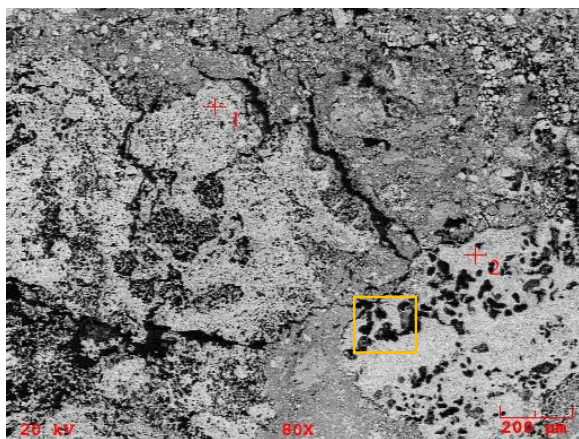


Hol5.
80x.

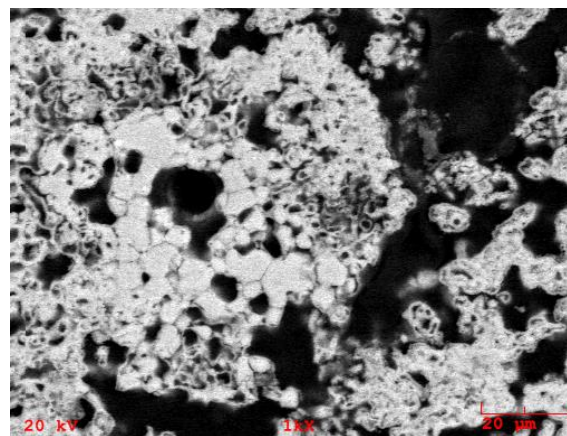


Hol5.
1200x

These images focus on the fine-plaster layer of sample Hol5. The second image highlights the transition from the fine-plaster to the coarse-plaster layer. Images by Kaitlin R. Ahern.

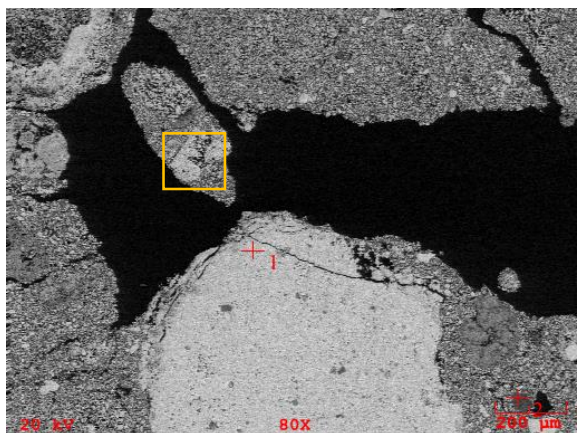


Hol6.
80x

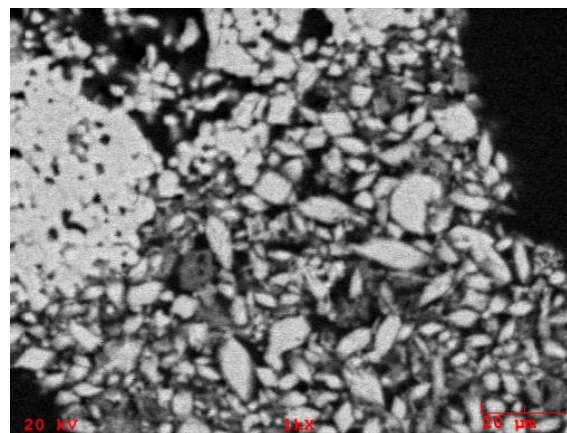


Hol6.
1000x

Both images show the coarse-plaster layer of sample Hol6. Images by Kaitlin R. Ahern.

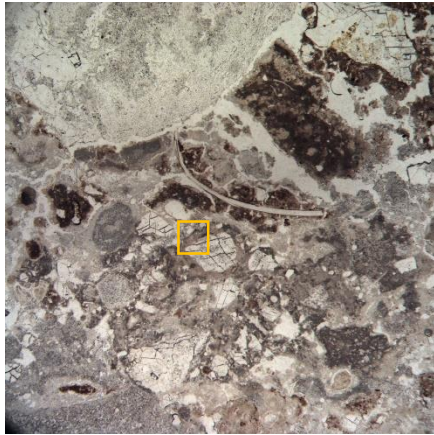


Hol7.
80x

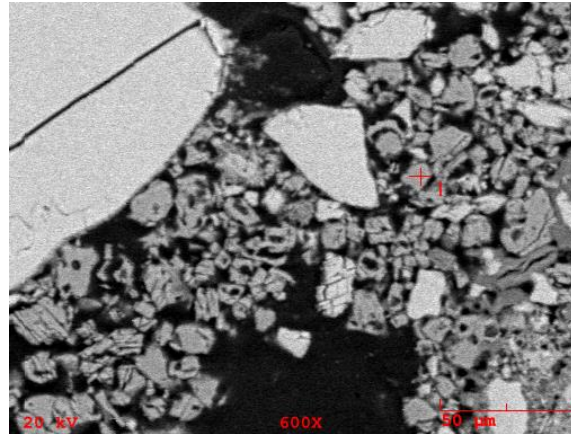


Hol7.
1000x

This set of images focuses on the coarse-plaster layer of sample Hol7. Images by Kaitlin R. Ahern.



Optical image of Wit4 that highlights the location of the adjunct image that was taken with SEM-EDS.



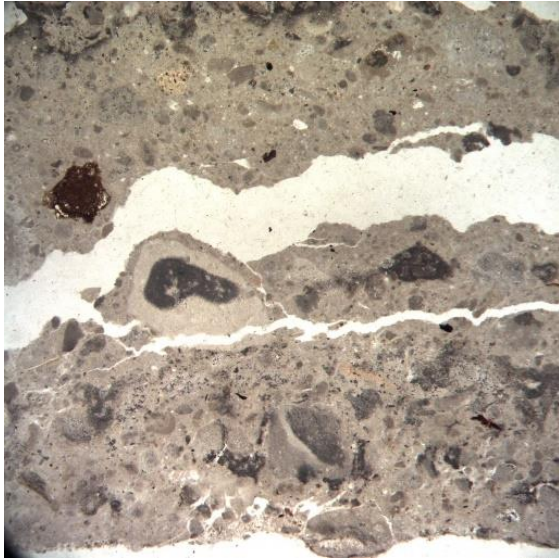
Wit4. 600x.

Inclusion of dolomite and calcite.

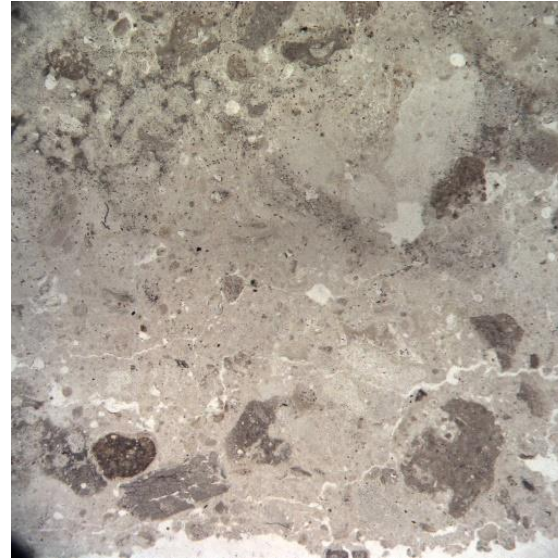
Image taken with SEM-EDS.

Images by Kaitlin R. Ahern.

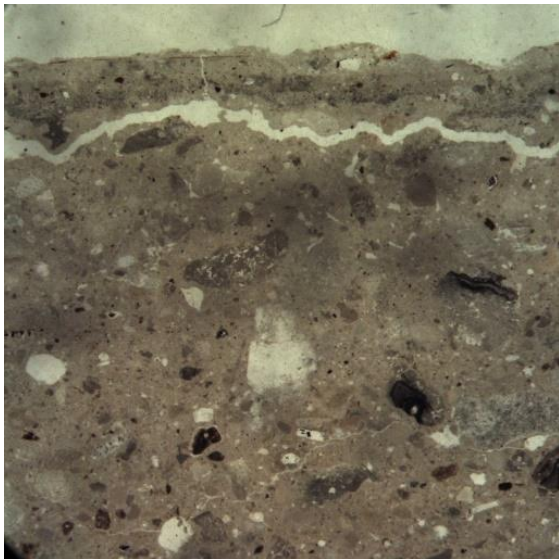
Appendix A.3: Thin Sections under Optical Microscope



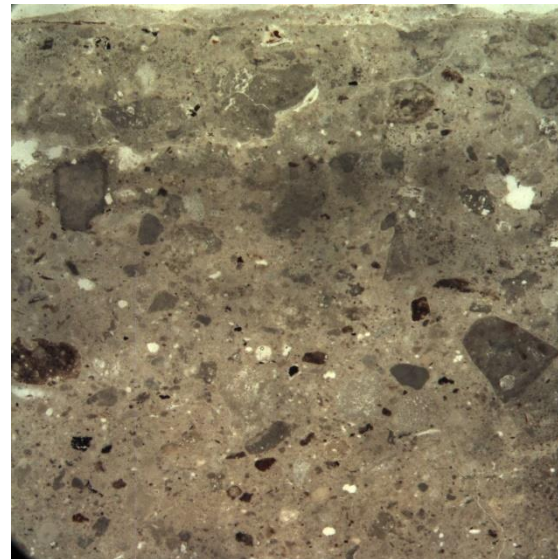
Sample Civ2.
2.5x



Sample Hol1.
2.5x

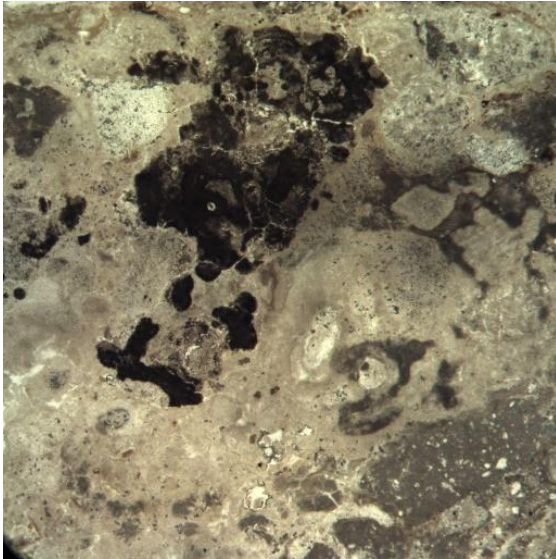


Sample Hol4.
2x. Note the thin
line at the top of
the sample.

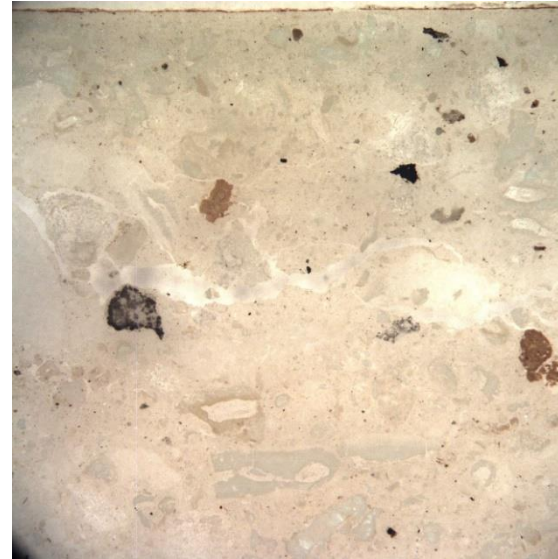


Sample Hol5.
1.5x.

Note the thin red
line at the top of
the sample.



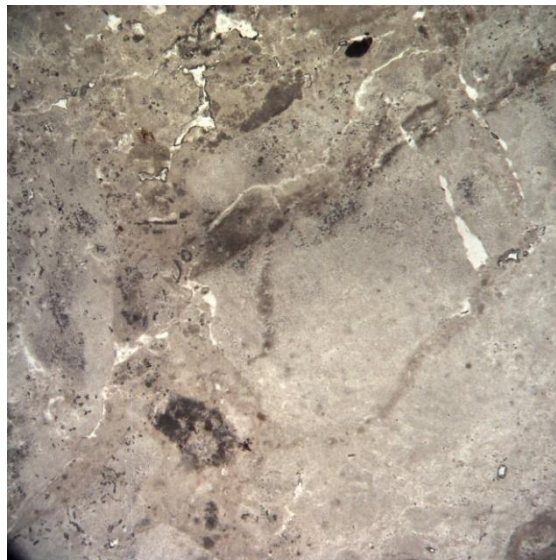
Sample Hol6.
2.5x



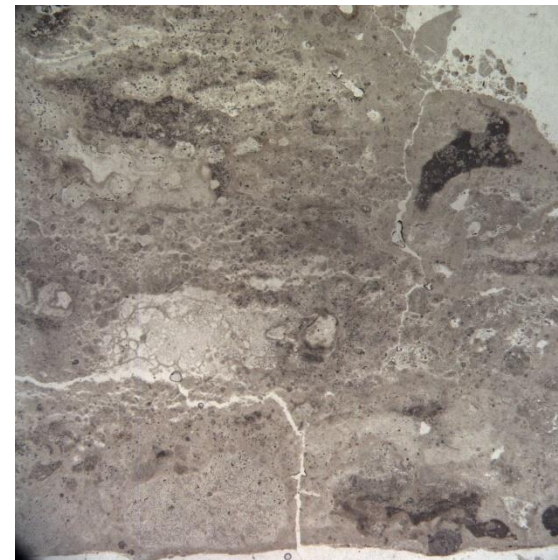
Sample Hol7.
1x

This image is oversaturated with light, as the color of this sample was the same as found in Sample Hol8.

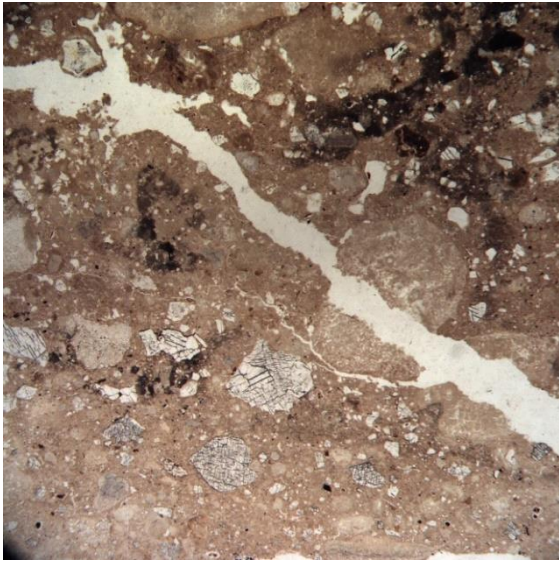
The thin red line at the top of the sample is a layer of painted plaster.



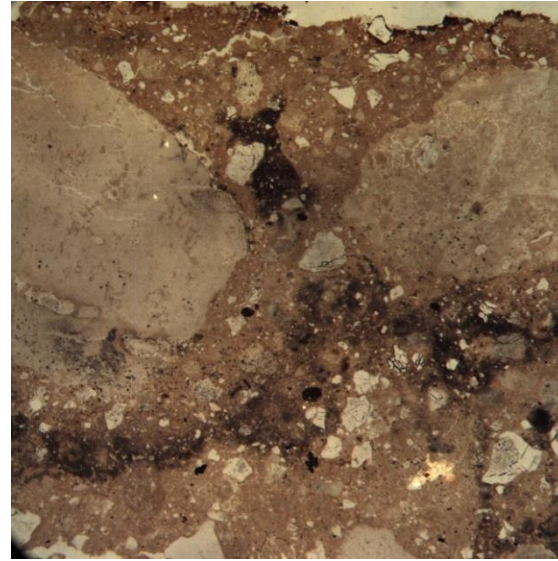
Sample Hol8.
2.5x



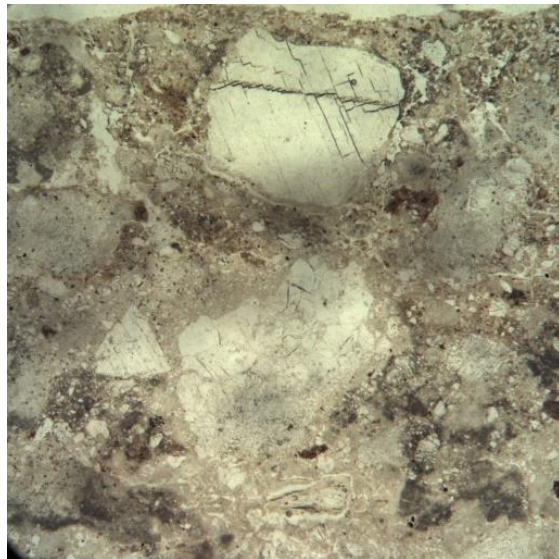
Sample Hol9.
2.5x



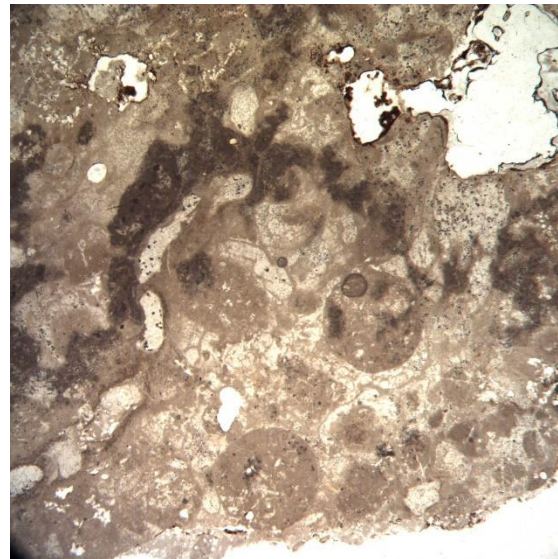
Sample Wit1.
2.5x



Sample Wit1b.
2.5x



Sample Wit2.
2.5x

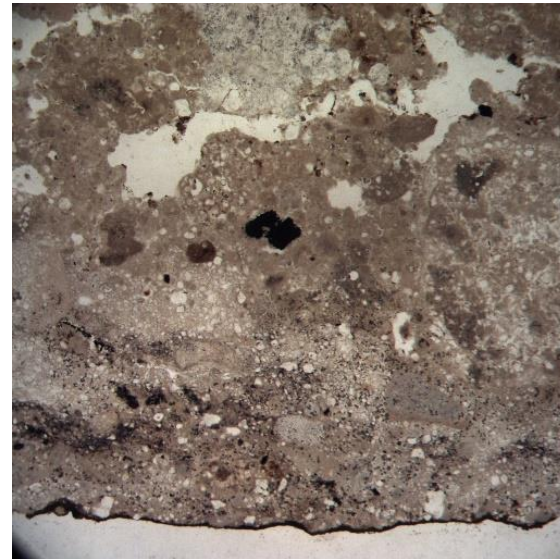


Sample Wit3.
2.5x

Note the peloids
towards the bottom
of the image.

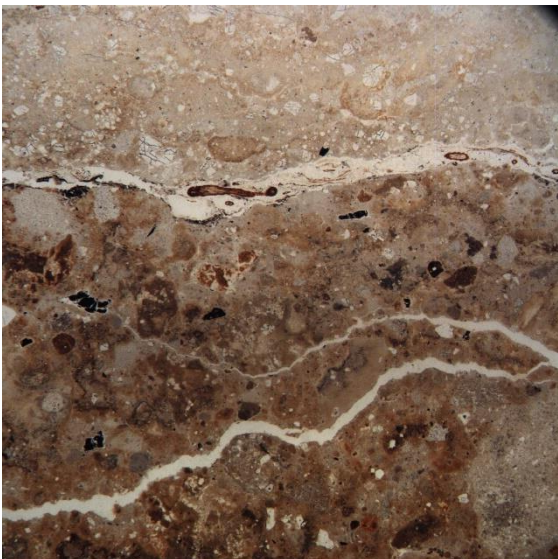


Sample Wit4.
2.5x



Sample Wit5.
3.5x

Note the dark color
of the floor.



Sample Wit6.
2.5x

Note the organics
separating the
fine-plaster and
coarse-plaster
layers.



Sample Wit7.
1x

Appendix B: Bulk portable XRF data

The pXRF data was obtained via a Bruker Tracer 5i handheld energy dispersive X-ray spectrometer. Multiple readings were taken for each sample with the goal of measuring the different plaster layers. I was also interested in investigating the homogeneity and heterogeneity of the various parts of the samples. The most heterogeneity occurred between the fine-and coarse-plaster layers, which was expected as the latter always contained aggregates. There were a couple of minor complications encountered when obtaining and later examining the portable XRF readings of these samples. Although I labeled certain readings as fine-plaster, these layers were generally too thin to examine on their own. Thus, the readings for the fine-plaster layers frequently incorporated some of the coarse-plaster layers. In addition, two of the samples (Civ1 and Wit5) lacked any demarcation between a fine-and coarse-plaster layer. Thus, the readings for these samples are divided into their physical positioning on the sample and are labeled top and middle. Finally, sample Wit4 was not included in the following PXRF tables as it was a distinct outlier when compared with the other samples.

Sample	Al K12	Ar K12	Ba L1	Ca K12	Cl K12	Cr K12	Fe K12	K K12	Mg K12	Mn K12	P K12	Rh L1	S K12	Si K12	Ti K12
Civ1 top	2853	6450	299	1084562	18021	393	20630	9146	227	387	499	27687	2041	21461	2021
Civ1 middle	1167	5338	351	1176126	13678	57	4624	5647	135	333	342	27687	1868	8364	66
Civ2 coarse-plaster	1484	5175	367	1373594	8860	332	5537	2622	229	282	641	27687	3281	12234	22
Civ2 fine-plaster	1546	4832	351	1488043	9775	227	5887	2578	155	361	466	27687	2429	10338	181
Civ2 coarse-plaster	1508	5138	397	1404692	8081	189	8110	2655	108	205	770	27687	3354	9380	54
Hol1 intrusion	1454	5430	304	1299593	2616	125	4352	3597	182	37	651	27687	1186	7997	144
Hol1 fine-plaster	1589	5729	231	1073315	4376	298	9002	4860	195	474	180	27687	1502	22279	563
Hol2 coarse-plaster	1526	6154	334	1226208	6168	434	5924	4695	124	80	396	27687	1436	26824	312
Hol2 fine-plaster	1244	6316	335	700403	6816	370	5027	10646	178	423	5473	27687	1125	30502	626
Hol3 coarse-plaster	2557	6601	461	1001247	9560	641	11779	18798	184	385	146	27687	1811	50111	914
Hol3 fine-plaster	2173	6815	442	804709	9914	705	12116	18774	210	639	199	27687	4474	66457	1306
Hol3 inclusion	2420	7539	653	960425	10121	919	11548	20432	177	534	132	27687	2649	80029	772

Sample	Al K12	Ar K12	Ba L1	Ca K12	Cl K12	Cr K12	Fe K12	K K12	Mg K12	Mn K12	P K12	Rh L1	S K12	Si K12	Ti K12
Hol4 coarse- plaster	2406	6682	417	1347661	7418	526	15437	5712	197	416	369	27687	1818	29629	1352
Hol4 fine- plaster	1298	6262	681	1023742	12510	390	6360	5743	155	220	494	27687	1622	17923	275
Hol5 coarse- plaster	1485	5750	330	1376072	6695	139	6500	3230	160	70	587	27687	1639	13075	264
Hol5 fine- plaster	1325	6089	542	1101955	8053	323	5991	6094	94	371	300	27687	1708	17290	396
Hol6 coarse- plaster	1118	5686	482	1022516	11512	154	4400	4445	170	301	699	27687	1328	6759	1
Hol6 fine- plaster	1100	6811	179	1296221	13493	42	3952	3222	248	202	639	27687	1723	3034	64
Hol7 coarse- plaster	2054	6254	497	1241240	7978	485	8610	3881	193	221	558	27687	922	26740	523
Hol7 fine- plaster	1365	6063	487	1026321	14542	125	8127	4999	196	301	435	27687	1028	10242	110
Hol8 coarse- plaster	1607	5528	416	1228396	8793	297	7421	2400	198	389	513	27687	1750	25576	281
Hol8 fine- plaster	1402	6302	382	1155314	8667	227	5298	3998	205	366	556	27687	2403	24986	209

Sample	Al K12	Ar K12	Ba L1	Ca K12	Cl K12	Cr K12	Fe K12	K K12	Mg K12	Mn K12	P K12	Rh L1	S K12	Si K12	Ti K12
Hol9 fine- plaster	1271	5723	297	892522	9340	330	5066	6740	156	179	279	27687	1594	24497	353
Hol9 inclusion	1643	5459	374	1515682	3370	222	6331	4542	172	180	844	27687	1884	7057	97
Wit1 coarse- plaster	1801	5095	599	1322601	9542	243	9333	4328	158	235	520	27687	1033	11055	562
Wit1 fine- plaster	1137	7059	449	462599	1923	246	4326	12922	151	643	103	27687	794	23208	470
Wit1b coarse- plaster	2070	5744	283	1457606	7991	430	10718	3909	273	107	677	27687	1130	11783	611
Wit1b fine- plaster	1653	6248	595	1024717	7673	297	7167	9197	147	418	430	27687	1153	16297	246
Wit2 inclusion	1722	7909	266	2135246	534	443	3175	1517	271	60	1041	27687	973	3372	1
Wit2 fine- plaster	2561	4588	219	943084	5432	468	13395	4168	145	156	295	27687	368	18795	1206
Wit3 coarse- plaster	1198	4792	418	1233939	8597	297	6778	2990	216	335	500	27687	942	5342	356
Wit3 fine- plaster	1827	5555	341	1162770	9349	133	9303	3317	210	300	800	27687	813	10560	382
Wit3 inclusion	1487	6422	302	1964452	1	234	3146	351	527	456	1437	27687	1095	2484	1

Sample	Al K12	Ar K12	Ba L1	Ca K12	Cl K12	Cr K12	Fe K12	K K12	Mg K12	Mn K12	P K12	Rh L1	S K12	Si K12	Ti K12
Wit5 top	1418	6301	278	1184028	13748	200	7192	4800	241	470	485	27687	1050	7965	607
Wit5 middle	1622	5534	374	1282272	8480	204	7955	4624	273	149	700	27687	995	8583	283
Wit6 coarse-plaster	1443	5012	644	1395065	4744	41	5116	2973	289	253	849	27687	1467	5987	65
Wit6 fine-plaster 1	910	5532	476	613689	2071	162	4080	9056	180	423	287	27687	628	10394	199
Wit6 fine-plaster 2	1142	5625	340	684996	2431	329	4609	8891	277	456	161	27687	846	10309	219
Wit7 coarse-plaster	1658	6225	414	1171526	10091	70	7993	8943	238	103	617	27687	1278	8962	692
Wit7 fine-plaster	1618	6767	415	1108180	8854	126	8104	6533	343	474	367	27687	1756	12346	452

BIBLIOGRAPHY

Abrams, Elliot M. 1994. *How the Maya Built their World: Energetics and Ancient Architecture*. Austin: University of Texas Press.

Abrams, Elliot M. 1996. "The Evolution of Plaster Production and the Growth of the Copan Maya State". In *Arqueología Mesoamericana. Homenaje a William T. Sanders 2*, coordinated by A. Guadalupe Mastache, Jeffrey R. Parson, Robert S. Santley, and Mari Carmen Serra Puche, 193-208. Mexico: INAH.

Abrams, Elliot M., and Ann Corinne Freter. 1996. "A Late Classic Lime-Plaster Kiln from the Maya Centre of Copan, Honduras". *Antiquity* 70 (268): 422-428.

Abrams, Elliot M., John Parhamovich, Jared A. Butcher, and Bruce McCord. 2012. "Chemical Composition of Architectural Plaster at the Classic Maya Kingdom of Piedras Negras, Guatemala". *Journal of Archaeological Science* 39 (5): 1648-1654.

Adams, Richard E. W. and T. Patrick Culbert. 1977. "The Origins of Civilization in the Maya Lowlands". In *Origins of Maya Civilization*, edited by Richard E. W. Adams, 3-24. Albuquerque: University of New Mexico Press.

Agrinier, Pierre. 2000. *Mound 27 and the Middle Preclassic Period at Mirador, Chiapas, Mexico*. (Papers of the New World Archaeological Foundation). No. 58. Utah: Brigham Young University.

Ahern, Kaitlin. 2014a. "Building a Legacy: Preliminary Considerations of Architecture and Urbanism in the Middle Formative Period Maya Lowlands." Unpublished MA thesis, University at Buffalo.

Ahern, Kaitlin. 2014b. "Informe por Excavación CIV.T.12, Estructura 9, Cival". In *Investigaciones Arqueológicas en la region de Holmul, Peten, Guatemala. Informe Preliminar de la Temporada 2014*, edited by Francisco Estrada-Belli. Boston University.

Ahern, Kaitlin. 2019. "Informe de la Atalaya, Witzna Este, Witzna". In *Investigaciones Arqueológicas en la region de Holmul, Petén, Guatemala. Informe Preliminar de la Temporada 2018*, edited by Francisco Estrada-Belli, 110-134. Boston University. Electronic document, <https://www.bu.edu/holmul/reports>, accessed May 3, 2020.

Ahern, Kaitlin. 2020. "Excavación WIT.T.13, La Atalaya, Witzna Este." In *Investigaciones Arqueológicas en la region de Holmul, Petén, Guatemala. Informe Preliminar de la Temporada 2019*, edited by Francisco Estrada-Belli, 106-114. Boston University. Electronic document, <https://www.bu.edu/holmul/reports>, accessed May 3, 2020.

Ahern, Kaitlin and M. M. Colindres Díaz. 2015. "Informe de la Excavacion CIV.T.71, Estructura 9, Cival". In *Investigaciones Arqueológicas en la region de Holmul, Peten, Guatemala*. Informe Preliminar de la Temporada 2014, edited by Francisco Estrada-Belli, 34-41. Boston University. Electronic document, <https://www.bu.edu/holmul/reports>, accessed May 3, 2020.

Aimers, James J, and Prudence M. Rice. 2006. "Astronomy, Ritual, and the Interpretation of Maya "E-Groups" Architectural Assemblages". *Ancient Mesoamerica* 17: 79-96.

Aoyama, Kazuo, Takeshi Inomata, Daniela Triadan, Flory Pinzón, Juan Manuel Palomo, Jessica MacLellan, and Ashley Sharpe. 2017. "Early Maya Ritual Practices and Craft Production: Late Middle Preclassic Ritual Deposits Containing Obsidian Artifacts at Ceibal, Guatemala." *Journal of Field Archaeology* 42 (5): 408-422.

Aoyama, Kazuo, Takeshi Inomata, Flory Pinzón, and Juan Manuel Palomo. 2017. "Polished Greenstone Celt Caches from Ceibal: The Development of Maya Public Rituals." *Antiquity* 91 (357): 701-717.

Arroyave, Ana Lucia, César Enriquez, Adeldo Canan, and Bhanny Girón. 2019. "Análisis de Cerámica y Lítica, Temporadas 2016-2018 Proyecto Arqueológico Holmul." In *Investigaciones Arqueológicas en la region de Holmul, Petén, Guatemala. Informe Preliminar de la Temporada 2018*, edited by Francisco Estrada-Belli, 187-212. Boston University. Electronic document, <https://www.bu.edu/holmul/reports>, accessed January 12, 2019.

Arroyave, Ana Lucia. 2020. "Análisis de Cerámica. Temporada 2019." In *Investigaciones Arqueológicas en la region de Holmul, Petén, Guatemala. Informe Preliminar de la Temporada 2019*, edited by Francisco Estrada-Belli, 305-333. Boston University. Electronic document, <https://www.bu.edu/holmul/reports>, accessed May 3, 2020.

Ashmore, Wendy. 1991. "Site-planning Principles and Concepts of Directionality among the Ancient Maya." *Latin American Antiquity* 2 (3): 199-226.

Ashmore, Wendy. 1989. "Construction and Cosmology: Politics and Ideology in Lowland Maya Settlement Patterns". In *Word and Image in Maya Culture: Explorations in Language, Writing, and Representation*, edited by William F. Hanks and Don S. Rice, 272-286. Salt Lake City: University of Utah Press.

Assman, Jan. 1995. "Collective Memory and Cultural Identity". *New German Critique* 65: 125-133.

Aveni, Anthony F, Anne S. Dowd, and Benjamin Vining. 2003. "Maya Calendar Reform? Evidence from Orientations of Specializes Architectural Assemblages". *Latin American Antiquity* 14 (2): 159-178.

Aveni, Anthony F. and Horst Hartung. 1989. "Uaxactun, Guatemala, Group E and Similar Assemblages: An Archaeoastronomical Reconsideration". In *World Archaeoastronomy*, edited by Anthony F. Aveni, 441-461. Cambridge: Cambridge University Press.

Aveni, Anthony F. 1975. "Possible Astronomical Orientations in Ancient Mesoamerica". In *Archaeoastronomy in Pre-Columbian America*, edited by Anthony F. Aveni, 163-190. Austin: University of Texas Press.

Awe, Jaime Jose. 1992. "Dawn in the Land between the Rivers: Formative Occupation at Cahal Pech, Belize and its Implications for Preclassic Development in the Maya Lowlands." PhD diss., University College London (University of London).

Awe, Jaime J., Julie A. Hoggarth, and James J. Aimers. 2017. "Of Apples and Oranges: The Case of E-Groups and Eastern Triadic Architectural Assemblages". In *Maya E-Groups: Calendars, Astronomy, and Urbanism in the Early Lowlands*, edited by David A. Freidel, Arlen F. Chase, Anne S. Dowd, and Jerry Murdock, 412-449. USA: University Press of Florida.

Barba, Luis. 2013. "El Uso de la Cal en el Mundo Prehispánico Mesoamericano". In *La Cal: Historia, Propiedades y Usos*, edited by Luis Barba and Isabel Villaseñor, 19-46. Mexico City: Universidad Nacional Autónoma de México Instituto de Investigaciones Antropológicas.

Barba, Luis, Jorge Blancas, Linda R. Manzanilla, Agustín Ortiz, Donatella Barca, Gino M. Crisci, Domenico Miriello, and Alessandra Pecci. 2009. "Provenance of the Limestone used in Teotihuacan (Mexico): a Methodological Approach". *Archaeometry* 51 (4): 525-545.

Barca, Donatella, Domenico Miriello, Alessandra Pecci, Luis Barba, Agustín Ortiz, Linda R. Manzanilla, Jorge Blancas, and Gino M. Crisci. 2013. "Provenance of Glass Shards in Archaeological Lime Plasters by LA-ICP-MS: Implications for the Ancient Routes from the Gulf of Mexico to Teotihuacan in Central Mexico." *Journal of Archaeological Science* 40 (11): 3999-4008.

Beach, Timothy, Nicholas Dunning, Sheryl Luzzadder-Beach, Duncan E. Cook, and Jon Lohse. 2006. "Impacts of the Ancient Maya on Soils and Soil Erosion in the Central Maya Lowlands." *Catena* 65 (2): 166-178.

Becker, Marshall J. 1992. "Burials as Caches; Caches as Burials: A New Interpretation of the Meaning of Ritual Deposits among the Classic Period Lowland Maya." In *New Theories on the Ancient Maya*, edited by Elin C. Danien and Robert J. Sharer, 185-196. University Museum Monograph 77. Philadelphia: University of Pennsylvania.

Bishop, Ronald L., Robert L. Rands, and George R. Holley. 1982. "Ceramic Compositional Analysis in Archaeological Perspective". *Advances in Archaeological Method and Theory* 5: 275-330.

Blair, Elliot Hampton. 2015. "Making Mission Communities: Population Aggregation, Social Networks, and Communities of Practice at 17th Century Mission Santa Catalina de Guale." PhD diss., UC Berkeley.

Blake, Emma. 2004. "Space, Spatiality, and Archaeology". In *A Companion to Social Archaeology*, edited by Lynn Meskell and Robert W. Preucel, 230-254. Oxford: Blackwell Publishing Ltd.

Blezard, Robert G. 1998. "The History of Calcareous Cements". In *Lea's Chemistry of Cement and Concrete*, edited by Peter C. Hewlett, 1-23. Oxford: Elsevier Butterworth-Heinemann.

Blom, Frans. 1924. "Report on Mr. Frans Blom on the Preliminary Work at Uaxactun, Guatemala. Carnegie Institution of Washington". *Yearbook* 23 (1): 217-219.

Borgstede, Greg. 2010. "Social Memory and Sacred Sites in the Western Maya Highlands: Examples from Jacaltenango, Guatemala". *Ancient Mesoamerica* 21 (2): 385-392.

Bourdieu, Pierre. 1977. *Outline of a Theory of Practice*, translated by Richard Nice. Cambridge: Cambridge University Press. First published 1972.

Bourdieu, Pierre. 1990. *The Logic of Practice*. Stanford: Stanford University Press.

Boynton, Robert S. 1980. *Chemistry and Technology of Lime and Limestone*. New York: Wiley and Sons.

Braswell, Geoffrey E. 2003. "Introduction: Reinterpreting Early Classic Interaction." *The Maya and Teotihuacan: Reinterpreting Early Classic Interaction*, edited by Geoffrey E. Braswell, 1-43. Austin: University of Texas Press.

Brenner, Mark, Michael F. Rosenmeier, David A. Hodell, and Jason H. Curtis. 2002. "Paleolimnology of the Maya lowlands: Long-Term Perspectives on Interactions among Climate, Environment, and Humans." *Ancient Mesoamerica* 13 (1): 141-157.

Brown, Kathryn M. and James F. Garber. 2008. "Establishing and Reusing Sacred Place: A Diachronic Perspective from Blackman Eddy, Belize." In *Ruins of the Past: The Use and Perception of Abandoned Structures in the Maya Lowlands*, edited by Travis W. Stanton and Aline Magnoni, 147-170. Boulder, CO: University Press of Colorado.

Callaghan, Michael G., and Nina Neivens de Estrada. 2016. *The Ceramic Sequence of the Holmul Region, Guatemala*. Tucson: University of Arizona Press.

Callaghan, Michael George. 2008. "Technologies of Power: Ritual Economy and Ceramic Production in the Terminal Preclassic Period Holmul region, Guatemala." PhD diss., Vanderbilt University.

Calvo, Josué. 2014. "Excavación CIV.T.68, Estructura 9, Grupo E, Cival." In *Investigaciones Arqueológicas en la region de Holmul, Peten, Guatemala*. Informe Preliminar de la Temporada 2014, edited by Francisco Estrada-Belli, 58-75. Boston University. Electronic document, <https://www.bu.edu/holmul/reports>, accessed, January 12, 2019.

Canuto, Marcello A., Francisco Estrada-Belli, Thomas G. Garrison, Stephen D. Houston, Mary Jane Acuña, Milan Kováč, Damien Marken, et al. 2018. "Ancient lowland Maya Complexity as Revealed by Airborne Laser Scanning of Northern Guatemala." *Science* 361 (6409): eaau0137. [10.1126/science.aau0137](https://doi.org/10.1126/science.aau0137)

Carcuz Chinchilla, Sheryl 2020. "Excavación Witzna Este, Atalaya, Murallas que Protegían la Atalaya." In *Investigaciones Arqueológicas en la region de Holmul, Petén, Guatemala. Informe Preliminar de la Temporada 2019*, edited by Francisco Estrada-Belli, 115-134. Boston University. Electronic document, <https://www.bu.edu/holmul/reports>, accessed May 3, 2020.

Castanzo, Ronald A., and J. Heath Anderson. 2004. "Formative Period Lime Kilns in Puebla, Mexico." *Mexicon* 26: 86-90.

Chase, Arlen F., and Diana Z. Chase. 1995. "External Impetus, Internal Synthesis and Standardization: E-Group Assemblages and the Crystallization of Classic Maya Societies in the Southern Lowlands." In *The Emergence of Maya Civilization: The Transition from the Pre-Classic to the Early Classic*, edited by Nikolai Grubb, 87-101. Acta Mesoamericana, 8. Verlag Anton Saurwein.

Chase, Diane Z., and Arlen F. Chase. 1998. "The Architectural Context of Caches, Burials, and Other Ritual Activities for the Classic Period Maya (as reflected at Caracol, Belize)." In *Function and Meaning in Classic Maya Architecture*, edited by Stephen D. Houston, 299-332. USA: Dumbarton Oaks.

Clark, John E. 2004. "Mesoamerica goes Public: Early Ceremonial Centers, Leaders, and Communities." In *Mesoamerican Archaeology*, edited by Julia A. Hendon and Rosemary Joyce, 43-72. Malden, MA: Blackwell Publishing Ltd.

Clark, John E., and Richard D. Hansen. 2001. "The Architecture of Early Kingship: Comparative Perspectives on the Origins of the Maya Royal Court." In *Royal Courts of the Ancient Maya: Volume 2: Data and Case Studies*, edited by Takeshi Inomata and Stephen D. Houston, 102-137. Boulder, Colorado: Westview Press.

Coe, Michael D. 1977. "Olmec and the Maya: A Study in Relationships." In *Origins of Maya Civilization*, edited by Richard E. W. Adams, 183-196. Albuquerque: University of New Mexico Press.

Coe, Michael D. 1956. "The Funerary Temple among the Classic Maya." *Southwestern Journal of Anthropology* 12 (4): 387-394.

Coe, Michael D. 1987. *The Maya*. 4th edition. Great Britain: Thames and Hudson.

Coe, William R. 1959. *Piedras Negras Archaeology: Artifacts, Caches, and Burials*. Philadelphia: University Museum, University of Pennsylvania.

Coe, William R. 1990. *Tikal Report No. 14. Volume I. Excavations in the Great Plaza, North Terrace and North Acropolis of Tikal*. Philadelphia: University Museum, University of Pennsylvania.

Coggins, Clemency C. 1980. "The Shape of Time: Some Political Implications of a Four Part Figure." *American Antiquity* 45 (4): 727-739.

Connerton, Paul. 1989. *How Societies Remember*. Cambridge: Cambridge University Press.

Craig, Nathan, Robert J. Speakman, Rachel S. Popelka-Filcoff, Michael D. Glascock, J. David Robertson, M. Steven Shackley, and Mark S. Aldenderfer. 2007. "Comparison of XRF and PXRF for Analysis of Archaeological Obsidian from Southern Peru." *Journal of Archaeological Science* 34 (12): 2012-2024.

Cresswell, Tim. 2009. "Place." In *International Encyclopedia of Human Geography*, edited by Rob Kitchin and Nigel Thrift, 169-177. Oxford: Elsevier.

Cyphers, Ann, and Anna Di Castro. 2009. "Early Olmec Architecture and Imagery." In *The Art of Urbanism: How Mesoamerican Kingdoms Represented Themselves in Architecture and Imagery*, edited by William L. Fash and Leonardo López Luján, 21-52. Washington, DC: Dumbarton Oaks.

Dix, Brian. 1982. "The Manufacture of Lime and its Uses in the Western Roman Provinces." *Oxford Journal of Archaeology* 1 (3): 331-346.

Dobres, Marcia-Anne, and John E. Robb. 2000. "Agency in Archaeology: Paradigm or Platitute." In *Agency in Archaeology*, edited by Marcia-Anne Dobres and John E. Robb, 2-14. New York: Routledge Publishing.

Dornan, Jennifer L. 2002. "Agency and Archaeology: Past, Present, and Future Directions." *Journal of Archaeological Method and Theory* 9 (4): 303-329.

Doyle, James. 2012. "'Regroup on 'E-Groups': Monumentality and Early Centers in the Middle Preclassic Maya Lowlands." *Latin American Antiquity* 23 (4): 355-379.

Doyle, James. 2017. "A Tale of Two E-Groups: El Palmar and Tikal, Petén, Guatemala." In *Maya E-Groups: Calendars, Astronomy, and Urbanism in the Early Lowlands*, edited by David A., Freidel, Arlen F. Chase, Anne S. Dowd, and Jerry Murdock, 253-292. Florida: University Press of Florida.

Drucker, Philip, Robert F. Heizer, and Robert J. Squier. 1959. *Excavations at La Venta Tabasco, 1955*. Bureau of American Ethnology Bulletin 170. Smithsonian Institution, Washington, DC.

Dunning, Nicholas, David Wahl, Timothy Beach, John Jones, Sheryl Luzzadder-Beach, and Carmen McCane. 2014. "The End of the Beginning: Drought, Environmental Change, and the Preclassic to Classic Transition in the East-Central Maya Lowlands." In *The Great Maya*

Droughts in Cultural Context: Case Studies in Resilience and Vulnerability, edited by Gyles Iannone, 107-126. Boulder: University Press of Colorado.

Eckert, Suzanne L., Kari L. Schleher, and William D. James. 2015. "Communities of Identity, Communities of Practice: Understanding Santa Fe Black-on-White Pottery in the Española Basin of New Mexico." *Journal of Archaeological Science* 63: 1-12.

Elsen, Jan. 2006. "Microscopy of Historic Mortars—a Review." *Cement and Concrete Research* 36 (8): 1416-1424.

Estrada-Belli, Francisco, and Alexandre Tokovinine. 2016. "A King's Apotheosis: Iconography, Text, and Politics from a Classic Maya Temple at Holmul." *Latin American Antiquity* 27 (2): 149-168.

Estrada-Belli, Francisco, Jeremy Bauer, Molly Morgan, and Angel Chavez. 2003. "Symbols of Early Maya Kingship at Cival, Petén, Guatemala." *Antiquity* 77 (4).

Estrada-Belli, Francisco. 2001. *Archaeological Investigations at Holmul, Guatemala. Preliminary Report of the 2001 Season*. Boston University Archaeology Department, Boston. Electronic document, <https://www.bu.edu/holmul/reports>, accessed, January 12, 2019.

Estrada-Belli, Francisco. 2004. *Investigaciones Arqueológicas en la region de Holmul, Petén, Guatemala. Informe Preliminar de la Temporada 2003*. Boston University Archaeology Department, Boston. Electronic document, <https://www.bu.edu/holmul/reports>, accessed, January 12, 2019.

Estrada-Belli, Francisco. 2005. *Investigaciones Arqueológicas en la region de Holmul, Petén, Guatemala. Informe Preliminar de la Temporada 2004*. Boston University Archaeology Department, Boston. Electronic document, <https://www.bu.edu/holmul/reports>, accessed, January 12, 2019.

Estrada-Belli, Francisco. 2006. "Lightning Sky, Rain, and the Maize God: the Ideology of Preclassic Maya Rulers at Cival, Petén, Guatemala." *Ancient Mesoamerica* 17 (1): 57-78.

Estrada-Belli, Francisco. 2008. *Investigaciones Arqueológicas en la region de Holmul, Petén: Holmul, Cival, La Sufricaya y K'o. Informe Preliminar de la Temporada 2007*. Boston University Archaeology Department, Boston. Electronic document, <https://www.bu.edu/holmul/reports>, accessed, January 12, 2019.

Estrada-Belli, Francisco. 2009. *Investigaciones Arqueológicas en la region de Holmul, Petén: Holmul y Hamontun. Informe Preliminar de la Temporada 2009*. Boston University Archaeology Department, Boston. Electronic document, <https://www.bu.edu/holmul/reports>, accessed, January 12, 2019.

Estrada-Belli, Francisco. 2011. *The First Maya Civilization: Ritual and Power Before the Classic Period*. New York: Routledge.

Estrada-Belli, Francisco. 2012. "Early Civilization in the Maya Lowlands, Monumentality, and Place Making: a View from the Holmul Region." In *Early New World Monumentality*, edited by Richard L. Burger and Robert M. Rosenwig, 198-227. Gainesville: University Press of Florida.

Estrada-Belli, Francisco. 2014. *Investigaciones Arqueológicas en la region de Holmul, Petén, Guatemala. Informe Preliminar de la Temporada 2013*. Boston University Archaeology Department, Boston. Electronic document, <https://www.bu.edu/holmul/reports>, accessed, January 12, 2019.

Estrada-Belli, Francisco 2015. *Investigaciones Arqueológicas en la region de Holmul, Petén, Guatemala. Informe Preliminar de la Temporada 2014*. Boston University Archaeology Department, Boston. Electronic document, <https://www.bu.edu/holmul/reports>, accessed, January 12, 2019.

Estrada-Belli, Francisco. 2016a. "Regional and Interregional Interaction and the Preclassic Maya." In *The Origins of Maya States*, edited by Loa P. Traxler and Robert J. Sharer, 225-270. Vol. 7. Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology.

Estrada-Belli, Francisco. 2016b. *Investigaciones Arqueológicas en la region de Holmul, Petén, Guatemala. Informe Preliminar de la Temporada 2016*. Boston University Archaeology Department, Boston. Electronic document, <https://www.bu.edu/holmul/reports>, accessed, January 12, 2019.

Estrada-Belli, Francisco. 2017. "The History, Function, and Meaning of Preclassic E Groups in the Cival Region." In *Maya E-Groups: Calendars, Astronomy, and Urbanism in the Early Lowlands*, edited by David A., Freidel, Arlen F. Chase, Anne S. Dowd, and Jerry Murdock, 293-327. Florida: University Press of Florida.

Estrada-Belli, Francisco, ed. 2019. *Investigaciones Arqueológicas en la region de Holmul, Petén, Guatemala. Informe Preliminar de la Temporada 2018*. Boston University Archaeology Department, Boston. Electronic document, <https://www.bu.edu/holmul/reports>, accessed, July 26, 2019.

Fialko, Vilma. 2005. "Diez Años de Investigaciones Arqueológicas en la cuenca del Río Holmul, Región noreste de Petén". In *XVIII Simposio de Investigaciones Arqueológicas en Guatemala*, , edited by Juan Pedro Laporte, Barbara Arroyo, and Héctor E. Mejía, 244-260. Museo Nacional de Arqueología y Etnología, Guatemala.

Fenn, Thomas R., Barbara J. Mills and Maren Hopkins. 2006. "The Social Contexts of Glaze Paint Ceramic Production and Consumption in the Silver Creek Area." In *The Social Life of Pots: Glaze Wares and Cultural Dynamics in the Southwest, Ad 1250-1680*, edited by Judith A. Habicht-Mauche, Suzanne L. Eckert and Deborah L. Huntley, 60-85. Tucson: University of Arizona Press.

- Fentress, James J., and Chris Wickham. 1992. *Social Memory*. Oxford, UK: Blackwell
- Folan, William J., Betty Faust, Wolfgang Lutz, and Joel D. Gunn. 2000. "Social and Environmental Factors in the Classic Maya Collapse." In *Population, Development, and Environment on the Yucatan: From Ancient Maya to 2030*, edited by Wolfgang Lutz, Leonel Prieto, and Warren Sanderson, 2-32. International Institute for Applied Systems Analysis.
- Garber, James F., M. Kathryn Brown, J. J. Awe, and Christopher J. Hartman. 2004a. "Middle Formative Prehistory of the Central Belize Valley: An Examination of Architecture, Material Culture, and Sociopolitical Change at Blackman Eddy." In *The Ancient Maya of the Belize Valley: Half a Century of Archaeological Research*, edited by James F. Garber, 24-47. Florida: University Press of Florida
- Garber, James F., M. K. Brown, W. D. Driver, D. M. Glassman, C. J. Hartman, F. K. Reilly and L. Sullivan. 2004b. "Archaeological Investigations at Blackman Eddy." In *The Ancient Maya of the Belize Valley: Half a Century of Archaeological Research*, edited by James F. Garber, 48-85. Gainesville, Florida: University Press of Florida.
- Garber, James F., and Jaime J. Awe. 2009. "A Terminal Early Formative Symbol System in the Maya Lowlands: the Iconography of the Cunil Phase (1100-900BC) at Cahal Pech." *Research Reports in Belizean Archaeology* 6: 151-159.
- Gerhardt, Juliette C. 1988. *Preclassic Maya Architecture at Cuello, Belize*. Oxford: British Archaeological Reports, International Series 464.
- Gerhardt, Juliette C., and Norman Hammond. 1991. "The Community of Cuello: The Ceremonial Core." In *Cuello: An Early Maya Community in Belize*, edited by Norman Hammond, 98-117. Cambridge: Cambridge University Press.
- Giddens, Anthony. 1979. *Central Problems in Social Theory: Action, Structure, and Contradiction in Social Analysis*. Berkeley and Los Angeles: University of California Press.
- Giddens, Anthony. 1984. *The Constitution of Society: Outline of the Theory of Structuration*. Berkeley and Los Angeles: University of California Press.
- Giddens, Anthony. 1991. *Modernity and Self-Identity: Self and Society in the Late Modern Age*. Stanford University Press.
- Gillespie, Susan D. 2010. "Maya Memory Work." *Ancient Mesoamerica* 21 (2): 401-414.
- Gillot, Céline. 2014. "The Use of Pozzolanic Materials in Maya Mortars: New Evidence from Río Bec (Campeche, Mexico)." *Journal of Archaeological Science* 47: 1-9.
- Girón, Bhanny. 2019. "Witzna Este, Estructura 9." In *Investigaciones Arqueológicas en la region de Holmul, Petén, Guatemala. Informe Preliminar de la Temporada 2018*, edited by Francisco Estrada-Belli, 135-159. Boston University.

Golden, Charles. 2010. "Frayed at the Edges: Collective Memory and History on the Borders of Classic Maya Polities." *Ancient Mesoamerica* 21: 373-384.

Gourdin, William Hugh, and W. David Kingery. 1975. "The Beginnings of Pyrotechnology: Neolithic and Egyptian Lime Plaster." *Journal of Field Archaeology* 2 (1-2): 133-150.

Grove, David C. 1987. "Raw Materials and Sources." In *Ancient Chalcatzingo*, edited by David C. Grove, 376-386. Austin: University of Texas Press.

Grove, David C. and Susan D. Gillespie. 2009. "People of the Cerro: Landscape, Settlement, and Art of Middle Formative Period Chalcatzingo." In *The Art of Urbanism: How Mesoamerican Kingdoms Represented themselves in Architecture and Imagery*, edited by William L. Fash and Leonardo López Luján, 53-76. Washington DC.: Dumbarton Oaks.

Halbwachs, Maurice. 1992. *On Collective Memory*, edited and translated by Lewis Coser. Illinois: Chicago University Press Chicago.

Hall, Edwin T. 1966. *The Hidden Dimension*. Garden City, NY: Doubleday.

Hall, Edwin T. 1968. "Proxemics." *Current Anthropology* 9 (1): 83-108.

Hall, Edwin T. 1972. "Silent Assumptions in Social Communication." In *People and Buildings*, edited by Robert Gutman, 135-151. New York: Basic Books.

Hammond, Norman, and Juliette Cartwright Gerhardt. 1990. "Early Maya Architectural Innovation at Cuello, Belize." *World Archaeology* 21 (3): 461-481.

Hammond, Norman, and Charles H. Miskicek. 1981. "Ecology and Economy of a Formative Maya Site at Cuello, Belize." *Journal of Field Archaeology* 8 (3): 259-269.

Hansen, Eric F., Carlos Rodriguez-Navarro, and Richard D. Hansen. 1997. "Incipient Maya Burnt-lime Technology: Characterization and Chronological Variations in Preclassic Plaster, Stucco and Mortar at Nakbe, Guatemala." In *Materials Research Society Symposium Proceedings vol. 462*, edited by Pamela B. Vandiver, James R. Druzik, John Merkel, and J. Steward, 207-216. Pittsburg: Materials Research Society.

Hansen, Eric F. 2000. "Ancient Maya Burnt-Lime Technology: Cultural Implications of Technological Styles." PhD diss., University of California Press, Berkeley.

Hansen, Richard D., Steven Bozarth, John Jacob, David Wahl, and Thomas Schreiner. 2002. "Climatic and Environmental Variability in the Rise of Maya Civilization: A Preliminary Perspective from Northern Petén." *Ancient Mesoamerica* 13 (2): 273-295.

Hansen, Richard D., Wayne K. Howell, and Stanley P. Guenter. 2008. "Forgotten Structures, Haunted Houses, and Occupied Hearts: Ancient Perspectives and Contemporary Interpretations

of Abandoned Sites and Buildings in the Mirador Basin, Guatemala.” In *Ruins of the Past: The Use and Perception of Abandoned Structures in the Maya Lowlands*, edited by Travis W. Stanton and Aline Magnoni, 25-64. University Press of Colorado.

Hansen, Richard D. 1998. “Continuity and Disjunction: The Pre-Classic Antecedents of Classic Maya Architecture.” In *Function and Meaning in Classic Maya Architecture*, edited by Stephen D. Houston, 49-122. Washington, D.C.: Dumbarton Oaks.

Hansen, Richard D. 2016. “Cultural and Environmental Components of the First Maya States: A Perspective from the Central and Southern Maya Lowlands.” In *The Origins of Maya States*, edited by Loa P. Traxler and Robert J. Sharer, 329-416. Vol. 7. Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology.

Harker, Richard, Cheleen Mahar, and Chris Wilkes, eds. 2016. *An Introduction to the Work of Pierre Bourdieu: The Practice of Theory*. Springer.

Henderson, John S. 1997. *The World of the Ancient Maya*. 2nd edition. USA: Cornell University Press.

Hendon, Julia A. 2000. “Having and Holding: Storage, Memory, Knowledge, and Social Relations.” *American Anthropologist* 102: 42-53.

Hendon, Julia A. 2010. *Houses in a Landscape: Memory and Everyday Life in Mesoamerica*. Durham: Duke University Press.

Houston, Stephen D. 1998. “Classic Maya Depictions of the Built Environment.” In *Function and Meaning in Classic Maya Architecture*, edited by Stephen D. Houston, 333-372. Washington, DC: Dumbarton Oaks.

Hurst, Heather. 2009. “Murals and the Ancient Maya Artist: A Study of Art Production in the Guatemalan Lowlands.” PhD diss., Yale University.

Hughes, John J., and Jan Válek. 2003. *Mortars in Historic Buildings: A Review of the Conservation, Technical and Scientific Literature*. Edinburgh, Scotland: Historic Scotland.

Iceland, Harry B. 2005. “The Preceramic to Early Middle Formative Transition in Northern Belize: Evidence for the Ethnic identity of the Preceramic Inhabitants.” In *New Perspectives on Formative Mesoamerican Cultures*, edited by Terry G. Powis, 15-26. Oxford: BAR International Series 1377.

Inomata, Takeshi. 1997. “The Last Day of a Fortified Classic Maya Center: Archaeological Investigations at Aguateca, Guatemala.” *Ancient Mesoamerica* 8 (2): 337-351.

Inomata, Takeshi. 2014. “Plaza Builders of the Preclassic Maya Lowlands: the Construction of a Public Space and a Community at Ceibal, Guatemala.” In *Mesoamerican Plazas: Arenas of*

Community and Power, edited by Kenichiro Tsukamoto and Takeshi Inomata, 19-33. Tucson: University of Arizona Press.

Inomata, Takeshi. 2017. "The Isthmian Origins of the E Group and its Adoption in the Maya Lowlands." In *Maya E-Groups: Calendars, Astronomy, and Urbanism in the Early Lowlands*, edited by David A., Freidel, Arlen F. Chase, Anne S. Dowd, and Jerry Murdock, 215-252. Florida: University Press of Florida.

Inomata, Takeshi, and Daniela Triadan, eds. 2018. *Informe del Proyecto Arqueológico Usumacinta Medio: La Temporada de 2018*. Report presented to the Instituto Nacional de Antropología e Historia.

Inomata, Takeshi, Flory Pinzón, Juan Manuel Palomo, Ashley Sharpe, Raúl Ortiz, María Belén Méndez, and Otto Román. 2017. "Public Ritual and Interregional Interactions: Excavations of the Central Plaza of Group A, Ceibal." *Ancient Mesoamerica* 28: 203-232.

Inomata, Takeshi, Jessica MacLellan, Daniela Triadan, Jessica Munson, Melissa Burham, Kazuo Aoyama, Hiroo Nasu, Flory Pinzón, and Hitoshi Yonenobu. 2015. "Development of Sedentary Communities in the Maya Lowlands: Coexisting Mobile Groups and Public Ceremonies at Ceibal, Guatemala." *Proceedings of the National Academy of Sciences* 112 (14): 4268-4273.

Inomata, Takeshi, and Daniela Triadan. 2015. "Middle Preclassic Caches from Ceibal, Guatemala." *Maya Archaeology* 3: 56-90.

Inomata, Takeshi, and Kenichiro Tsukamoto. 2014. "Gathering in an Open Space: Introduction to Mesoamerican Plazas." In *Mesoamerican Plazas: Arenas of Community and Power*, edited by Kenichiro Tsukamoto and Takeshi Inomata, 3-15. Tucson: University of Arizona Press.

Inomata, Takeshi, Daniela Triadan, Kazuo Aoyama, Victor Castillo, and Hitoshi Yonenobu. 2013. "Early Ceremonial Constructions at Ceibal, Guatemala, and the Origins of Lowland Maya Civilization". *Science* 340 (6131): 467-471.

Joyce, Arthur A. 2009. "The Main Plaza of Monte Albán: a Life History of Place." In *The Archaeology of Meaningful Places*, edited by Brenda J. Bowser and María Nieves Zedeno, 32-52. Salt Lake City: The University of Utah Press.

Joyce, Rosemary A. 2000. "Heirlooms and Houses: Materiality and Social Memory." In *Beyond Kinship: Social and Material Reproduction in House Societies*, edited by Rosemary A. Joyce and Susan D. Gillespie, 64-76. Philadelphia: University of Pennsylvania Press.

Joyce, Rosemary A. 2003. "Concrete Memories: Fragments of the Past in the Classic Maya Present (500-1000 AD)." In *Archaeologies of Memory*, edited by Ruth M. Van Dyke and Susan E. Alcock, 104-125. Oxford: Blackwell Publishers Ltd.

Kidder, Tristram R. 2004. "Plazas as Architecture: An Example from the Raffman Site, Northeast Louisiana." *American Antiquity* 69 (3): 514-532.

Kingery, David W., Pamela B. Vandiver, and Martha Prickett. 1988. "The Beginnings of Pyrotechnology, part II: Production and use of Lime and Gypsum Plaster in the Pre-Pottery Neolithic Near East." *Journal of Field Archaeology* 15 (2): 219-243.

Kohring, Sheila. 2012. "Conceptual Knowledge as Technologically Materialised: A Case Study of Pottery Production, Consumption and Community Practice." In *Embodied Knowledge: Historical Perspectives on Technology and Belief*, edited by Marie Louise Stig Sørensen and Katharina Rebay-Salisbury, 106-116. Oxford: Oxbow.

Kosakowsky, Laura J., and Duncan C. Pring. 1998. "The Ceramics of Cuello, Belize: A New Evaluation." *Ancient Mesoamerica* 9: 55-66.

Kunen, Julie L., Mary Jo Galindo, and Erin Chase. 2002. "Pits and Bones: Identifying Maya Ritual Behavior in the Archaeological Record." *Ancient Mesoamerica* 13 (2): 197-211.

Kwoka, Joshua J. 2017. "Finding Value in the Mundane." In *The Value of Things: Prehistoric to Contemporary Commodities in the Maya Region*, edited by Jennifer P. Mathews and Thomas H. Guderjan, 49-66. Tucson: The University of Arizona Press.

Laporte, Juan Pedro and Vilma Fialko. 1995. "Un Reencuentro con Mundo Perido, Tikal, Guatemala." *Ancient Mesoamerica* 6: 41-94.

Laporte, Juan Pedro and Vilma Fialko. 1990. "New Perspectives in Old Problems: Dynastic References for the Early Classic at Tikal." In *Vision and Revision in Maya Studies*, edited by Flora Clancy and Peter Harrison, 33-66. Albuquerque: University of New Mexico Press.

Lave, Jean, and Etienne Wenger. 1991. *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press.

Leyden, Barbara W. 2002. "Pollen Evidence for Climatic Variability and Cultural Disturbance in the Maya Lowlands." *Ancient Mesoamerica* 13 (1): 85-101.

Liebmann, Matthew Joseph 2008. "The Intersections of Archaeology and Postcolonial Studies." In *Archaeology and the Postcolonial Critique*, edited by Matthew Liebmann and U.Z. Rizvi, 1-20. Lanham MD: Altamira Press.

Littmann, Edwin R. 1957. "Ancient Mesoamerican Mortars, Plasters, and Stuccos: Comalcalco, part I." *American Antiquity* 23 (2-1): 135-140.

Littmann, Edwin R. 1958. "Ancient Mesoamerican Mortars, Plasters, and Stuccos: The Composition and Origin of Sascab." *American Antiquity* 24 (2): 172-176.

Littmann, Edwin R. 1959. "Ancient Mesoamerican Mortars, Plasters, and Stuccos: Palenque, Chiapas." *American Antiquity* 25: 264-266.

- Littmann, Edwin R. 1960. "Ancient Mesoamerican Mortars, Plasters, and Stuccos: The use of Bark Extracts in Lime Plasters." *American Antiquity* 25: 593-597.
- Littmann, Edwin R. 1962. "Ancient Mesoamerican Mortars, Plasters, and Stuccos: Floor Constructions at Uaxactun." *American Antiquity* 28 (1): 100-103.
- Littmann, Edwin R. 1967. "Patterns in Maya Floor Construction." *American Antiquity* 32 (4): 523-533.
- Littmann, Edwin R. 1972. "A Study of Altar de Sacrificios Floors. Appendix C." In *Excavations at Altar de Sacrificios: Architecture, Settlement, Burials and Caches*, edited by A. Ledyard Smith. Cambridge, MA: Peabody Museum.
- Littmann, Edwin R. 1977. "The Physical Aspects of Some Teotihuacan Murals. Appendix 2." In *The Mural Painting of Teotihuacan*, edited by Arthur G. Miller, 175-189. Washington, D.C.: Dumbarton Oaks.
- Littmann, Edwin R. 1978. "Preliminary Report on Plaster Floors at Cuello, Archaeological Research Program." In *Cuello Project 1978 Interim Report, Publication 1*, edited by Norman Hammond, 88-99. New Brunswick: Douglass College, Rutgers University.
- Littmann, Edwin R. 1990. "Observations on the Floors of Platforms 5D-1 and 5D-4 (Group 5D-2). Appendix G." In *Tikal Report No. 14, Excavations in the Great Plaza, North Terrace and North Acropolis of Tikal Series*, edited by William R. Coe and William A. Haviland, 999-1002. University of Pennsylvania Museum of Archaeology and Anthropology.
- Lockett-Harris, Joshuah J. 2016. "Sacred Space, Ancestors, and Authority: New Evidence of Developing Middle Formative Period Socio-Political Complexity from Ka-Kabish, Northern Belize." MA thesis, Trent University.
- Lohse, Jon C. 2010. "Archaic Origins of the Lowland Maya." *Latin American Antiquity* 21 (3): 312-352.
- Lohse, Jon, Jaime Awe, Cameron Griffen, Robert M. Rosenwig, and Fred Valdez, Jr. 2006. "Pre-ceramic Occupations in Belize: Updating the Paleoindian and Archaic Record." *Latin American Antiquity* 17 (2): 209-226.
- Low Setha, M. 2000. *On the Plaza: The Politics of Public Space and Culture*. Austin: University of Texas Press.
- Low, Setha M., and Denise Lawrence-Zúñiga. 2003. "Locating Culture." In *The Anthropology of Space and Place: Locating Culture*, edited by Setha M. Low and Denise Lawrence-Zúñiga, 1-48. Malden, MA: Blackwell Publishers Ltd.

Lowe, Gareth W. 1981. "Olmec Horizons Defined in Mound 20. San Isidro, Chiapas." In *The Olmec and Their Neighbors: Essays in Memory of Matthew W. Stirling*, edited by Elizabeth Benson, 231-255. Washington, DC: Dumbarton Oaks.

MacKenzie, William Scott, and Anthony E. Adams. 1994. *A Color Atlas of Rocks and Minerals in Thin Section*. Manson Publishing Ltd.

MacKinnon, J. Jefferson, and Emily M. May. 1990. "Small-scale Maya Lime Making in Belize: Ancient and Modern." *Ancient Mesoamerica* 1 (2): 197-203.

Magaloni, Diana, T. Falcon, J. Cama, R. W. Siegel, R. Lee, R. Pancella, L. Baños, and V. Castano. 1992. "Electron Microscopy Studies of the Chronological Sequences of Teotihuacan Plaster Technique." In *Materials Research Society Symposium Proceedings Vol. 267: Materials Issues in Art and Archaeology III*, edited by Pamela B. Vandiver, James R. Druzik, George S. Wheeler, and Ian C. Freestone, 997-1005. Pittsburgh: Materials Research Society.

Magaloni, Diana, R. Pancella, Y. Fruh, J. Cañetas, and V. Castaño. 1995a. "Studies on the Mayan Mortars Technique." In *Materials Research Society Symposium Proceedings Vol. 352: Materials Issues in Art and Archaeology IV*, edited by Pamela B. Vandiver, James R. Druzik, Jose Luis Galvan Madrid, Ian C. Freestone, George S. Wheeler, 483-489. Pittsburgh: Materials Research Society.

Magaloni, Diana, R. Newman, L. Banos, V. Castano, R. Pancella and Y. Fruh. 1995b. "An Analysis of Mayan Painting Techniques at Bonampak, Chiapas, Mexico." In *Materials Research Society Symposium Proceedings vol. 352: Materials Issues in Art and Archaeology IV*, edited by Pamela B. Vandiver, James R. Druzik, Jose Luis Galvan Madrid, Ian C. Freestone, and George S. Wheeler, 381-388. Pittsburgh: Materials Research Society.

Magaloni, Diana. 1995. "El Espacio Pictórico Teotihuacano. Tradición y Técnica." In *La Pintura Mural Prehispánica en México*, edited by Beatriz De La Fuente, 187-225. Mexico: Universidad Nacional Autonoma de Mexico, Instituto de Investigaciones Estéticas

Magaloni, Diana. 1996. "Materiales y Tecnicas de la Pintura Mural Maya." Tesis, Universidad Nacional Autonomoa de Mexico.

Martin, Simon, and Nikolai Grube. 2008. *Chronicle of the Maya Kings and Queens: Deciphering the Dynasties of the Ancient Maya*, 2nd ed. London: Thames and Hudson.

McAnany, Patricia A. 1995. *Living with the Ancestors: Kinship and Kingship in Ancient Maya Society*. Austin: University of Texas Press.

Merwin, Raymond Edwin, and George Clapp Vaillant. 1932. *The Ruins of Holmul, Guatemala: With 31 Illustr. in the Text, 36 Plates and Frontispiece*. Cambridge, MA: Peabody Museum of American Archaeology and Ethnology, Harvard University.

Miriello, Domenico, Donatella Barca, Gino M. Crisci, Luis Barba, Jorge Blancas, Agustín Ortíz, Alessandra Pecci, and L. López Luján. 2011. "Characterization and Provenance of Lime Plasters from the Templo Mayor of Tenochtitlan (Mexico City)." *Archaeometry* 53: 1119–1141.

Miriello, Domenico, Donatella Barca, Alessandra Pecci, Raffaella De Luca, Gino M. Crisci, L. López Luján, and Luis Barba. 2013. "Plasters from Different Buildings of the Sacred Precinct of Tenochtitlan (Mexico City): Characterization and Provenance." *Archaeometry* 57 (1): 100-127.

Mongelluzzo, Ryan William. 2011. "Experiencing Maya Palaces: Royal Power, Space, and Architecture at Holmul, Guatemala." PhD diss., University of California, Riverside.

Moore, Jerry D. 1996. "The Archaeology of Plazas and the Proxemics of Ritual: Three Andean Traditions." *American Anthropologist*, 98 (4): 789-802.

Morgan, Molly and Jeremy Bauer. 2004. "Investigations of Structure 7 and Stela 2 at Cival, Peten, Guatemala." In *Investigaciones Arqueológicas en la region de Holmul, Petén, Guatemala*. Informe Preliminar de la Temporada 2003, edited by Francisco Estrada-Belli, 100-136. Boston University Archaeology Department. Electronic document, <https://www.bu.edu/holmul/reports>, accessed, January 12, 2019.

Morris, Earl Halstead, Jean Charlot, and Ann Axtell Morris. 1931. *The Temple of the Warriors at Chichen Itza, Yucatan*. Vol. 2. Washington: Carnegie Institution of Washington.

Munson, Jessica. 2012. "Temple Histories and Communities of Practice in Early Maya Society: Archaeological Investigations at Caobal, Petén, Guatemala." PhD diss., University of Arizona, Tucson.

Murakami, Tatsuya. 2010. "Power Relations and Urban Landscape Formation: a Study of Construction Labor and Resources at Teotihuacan." PhD diss., Arizona State University, Tempe.

Murakami, Tatsuya. 2014. "Social Identities, Power Relations, and Urban Transformations: Politics of Plaza Construction at Teotihuacan." In *Mesoamerican Plazas: Arenas of Community and Power*, edited by Kenichiro Tsukamoto and Takeshi Inomata, 34-49. Tucson: University of Arizona Press.

Murakami, Tatsuya. 2016. "Materiality, Regimes of Value, and the Politics of Craft Production, Exchange, and Consumption: A Case of Lime Plaster at Teotihuacan, Mexico." *Journal of Anthropological Archaeology*, 42 (1): 56-78.

Murakami, Tatsuya, Gregory Hodgins, and Arleyn W. Simon. 2013. "Characterization of Lime Carbonates in Plasters from Teotihuacan, Mexico: Preliminary Results of Cathodoluminescence and Carbon Isotope Analyses." *Journal of Archaeological Science* 40 (2): 960-970.

Neivens, Nina 2018. "The 'Olmec' Style Phenomenon and the Adoption of Ceramics in the Maya Lowlands: The Pre-Mamon Ceramics from Holmul and Tikal, Guatemala." PhD diss., Tulane University.

Neivens de Estrada, Nina and Diana Méndez. 2009. "Excavaciones en el Edificio N, Grupo II de Holmul. Excavaciones HOL.T.71, HOL.T.76 y HOL.T.77." In *Investigaciones Arqueológicas en la región de Holmul, Petén, Guatemala. Informe Preliminar de la Temporada 2009*, edited by Francisco Estrada-Belli, 58-79. Boston University Archaeology Department, Boston. Electronic document, <https://www.bu.edu/holmul/reports>, accessed, January 12, 2019.

Neivens de Estrada, Nina. 2006. "Edificio B, Group II, Homul." In *Investigaciones Arqueológicas en la región de Holmul, Petén, Guatemala. Informe preliminar de la temporada 2005*, edited by Francisco Estrada-Belli, 22-27. Vanderbilt University.

Nora, Pierre. 1989. "Between Memory and History: Les Lieux de Memoire." *Representations* 26: 7-25.

Olick, Jeffrey K., and Joyce Robbins. 1998. "Social Memory Studies: From "Collective Memory" to the Historical Sociology of Mnemonic Practices." *Annual Review of Sociology* 24 (1): 105-140.

Ortner, Sherry B. 1996. *Making Gender: The Politics and Erotics of Culture*. Boston: Beacon Press

Ortner, Sherry B. 1984. "Theory in Anthropology Since the Sixties." *Comparative Studies in Society and History* 26 (1): 126-166.

Ossa, Alanna. 2014. "Plazas in Comparative Perspective in South-Central Veracruz from the Classic to Postclassic Period (AD 300-1350)." In *Mesoamerican Plazas: Arenas of Community and Power*, edited by Kenichiro Tsukamoto and Takeshi Inomata, 130-146. Tucson: University of Arizona Press.

Pauketat, Timothy R. 2000. "The Tragedy of the Commoners." In *Agency in Archaeology*, edited by Marcia-Anne Dobres and John E. Robb, 113-129. London: Routledge.

Pauketat, Timothy R. 2001. "Practice and History in Archaeology: An Emerging Paradigm." *Anthropological Theory* 1 (1): 73-98.

Pecci, Alessandra, Domenico Miriello, Donatella Barca, Gino M. Crisci, Raffaella De Luca, Agustin Ortiz, Linda R. Manzanilla, Jorge Blancas, and Luis Barba. 2016. "Identifying a Technological Style in the Making of Lime Plasters at Teopancazco (Teotihuacan, México)." *Archaeological and Anthropological Sciences*: 1-21.

Pedersen, Lyssabeth C. 2016. "The Shaft Caches of Structure 4: An Analysis of the Archaeological Evidence and Symbolism." In *The Ancient Maya City of Blue Creek, Belize Wealth, Social Organization and Ritual*, edited by Thomas Guderjan, 211-232. BAR International Series 2796. Oxford: British Archaeological Reports.

- Perea, Marta. 2017. "Excavacion WIT.L.16, Estructura 2 Plaza Central, Witzna." In *Investigaciones Arqueológicas en la region de Holmul, Petén, Guatemala. Informe Preliminar de la Temporada 2016*, edited by Francisco Estrada-Belli, 253-262. Boston University Archaeology Department, Boston. Electronic document, <https://www.bu.edu/holmul/reports>, accessed, January 12, 2019.
- Pohl, Mary D., Kevin O. Pope, John G. Jones, John S. Jacob, Dolores R. Piperno, Susan D. DeFrance, David L. Lentz, John A. Gifford, Marie E. Danforth, and J. Kathryn Josserand. 1996. "Early Agriculture in the Maya lowlands." *Latin American Antiquity* 7 (4): 355-372.
- Pollard, A. Mark, and Carl Heron. 2008. *Archaeological Chemistry*. Cambridge: Royal Society of Chemistry.
- Pred, Allen. 1984. "Place as Historically Contingent Process: Structuration and the Time-Geography of Becoming Places." *Annals of the Association of American Geographers* 74 (2): 279-297.
- Preucel, Robert W. and Lynn Meskell. 2004. "Places." In *A Companion to Social Archaeology*, edited by Lynn Meskell and Robert W. Preucel, 215-229. Oxford: Blackwell Publishing Ltd.
- Proskouriakoff, Tatiana. 1993. *Maya History*, edited by Rosemary A. Joyce. Austin: University of Texas Press.
- Pring, Duncan C. 1977. "Influence or Intrusion? The Protoclassic in the Maya Lowlands." In *Social Process in Maya Prehistory: Studies in Memory of Sir Eric Thompson*, edited by Norman Hammond, 135-165. London: Academic Press.
- Reese-Taylor, Kathryn. 2012a. "Sacred Places and Sacred Landscapes." In *The Oxford Handbook of Mesoamerican Archaeology*, edited by Deborah L. Nichols and Christopher A. Pool, 752-763. Oxford: Oxford University Press.
- Reese-Taylor, Kathryn. 2012b. "Ritual Circuits as Key Elements in Maya Civic Center Designs." In *Heart of Creation: The Mesoamerican World and the Legacy of Linda Schele*, edited by Andrea Stone, 143-165. The University of Alabama Press.
- Relph, Edward. 1976. *Place and Placelessness*. London: Pion.
- Rice, Don S., and Prudence M. Rice. 1981. "Muralla de Leon: a Lowland Maya Fortification." *Journal of Field Archaeology*, 8 (3): 271-288.
- Rice, Prudence M. 2009. *Maya Calendar Origins: Monuments, Mythistory, and the Materialization of Time*. USA: University of Texas Press.
- Rice, Prudence M. 2015. "Middle Preclassic Interregional Interaction and the Maya lowlands." *Journal of Archaeological Research* 23 (1): 1-47.

- Ricketson, Oliver G. Jr. 1928. "Notes on Two Maya Astronomic Observatories." *American Anthropologist* 30 (3): 434-444.
- Ricketson, Oliver G. Jr. 1933. "Excavations at Uaxactun." *The Scientific Monthly* 37 (1): 72-86.
- Ricketson, Oliver G., and Edith Bayles Ricketson. 1937. Uaxactun, Guatemala: Group E 1926-1931. Washington DC: Carnegie Institution of Washington.
- Roddick, Andrew P. 2009. "Communities of Pottery Production and Consumption on the Taraco Peninsula, Bolivia." PhD diss., University of California, Berkeley.
- Rodman, Margaret C. 1992. "Empowering Place: Multilocality and Multivocality." *American Anthropologist* 94 (3): 640-656.
- Rosenmeier, Michael F., David A. Hodell, Mark Brenner, Jason H. Curtis, and Thomas P. Guilderson. 2002. "A 4000-year Lacustrine Record of Environmental Change in the Southern Maya Lowlands, Peten, Guatemala." *Quaternary Research* 57 (2): 183-190.
- Russell, Bradley W., and Bruce H. Dahlin. 2007. "Traditional Burnt-Lime Production at Mayapán, Mexico." *Journal of Field Archaeology*, 32 (4): 407-423.
- Sassaman, Kenneth E., and Wictoria Rudolphi. 2001. "Communities of Practice in the Early Pottery Traditions of the American Southeast." *Journal of Anthropological Research* 57 (4): 407-425.
- Saturno, William A., David Stuart, and Boris Beltrán. 2006. "Early Maya Writing at San Bartolo, Guatemala." *Science* 311 (5765): 1281-1283.
- Saturno, William A., Karl A. Taube, David Stuart, and Heather Hurst. 2005. *The Murals of San Bartolo, El Petén, Guatemala Part 1: The North Wall*. Barnardsville, N.C., USA: Center for Ancient American Studies.
- Scarborough, Vernon L. 1998. "Ecology and Ritual: Water Management and the Maya." *Latin American Antiquity* 9 (2): 135-159.
- Schele, Linda, and Peter Mathews. 1999. *The Code of Kings: The Language of Seven Sacred Maya Temples and Tombs*. Simon and Schuster.
- Scholle, Peter A., and Dana S. Ulmer-Scholle. 2003. *A Color Guide to the Petrography of Carbonate Rocks: Grains, Textures, Porosity, Diagenesis*. Tulsa, Oklahoma: The American Association of Petroleum Geologists.
- Schreiner, Thomas Paul. 2002. "Traditional Maya Lime Production: Environmental and Cultural Implications of a Native American Technology." PhD diss., University of California, Berkeley.

- Schudson, Michael. 1997. "Dynamics of Distortion in Collective Memory." In *Memory Distortion: How Minds, Brains, and Societies Reconstruct the Past*, edited by Joseph T. Coyle, 346-365. Cambridge, MA: University Press.
- Schwake, Sonja A. and Gyles Iannone 2010. "Ritual Remains and Collective Memory: Maya Examples from West Central Belize." *Ancient Mesoamerica* 21 (2): 331-339.
- Seamon, David and Jacob Sowers. 2008. "Place and Placelessness, Edward Relph." In *Key Texts in Human Geography*, edited by Phil Hubbard, Rob Kitchen, and Gill Vallentine, 43-51. London: Sage.
- Seligson, Kenneth E. 2016. "The Prehispanic Maya Burnt Lime Industry: Socio-Economy and Environmental Resource Management in the Late and Terminal Classic Period Northern Maya Lowlands (650-950 CE)." PhD diss., The University of Wisconsin-Madison.
- Seligson, Kenneth E., Tomás Gallareta Negrón, Rossana May Ciau, and George J. Bey. 2017. "Using Multiple Lines of Evidence to Identify Prehispanic Maya Burnt-Lime Kilns in the Northern Yucatan Peninsula." *Latin American Antiquity* 28 (4): 558-576.
- Seligson, Kenneth, Soledad Ortiz Ruiz, and Luis Barba Pingarrón. 2018. "Prehispanic Maya Burnt Lime Industries: Previous Studies and Future Directions." *Ancient Mesoamerica* 30 (2): 199-219.
- Shackley, M. Steven. 2011. "An Introduction to X-Ray Fluorescence (XRF) Analysis in Archaeology." In *X-Ray Fluorescence Spectrometry (XRF) in Geoarchaeology*, edited by Steven M. Shackley, 7-44. New York: Springer New York.
- Sharer, Robert J. with Traxler, Loa P. 2006. *The Ancient Maya*. 6th edition. California: Stanford University Press.
- Smith, A. Ledyard. 1982. "Major Architecture and Caches". In *Excavations at Seibal, Department of Peten, Guatemala*, edited by Gordon R. Willey. *Memoirs of the Peabody Museum of Archaeology and Ethnology* 15 (1). Cambridge: Harvard University.
- Stanton, Travis W., and Aline Magnoni. 2008. "Places of Remembrance: The Use and Perception of Abandoned Structures in the Maya Lowlands." In *Ruins of the Past: The Use and Perception of Abandoned Structures in the Maya Lowlands*, edited by Travis W. Stanton and Aline Magnoni, 1-24. Colorado: University Press of Colorado.
- Stanton, Travis W., M. Kathryn Brown, and Jonathan B. Pagliaro. 2008. "Garbage of the Gods? Squatters, Refuse Disposal, and Termination Rituals Among the Ancient Maya." *Latin American Antiquity* 19 (3): 227-247.
- Starzmann, Maria Theresia. 2013. "Spontaneity and Habitus: Stone Tool Production in Communities of Practice at Fıstıklı Höyük." In *Interpreting the Late Neolithic of Upper*

Mesopotamia, edited by Olivier Nieuwenhuys, Peter M. M. G. Akkermans, Reinhard Bernbeck, and Jana Rogasch, 161-169. Turnhout: Brepols Publishers.

Stuardo, Rodrigo Liendo, Javier López Mejía, and Arianna Campiani. 2014. "The Social Construction of Public Spaces at Palenque and Chinikihá, Mexico." In *Mesoamerican Plazas: Arenas of Community and Power*, edited by Kenichiro Tsukamoto and Takeshi Inomata, 108-120. Arizona: University of Arizona Press.

Stuart, David. 1996. "Kings of Stone: a Consideration of Stelae in Ancient Maya Ritual and Representation." *RES: Anthropology and Aesthetics* 29 (1): 148-171.

Stuart, David. 2010. "Observations on the Ritual Meaning of Early Maya Stelae." In *The Place of Stone Monuments: Context, Use, and Meaning in Mesoamerica's Preclassic Transition*, edited by Julia Guernsey, John E. Clark, and Barbara Arroyo, 283-298. Vol. 25. Harvard University Press.

Sugiyama, Saburo, and Rubén Cabrera Castro. 2007. "The Moon Pyramid Project and the Teotihuacan State Polity: A Brief Summary of the 1998–2004 Excavations." *Ancient Mesoamerica* 18 (1): 109-125.

Tokovinine, Alexandre, and Francisco Estrada-Belli. 2015. "La Sufricaya: A Place in Classic Maya Politics." In *Classic Maya Politics of the Southern Lowlands: Integration, Interaction, Dissolution*, edited by Damien B. Marken and James L. Fitzsimmons, 195-224. Boulder: University Press of Colorado.

Tomasic, John J. 2009. "Investigating Terminal Preclassic and Classic Period Power and Weather at K'O, Guatemala." PhD diss., Vanderbilt University.

Traxler, Loa P., and Robert J. Sharer. 2016. *The Origins of Maya States*. Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology.

Tsukamoto, Kenichiro. 2014a. "Multiple Identities on the Plazas the Classic Maya Center of El Palmar, Mexico". In *Mesoamerican Plazas: Arenas of Community and Power*, edited by Kenichiro Tsukamoto and Takeshi Inomata, 50-67. Tucson: University of Arizona Press.

Tsukamoto, Kenichiro. 2014b. "Politics in Plazas: Classic Maya Ritual Performance at El Palmar, Campeche, Mexico." Ph.D. dissertation, Department of Anthropology, University of Arizona, Tucson.

Tuan, Yi-Fu. 1975. "Place: An Experiential Perspective". *Geographical Review*: 151-165.

Turner, Billie L., and Jeremy A. Sabloff. 2012. "Classic Period Collapse of the Central Maya Lowlands: Insights about Human–environment Relationships for Sustainability." *Proceedings of the National Academy of Sciences* 109 (35): 13908-13914.

Van Dyke, Ruth M., and Susan E. Alcock. 2003. "Archaeologies of Memory: An Introduction". In *Archaeologies of Memory*, edited by Ruth M. Van Dyke and Susan E. Alcock, 1-13. Malden, MA: Blackwell Publishers Ltd.

Velásquez Lopez, Antolín. 2011. "Geografía y Territorio: Patrón de Asentamiento del Sitio Arqueológico Cival, Petén, Guatemala." USAC thesis. Universidad de San Carlos de Guatemala.

Villaseñor, Isabel. 2009. "Lowland Maya Lime Plaster Technology: A Diachronic Approach." PhD diss., UCL (University College London), London, UK.

Villaseñor, Isabel, Elizabeth Graham, Ruth Siddall, and Clifford A. Price. 2011. "The Characterisation of Lime Plasters from Lamanai, Belize: A Diachronic Approach to the Study of Architectural Practices." In *Proceedings of the 37th International Symposium on Archaeometry, 13th-16th May 2008, Siena, Italy*, 329-334. Springer Berlin Heidelberg.

Villegas, Mercedes, and Ximena Vázquez. 1995. "Relative Dating of the Stucco Relieves at Palenque, Chiapas, based on Variation in Material Preparation." In *Materials Research Society Symposium Proceedings vol. 352: Materials Issues in Art and Archaeology IV*, edited by Pamela B. Vandiver, James R. Druzik, Jose Luis Galvan Madrid, Ian C. Freestone, and George S. Wheeler, 469-48. Pittsburgh: Materials Research Society.

Vitruvius, M. 1914. *The Ten Books on Architecture*, translated by M.H. Morgan. Cambridge: Harvard University.

Wagner, Logan, Box, Hal, and Morehead, and Susan Kline. 2013. *Ancient Origins of the Mexican Plaza: From Primordial Sea to Public Space*. Austin: University of Texas Press. Accessed October 26, 2019. ProQuest Ebook Central.

Wahl, David, Roger Byrne, Thomas Schreiner, and Richard Hansen. 2006. "Holocene Vegetation Change in the Northern Petén and its Implications for Maya Prehistory." *Quaternary Research* 65 (3): 380-389.

Wahl, David, Francisco Estrada-Belli, and Lysanna Anderson. 2013. "A 3400-year Paleolimnological Record of Prehispanic Human–environment Interactions in the Holmul Region of the Southern Maya Lowlands." *Palaeogeography, Palaeoclimatology, Palaeoecology* 379: 17-31.

Wahl, David, Roger Byrne, and Lysanna Anderson. 2014. "An 8700 year Paleoclimate Reconstruction from the Southern Maya Lowlands." *Quaternary Science Reviews* 103: 19-25.

Wahl, David, Lysanna Anderson, Francisco Estrada-Belli, and Alexandre Tokovinine. 2019. "Palaeoenvironmental, Epigraphic and Archaeological Evidence of Total Warfare among the Classic Maya." *Nature Human Behaviour*, 3 (10): 1049-1054.

Webster, David. 1976. "Lowland Maya Fortifications." *Proceedings of the American Philosophical Society*, 120 (5): 361-371.

Webster, James W., George A. Brook, L. Bruce Railsback, Hai Cheng, R. Lawrence Edwards, Clark Alexander, and Philip P. Reeder. 2007. "Stalagmite Evidence from Belize Indicating Significant Droughts at the Time of Preclassic Abandonment, the Maya Hiatus, and the Classic Maya Collapse." *Palaeogeography, Palaeoclimatology, Palaeoecology* 250 (1-4): 1-17.

Wenger, Etienne, Richard Arnold McDermott, and William Snyder. 2002. *Cultivating Communities of Practice: A Guide to Managing Knowledge*. Boston, MA: Harvard Business Press.

Wenger, Etienne. 1998. *Communities of Practice: Learning, Meaning, and Identity*. Cambridge: Cambridge University Press.

Wendrich, Willeke. 2013. *Archaeology and Apprenticeship: Body*

Knowledge, Identity, and Communities of Practice. Tucson: University of Arizona Press.

Willey, Gordon R., and James C. Gifford. 1961. "Pottery of the Holmul I style from Barton Ramie". In *Essays in Pre-Columbian Art and Archaeology*, edited by Samuel K. Lothrop, 152-170. Cambridge: Harvard University Press.

Willey Gordon, R. 1973. *The Altar de Sacrificios Excavations: General Summary and Conclusions*. Papers of the Peabody Museum of Archaeology and Ethnology, Vol. 64, No. 3. Gordon R. Willey, series editor. Cambridge: Harvard University Press.

Xiao, Ya, Xuan Fu, Haibing Gu, Feng Gao, and Shaojun Liu. 2014. "Properties, Characterization, and Decay of Sticky Rice–Lime Mortars from the Wugang Ming Dynasty City Wall (China)." *Materials Characterization* 90: 164-172.

Yang, Fuwei, Bingjian Zhang, Changchu Pan, and Yuyao Zeng. 2009. "Traditional Mortar Represented by Sticky Rice Lime Mortar—One of the Great Inventions in Ancient China." *Science in China Series E: Technological Sciences* 52 (6): 1641-1647.