Terminal Classic Shifts

Obsidian Trade and the Restructuring of Maya Economies in eastern Mesoamerica on a regional Scale (AD 800-950)

By Georg Aaron Müller

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Introduction

This thesis examines long-distance exchange and social networks with a particular focus on obsidian as a specific trade commodity. While it has been recognised that changing trade networks are a strong contributing factor to the shifts associated with the Terminal Classic (9th to 10th Century AD) (Golitko *et al.* 2012, 508), the nature of these networks is still highly debated with various models for it being introduced in the last decades. These vary in aspects such as localisation, hierarchy, and modes of transport and are based on a multiplicity of analytical models. One example of these is Social Network Analysis that aims at investigating interaction through a systemic approach that creates visual representations of involvement between different plotted points such as sites or artefacts (Golitko and Feinman 2015).

While making the picture clearer in many ways, the multitude of differing approaches has also brought up a plurality of new questions. This thesis aims at proposing answers to some of these questions. For this purpose, the thesis presents examples from various sites and proposed exchange networks published during the last two decades to answer the question of '*How did the extensive regional political changes and locational shifts in eastern Mesoamerica impact the distribution and procurement of obsidian during the Terminal Classic?*'

The thesis first provides an overview of primary changes and shifts associated with the Terminal Classic in eastern Mesoamerica as well as an introduction to the preceding Classic Period and exchange during that period to set a baseline. Afterwards, it gives an approach towards the importance of studying exchange in Mesoamerica, a region that never saw the introduction of large pack animals before the Spanish invasion and is characterised by a rugged, diverse landscape (Feinman 2019, 34). This will be followed by a more thorough introduction to different methodological frameworks that have been used to explain and understand exchange and interaction in general and specifically in eastern Mesoamerica as well as an introduction to the methods used by this thesis Furthermore, this includes a brief discussion on the possible merits of obsidian as a suitable proxy for tracking exchange patterns in eastern Mesoamerica. A variety of factors play into this, ranging from the wide distribution of obsidian among both elites and commoners as well as the ease and clarity of analysing where obsidian artefacts were sourced through both visual and chemical means (Braswell *et al.* 2000). Additionally, exploring exchange through examining obsidian makes it easier to track changes on a larger scale than by, for example, excavating marketplaces. Subsequently, the thesis

introduces two Social Network Analyses by Golitko and Feinman that explore obsidian exchange both in Mesoamerica as a whole and eastern Mesoamerica during the Terminal Classic (Golitko *et al.* 2012; Golitko and Feinman 2015). Even though these analyses discuss a broader scale both temporally and spatially, this thesis is specifically focused on aspects relevant to the Terminal Classic period. The Social Network Analyses are contrasted by an investigation of three case studies that aim at exploring Terminal Classic exchange through a smaller lens. The case studies include two lowland regions, the Petexbatún (Aoyama 2006; 2017) and northern Petén lakes (Ford *et al.* 1997; Źrałka and Hermes 2012), as well as the port site of Vista Alegre in the northern Yucatan (Glover *et al.* 2018). Consequently, the thesis discusses and compares the lines of argumentation that arise from both Social Network Analyses and cases studies. The goal of this is to bring the smaller and bigger picture of the discussion together and create a coherent narrative for Terminal Classic obsidian exchange and consequently answer the main research question. Only by understanding both sides of the argument, it is possible to create a meaningful understanding of this subject matter. Lastly, the thesis concludes upon the results and findings and reflects on itself.

While being aware that this substance matter deserves and needs further and more intricate research, the thesis will try to summarise the current state of said research at hand. Moreover, it aims at being a steppingstone for future investigations by opening a new perspective on Terminal Classic interaction through combining small- and large-scale analyses. In doing this, the thesis might raise more questions than give answers, but these are important for future research in a field that is central to understanding the developments of human societies in general, and the Maya in particular, because societies are formed and changed through interaction with others.

Terminal Classic in context

Before approaching the questions posed by this thesis, it is important to set the stage and form an understanding of the chronology associated with eastern Mesoamerica, a region populated by the Maya peoples. Therefore, it gives a short introduction to multiple facets that have to be considered when dealing with the Terminal Classic exchange of obsidian. This starts with the time period discussed as well as the immediately preceding centuries. First, the chapter gives a brief overview of the Classic period in eastern Mesoamerica and then introduces general points concerning the Terminal Classic. To interject, one of the subchapters reflects on obsidian trade before the Terminal Classic to highlight trends and differences that can be observed as part of the arrival of said period.

Figure 1: Map of eastern Mesoamerica including a smaller representation of Mesoamerica in general (Foley 2017, 41)

The Classic Maya

Located in the Yucatan as well as the low- and highlands of today's southern Mexico, Belize, Guatemala and Honduras, encompassing all of eastern Mesoamerica (Fig. 1), the Maya civilisation[1] arose during the 2nd millennium BC and would exist until the Spanish invasion in the 16th century AD. This does not mean that Maya culture ended at that time. Even though it was suppressed by New Spain and its successor states, Maya culture and language still exist today. Heritage efforts of recent years have led to a rediscovery and revival of common identity among contemporary Maya (Holbrock 2004, 263).

The region is characterised by a large variety of environments, something that becomes increasingly important when considering exchange. These include the drier Lowlands of the northern Yucatan, the cooler southern Highlands as well as the densely forested and central Petén region with its lakes and rivers connecting it to the Caribbean Sea and the Gulf of Mexico (Foias 2013, 7). The history of this area is normally classified into three main periods, pre-Classic, Classic and post-Classic (Table 1).

Period	Sub-Period	Dates
pre-Classic	Early pre-Classic	2000-1000BC
	Middle pre-Classic	1000-350BC
	Late pre-Classic	350BC-AD250
Classic	Early Classic	AD250-550
	Late Classic	AD550-830
	Terminal Classic	AD830-950
post-Classic	Early post-Classic	AD950-1200
	Late post-Classic	AD1200-~1539

Table 1: Chronology of eastern Mesoamerica (Estrada-Belli 2011, 3)

The Terminal Classic marks the final part of the Classic period and approximately covers the 9th and 10th centuries AD. Nevertheless, this temporal division differs between

[1] The term Maya civilisation is no longer commonly used to refer to the Maya societies that involved different peoples of the last 3000 years. It is used here to more easily refer to pre-Columbian Maya populations in specific.

regions and changes associated with the Terminal Classic can commence as early as the 8th century. One example of this is the Petexbatún, a region that will be discussed in greater detail at a later point (Demarest 2013, 41). However, before approaching this period, the thesis takes a short look at the 'main part' of the Classic period to understand the origin of Terminal Classic developments.

Mostly defined by the construction of monumental architecture and increased urbanism, the Classic Maya civilisation was concentrated in the southern Lowlands. By this time Maya art was largely centred on the rulers, which is recognized as an indicator for advanced hierarchisation at the time (Miller 1999; Foias 2013, 12). Furthermore, the influence of the central Mexican city of Teotihuacán played a central role in the political developments during this period at Classic sites such as Tikal, Copan, or Kaminaljuyú. The interaction between these sites ranged from cultural and material exchange to Teotihuacán's direct political influence on some of these Maya cities. One example of such a political aspect is the so-called *entrada* in AD378, which marked the arrival of a Teotihuacan style king at Tikal (Estrada-Belli *et al.* 2009). Coinciding with this was the adoption of Teotihuacan style symbolism and architecture as well as the importation of obsidian, although Teotihuacán's influence did not produce lasting cultural change (Foias 2013, 12). Subsequently, the eastern Mesoamerica would see centuries of rivalry between Tikal, Calakmul, and their respective allies. Nevertheless, the region also saw increases in population density, the complexity of cities as well as the creation of hieroglyphic texts. Along with this came a rise in economic connectivity and social stratification that also to increased political fragmentation resulting in heightened conflict between ever-growing cities (Foias 2013, 14). Before looking at the result of these developments that culminated in the events of the Terminal Classic, the thesis gives a short insight into the obsidian trade associated with this period.

Obsidian before

Obsidian trade of the Classic period was largely a continuation of pre-Classic distribution networks. Across Mesoamerica, exchange saw a slight increase during this time with Teotihuacan and Monte Albán playing a key role as connecting points with central Mexico. Particularly Teotihuacan has been associated with the focus of Classic trade routes on the Pacific coast (Golitko and Feinman 2015, 222; Love 2007, 299) (Fig. 2). Long-distance connection to these has been related to a few connecting sites or 'brokers' that acted as bridging entities between eastern and western Mesoamerica (Golitko and

Feinman 2015, 237). A key factor in this was the limited availability of obsidian due to it being a material of volcanic origin.

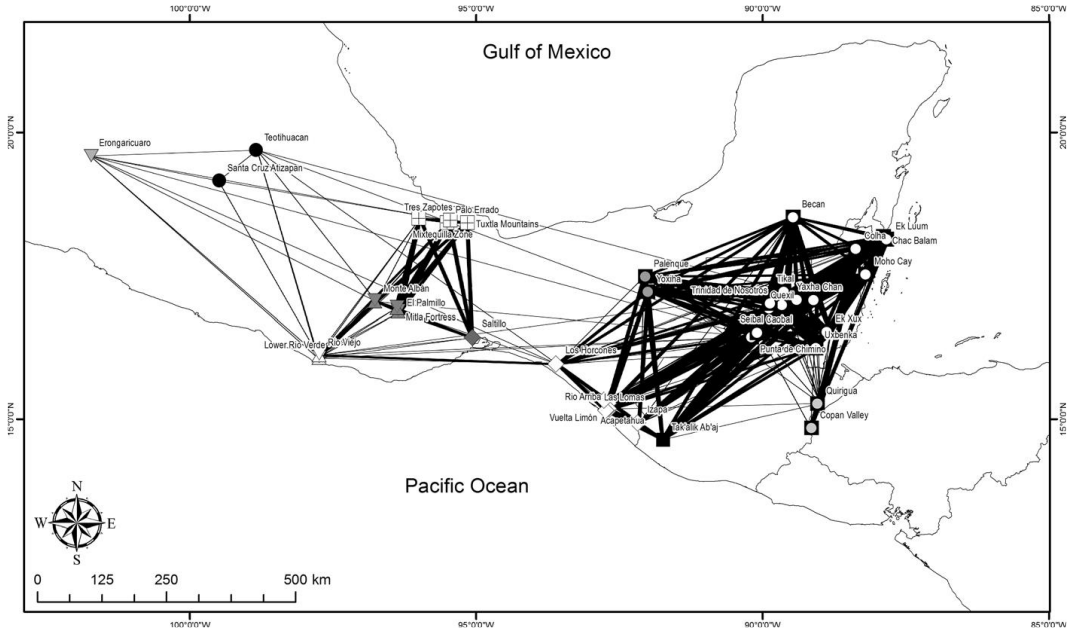

Figure 2: Network map of Classic Obsidian Trade; line thickness indicates the strength of economic ties (Golitko and Feinman 2015, 223)

The scarcity of the material has led to almost all obsidian finds to being associated with a limited number of sources, most notably El Chayal, San Martin Jilotepeque, and Ixtepeque in the southern Highlands as well as sites such as Zaragoza, Ucareo, and Pachuca in central México (Haines and Glascock 2013). Nevertheless, the Classic obsidian trade in eastern Mesoamerica mainly involved raw material coming from the highland region while central Mexican green obsidian has largely been associated with special elite interactions (Aoyama 2001; Silva de la Mora 2018). Along the same lines, the distribution of these fluctuated quite substantially on a spatial scale and is linked to political ties with Teotihuacan. An indicator for this comes from the presence of green obsidian at different sites. Particularly, the percentages in assemblages of larger Classic sites can be used as an example. At the site of Copán only 2.7% of Classic obsidian comes from central México compared to 13.8% and 18.8% respectively at the Teotihuacan linked sites of Tikal and Kaminaljuyú (Aoyama 2001, 352). While not necessarily fully representative, examples can be an indicator for a possible trend across the region during the Early Classic period.

A significant change occurred after the collapse of Teotihuacan around 650 AD. Central Mexican obsidian[2] became increasingly rare. At some seemingly not present at all. For example, in the north-western Lowlands, late Classic obsidian distribution in was almost entirely based on raw material from El Chayal that made up the overwhelming majority of recovered material. The other two highland sources were present in lesser quantities, while central Mexican obsidian accounted for only a very minor amount (Table 2) (Silva de la Mora 2018, 581). Along with this went an increase in elite influence on the

	ECH	IXP	SMJ	PC	PJ	ZRG	unk	Total
Amount	1296	8	17	5	1	9	2	**1338**
Percentage	**96,9%**	**0,6%**	**1,3%**	**0,4%**	**0,1%**	**0,7%**	**0,15%**	
HL	**98,7%**	MX	**1,1%**					

Table 2: Origin of Late Classic Obsidian in the north-western Lowlands (ECH=El Chayal; IXP=Ixtepeque; SMJ=San Martín Jilotepeque; PC= Pachuca; PJ=Penjamo; ZRG=Zaragoza; unk=unknown; HL=Highland sources; MX=central Mexican sources) (Silva de la Mora 2018)

distribution of obsidian among the inhabitants of settlements. Contrary to a widespread belief, this did not mean that obsidian was only considered as an elite object. It was available to a wide range of Maya society although the access to it was elite-controlled thus highly hierarchical. This draws from the example of Aguateca in the Petexbatún. Although the situation at this site is slightly different for non-El Chayal obsidian as highland obsidian artefacts at the site were only found in elite contexts (Aoyama 2006, 15). This might be an indication for non-El Chayal obsidian replacing central Mexican variants as elite commodities.

To summarise, Classic period obsidian exchange was part of extensive trading networks as well as subject to substantial change that coincided with the collapse of Teotihuacan. With the reduction in obsidian from central México, the region saw a heavy reliance on obsidian that mostly came from one source. At the same time distribution became increasingly hierarchical, which might relate to the increasing conflict mentioned in the previous sub-chapter. All in all, the nature of obsidian exchange during the centuries preceding the Terminal Classic becomes clear and can form the foundation for examining the exchange during that period.

[2] This generally describes Obsidian sourced from the central Mexican highlands, including from Zaragoza, Ucareo, and Pachuca, rather than sources located in today's country of México. The term will be used accordingly throughout the thesis.

The Notion of 'Collapse'

As the final part of background information, one must gain an understanding of the Terminal Classic in broader terms than exchange patterns of obsidian. Two main issues are important in this respect. Firstly, one must understand the notion of 'collapse' that has surrounded this period for a long time. Secondly, a brief introduction to political and societal changes associated with this point in time is necessary to understand how exchange fits into the equation.

Almost five decades ago, it has been theorised that the idea of 'collapse', in the overly dramatic implications of the word, does not correctly capture and describe the events of the Terminal Classic in eastern Mesoamerica (Andrews IV 1973, 243). Rather, terms such as 'decline' (Hammond *et al.* 1998), 'transition' (Demarest *et al.* 2005; Ringle and Bey III 2012), 'transformation' (Rosenswig and Masson 2002), or 'crumble' (Farriss 1984) have been used in recent times. While these might not perfectly meet the true nature of the Terminal Classic, they form a more grounded basis for an understanding of this period. The reasons behind this have been a matter of broad discussion and range from various environmental factors to multiple socio-political ones (Aimers 2007, 333; Chase and Chase 2006; Demarest 2013; Haug *et al.* 2003). Nevertheless, it is clear that the period certainly saw profound change and the collapse of major centres but also the continuation of many practices and the appearance of new sites and traditions (Aimers 2007, 331; Andres 2009; Andres *et al.* 2005). From now on the thesis will thus refer to the 'collapse' as the Terminal Classic transition (or transition in short), similarly to the way it has been done in several publications (Aimers 2007; Ringle and Bey III 2012). This is also where exchange comes into play. Sometimes theorised as a driving force behind the Terminal Classic transition in connection to the collapse of Teotihuacan (Webster 2002, 231), studying exchange is certainly important for our understanding of the transition due to the intricacy of networks, association with elites and, as a result, also for its implications regarding political shifts. The next chapter will further elaborate on that point.

Apart from changes in practices of exchange, the Terminal Classic is also associated with several other developments that set it apart from the previous period. Most notable is the stark population increase in the northern Yucatan that was most likely driven by migrations from both the Gulf Coast as well as the southern Lowlands (Aimers 2004). Along with this we see the emergence of, for example, Chichen Itza or the sites of

the Puuc region. It has to be kept in mind that the exact nature of this is still heavily debated with little agreement up to now (Aimers 2007, 354). While the period saw the collapse of multiple sites in the southern Lowlands, it also saw increased building activity and populations in the same region at locations such as Nakum or Ceibal (Źrałka and Hermes 2012, 164). Similar to sites in the northern Yucatan, these featured a new architectural style that is sometimes described as 'Mexican' (Aimers 2007, 340). A description that is also used for the pottery style found in both regions and continues into the post-Classic period (Aimers 2007, 339–40; Ringle *et al.* 1998; Smith and Heath-Smith 1980). These stylistic connections become interesting when studying them in the context of trade and the likelihood that the intellectual aspects associated with architectural and ceramic styles probably travelled along similar routes as materials like obsidian. Another aspect that has to be considered when talking about the Terminal Classic is the apparent political instability and increase warfare visible in the archaeological record (Aimers 2007, 335–43). The influence that these had on the developments of trading networks remains an interesting and much-debated question.

All in all, it becomes evident that the Terminal Classic was indeed an era of much change but also of developments that would continue into later periods. The question remains in what way this is true for obsidian exchange networks. But before addressing that question, the next chapter will tackle the merit of studying exchange in general and why obsidian can function as a proxy for this research in eastern Mesoamerica.

Studying Exchange

While the previous chapter gave an introduction to the regional and temporal background that the thesis deals with, the question remains why studies of obsidian exchange, in particular, can contribute to forming a clearer understanding of the political and locational shifts during the Terminal Classic. The next paragraphs give a brief insight into the way exchange and interaction have been studied over the last four decades and why studying these through a variety of frameworks is a substantial part of examining the Terminal Classic in easter Mesoamerica. Afterwards, the thesis gives an introduction to the methodological approach used. It will then conclude with looking at obsidian and its viability as a proxy for exchange studies in Mesoamerica..

Economic Interaction: Why bother?

Studying exchange is studying interaction. In turn, interaction is where humans experience change, become influenced and create new. This can manifest itself in a range of forms from the use of slightly different technologies to the establishment of new types of governance. While not solely based on the study of exchange, studying interaction is multifaceted and consists of various aspects that range from political and economic to personal. As a result, interaction study stands at the very centre of examining cultural contacts (Stein 2002). The challenge lies with the fundamentally static nature of the archaeological record that attempts to trace such a dynamic concept (Cusick 2015). They form an interconnected web of processes characterised by a certain openness that cannot be limited to clearly defined smaller entities but most often comprise larger scale worlds that interact on a macro-regional level (Feinman 2019, 35). By studying parts of these types of interaction, such as the exchange of commodities, significant implications, in turn, can be made for developments in smaller regions or at specific sites (Feinman 2019, 36). These regions or sites then gain meaning through their positioning as parts of a larger world they are directly engaged with and in.

Thus, the study of interaction has been impactful over the last half-century. This has brought up multiple paradigms and theoretical frameworks that work on global, regional and local scales. These include the introduction of world-systems approaches that were first conceived in the 1970s by Wallerstein to model the spread of capitalism during the last two centuries (Wallerstein 1974; 1976a; 1976b). These have been applied to a multitude of past societies but almost always reworked or adjusted to the context at hand (Chase-Dunn and Hall 1993; Smith and Berdan 2003; Stein 1999; Urban and Schortman 1992). In Mesoamerican archaeology, it led to an idea of power retention of

elites through the control of 'luxury goods' on a smaller scale as well as the idea of a system of leading cities controlling smaller entities especially during the Classic period (Santley and Alexander 1992, 23). While the capitalist background on the basis of a formalist point of view has led to questioning its applicability to past societies in general as part of substantivist critique, they form a part of the larger models of core-periphery systems that try to explain economic interaction through the driving forces of strong central areas (Chase-Dunn and Hall 1991). In recent years, globalisation theory has also been introduced to the discussion.

While highly debated due to the modern association of globalisation, a globalist approach can form a more overarching idea of connectivity that extends further than a systemic methods (Hodos 2016). The globalisation approach of the past does not look at regions or time periods in an isolated manner but considers them as an overall process that is sometimes described as 'peaks and valleys' of interregional interaction (Marcus 1998, 60–61). One of the aims is to identify earlier periods of this globalisation as surges in interaction that signify the long-distance exchange of materials and ideas and formation of a shared global culture (Jennings 2010, 20, 34).

Concepts of globalisation can be closely associated with aspects of agency as part of ideas such as entanglement that tries to grasp the interdependency between humans and things (Hodder 2012). Objects and humans do not exist in isolation but are always part of a larger world of dependencies (Hodder 2012, 88–89). Another example is the recently proposed notion of objectscapes (Pitts and Versluys 2021). The term introduces the notion of considering objects not as parts of intra-site activities but as indicators for entire regions. Here separate object groups can contribute to an overarching narrative that considers what objects did as active actors on a globalised approach to the past (Pitts and Versluys 2021, 368).

When it comes to Mesoamerica, globalisation theory has been applied sparingly at this point. Some of the few examples include discussions surrounding Aztec conquest (Berdan 2016) and long-distance exchange of metals between Mesoamerica and the coast of South America (Geurds 2016). On the other hand, more regionalised frameworks have also been introduced to the study of past interactions such as the idea of interaction spheres. It was introduced to Mesoamerican archaeology in the late 1970s (Freidel 1979) and built the basis of world-systems models, while retaining a more regionalised focus aimed at shorter-term 'institutional alignments' (Freidel 2019).

Social Network Analysis falls into the first, global, category of examining interaction. Less concerned with the more hierarchical nature of world systems, it aims at spatial mapping patterns of connectivity over time and analysing the functioning of these. In this, network approaches are systemic in nature but connect with ideas of human-thing entanglement on the basis of valuing relationships between entities such as ideas, objects, and people (Brughmans 2013, 625).

A central part of Social Network Analysis is the visualisation of quantified network ties, which is possible even if one is not working with a complete data set, for example, the natural incompleteness of the archaeological record. Normally large samples of archaeological assemblages are needed to do this effectively. The used data consists of designate 'nodes' which could signify, for example, sites or artefacts. These are connected by 'edges' that represent the ties or non-existence of such between two 'nodes' (Mizoguchi 2009). Furthermore, the strength of ties is determined by the number of existing connections as well as other factors such as similarities in the archaeological assemblage, for example, pottery styles (Golitko *et al.* 2012, 510). These can then be modelled to create a representation of a network through multiple methods. There are multiple techniques such as multidimensional scaling, principal component analysis or contour plots but the analysis that will be discussed at a later point in this thesis is based on spring embedding (Brughmans 2013, 629; DeJordy *et al.* 2007). This method is explained by DeJordy *et al.* (2007, 247) as follows

the (spring-embedding) algorithm works by modelling a network of social ties as a system of springs stretched between posts. If a pair of posts with a spring between them is placed too closely together, the spring is compressed and tries to push the posts apart (a property called node repulsion). If the posts are too far apart, the spring is stretched and tries to pull the posts together (a property called node-attraction).

Moreover, the Brainerd-Robinson coefficient (or BR value) can be used to display network integration. Displayed on a scale from 0 (complete dissimilarity between nodes) to 200 (complete similarity between nodes), the higher the number the more integrate a network and thus also the greater the connectivity between nodes of a network (Golitko and Feinman 2015, 213).

For the Mesoamerican region Social Network Analysis has been employed multiple times, for example, in relation to socio-political connections on the basis of stone monuments (Munson and Macri 2009), exchange of obsidian projectiles during the late post-Classic (Meissner 2017), and obsidian procurement during the whole of the pre-

Hispanic period and the Terminal Classic in particular (Golitko *et al.* 2012; Golitko and Feinman 2015).

Due to the very global nature of this approach to studying interaction, it runs the risk of fitting all nodes into an assigned cluster while diminishing the impact of particular actors. In this, Social Network Analysis is less predetermined compared to a world systems approach that has to assign core and periphery aspects to a region before studying it (Golitko and Feinman 2015, 213). The importance of sites is rather based on their positioning in a network, which only becomes visible after the analysis has been completed. One of the main limiting factors in Social Network Analysis is that it only represents the available data source rather than actual 'real-life' networks, which makes it very dependent on the completeness of the record (Brughmans 2013, 636).

A comparative Approach

Due to the globality and rather constructivist qualities that work in Social Network Analysis, regional variations and diversifications become less clear. Thus, the following chapter will present the results of one of these Social Network Analysis related to Terminal obsidian exchange and introduce multiple individual sites and smaller sub-regions and their obsidian record to compare the difference between them. Through this, the thesis blends the qualities of the 'bottom-down' nature of case studies with the general and occasionally 'top-down' aspects of Network Analysis.

Case studies as a well-established academic tool allow to apply larger concepts to a smaller scale and through this enable an examination of ideas in a comprised context. The result of case studies can both provide an in-depth look at specific aspect as well as a steppingstone for creating and testing hypotheses (Flyvbjerg 2006). Compared to network analysis, case studies also allow more clarity when it comes to inter-site and regional variation. For the Terminal Classic transition, this is particularly valid as there is large deviation when it comes to the onset of the period. Nevertheless, the small scale aspect of case studies can also create biases through the selection of specific sites or region as to their suitability and comparability (Levy 2008).

To account for the use and limitations of both approaches, the thesis follows a comparative approach in both the presentation of results and discussion of these to answer the main research question. Golitko and Feinman's two Social Network Analyses function as the primary source and starting stone in this. This primary source will be accompanied by a number of case studies from three different regions that have been selected based on environmental factors, geography, and social aspects that range from

political factors to population. The aim is to incorporate case studies based on their representation of the diverse transitions during the Terminal Classic. When it comes to the case studies from the Petexbatún, they are also selected to show the variation on a regional scale during this period that includes abandonment and fluorescing sites at the same time (Aoyama 2006; Demarest 2013). Furthermore, the selection of case studies is also based on the availability of obsidian source data. This data from all sites mentioned that are part of the case studies is presented in tables for clearer reference. The Social Network Analyses is accompanied by networks maps from both examples by Golitko and Feinman, while a general overview of all the sites and obsidian sources is provided through a map made in a GIS system by the author.

Obsidian as a Proxy

One question that remains and has to be answered prior to presenting the comparative case studies and Social Network Analysis is: Why use obsidian as the proxy in studying Mesoamerican exchange? Multiple factors play into the viability of obsidian to study Mesoamerican exchange. Being part of a large range of trade commodities, it was the main material to produce sharp-edged tools in ancient Mesoamerica and thus widely traded (Golitko and Feinman 2015, 209). Furthermore, as a lithic material, it has survived in much larger quantities than other important trade goods such as salt or textiles, which has led to large archaeological assemblages being available for study. These have in turn be matched to a range of sources in Mexico, Guatemala, and Honduras through the use of geochemical and visual analysis (Braswell *et al.* 2000; Golitko and Feinman 2015, 209). This establishes a clear record that can be built upon in terms of diachronic and inter-site variation of differently sourced obsidian.

Modelling Terminal Classic Exchange

With the context now fully established, this chapter presents both the main ideas and results that arise from Golitko and Feinman's Social Network Analyses of Terminal Classic obsidian exchange (Golitko *et al.* 2012; Golitko and Feinman 2015) as well as from different case studies that will frame the discussion. These case studies are split into two parts. The first part deals with examples from different areas of the Maya Lowlands such as the Petexbatún region that includes sites such as Aguateca, Ceibal and Punta de Chimino. Furthermore, this part will also briefly touch upon the Peten lakes region with a focus on the Tikal-Yaxha intersite area. The second half of the case studies in turn deals with the Northern Yucatan and in particular the coastal port site of Vista Alegre (Fig. 3). The focus on the Lowland region is based on the expectation that they might foster the most conclusive insight into the changing trade networks as the region is most closely associated with the developments that shaped the Terminal Classic transition.

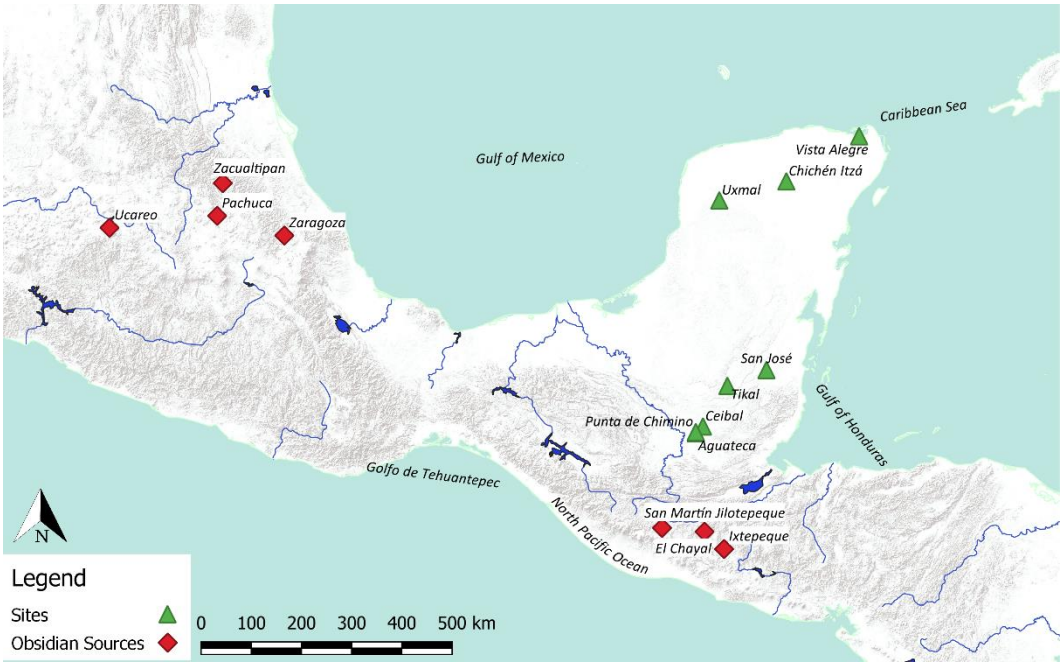

Figure 3: Map of Mesoamerica indicating the location of sites discussed in this thesis and important Obsidian sources

Social Network Analysis: A viable Option

As said in the previous chapter, the issue with many approaches towards studying exchange is the overall 'top-down' nature of most theoretical frameworks. Many assumptions are made based on this notion. They range from an idea that eastern Mesoamerican Exchange was mostly elite-driven (Golitko and Feinman 2015, 208) to the argument that the change to networks in Terminal Classic is based on the 'Classic core' in the southern Lowlands being outcompeted by its periphery, for example, the northern Yucatan (Rathje 1973). While the idea of network analysis is 'top-down' in nature due to

the large scale it covers, the previously mentioned views of elite-driven exchange based on a core-periphery principle are challenged by Golitko and Feinman in their research based on Social Network Analysis of obsidian. The two resulting papers, first the one chiefly concerned with the Terminal Classic (Golitko *et al.* 2012) and then the one dealing with a larger period from 900 BC – AD 1520 (Golitko and Feinman 2015), are presented as primary sources in the following paragraphs to create a picture of Terminal Classic obsidian exchange based on interconnectivity that can be compared to the various case studies that will follow.

The obsidian that was used for the first Social Network Analysis came from both well-established compilations of different assemblages (Braswell 2003; Braswell *et al.* 2000) as well as a range of primary sources. The most notable of these primary sources is the site of San José which is situated in an intermediate position between the Petén Lake region in the central Lowlands that includes the site of Tikal and Chetumal Bay on the Gulf shore of today's Belize (Fig. 3) (Golitko *et al.* 2012, 508). In total, the study was based on a range of obsidian artefacts from 121 archaeological sites with 47 of these including objects dating to the Terminal Classic while the rest is associated with the Classic and Postclassic period for comparative purposes. Golitko and Feinman did not consider sites with less than 10 samples for the research while the remaining ones were grouped into 13 different regional areas to achieve a clearer visual representation (Golitko *et al.*

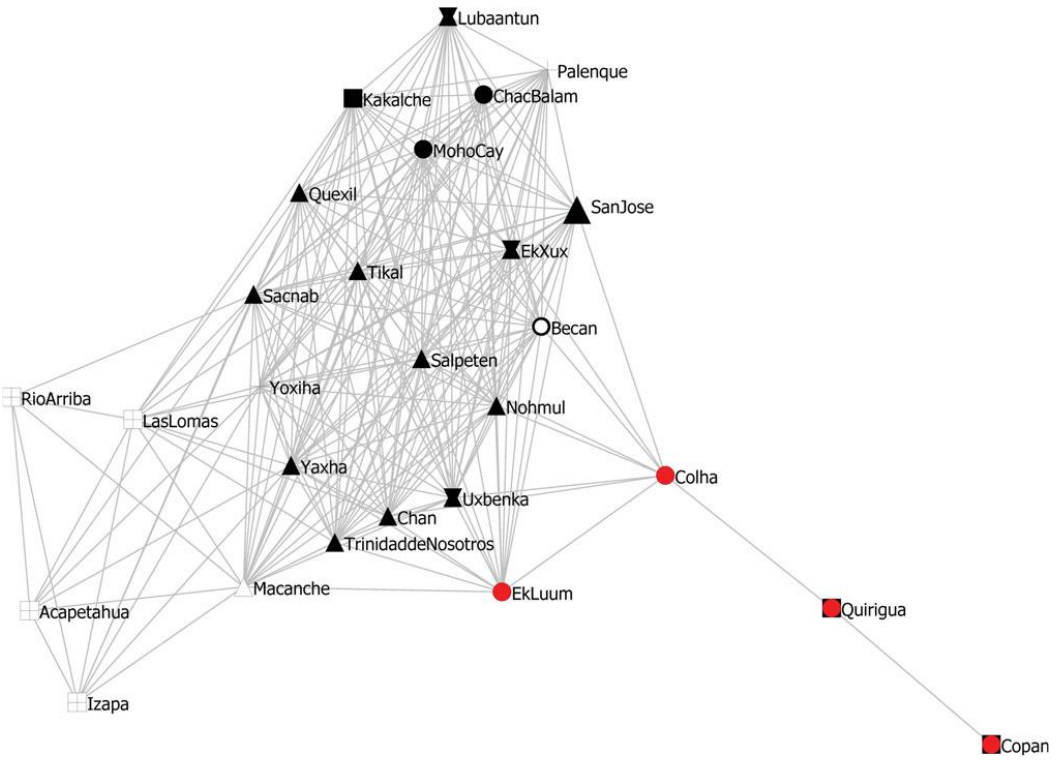

Figure 4: Classic Exchange factions as modelled by Golitko et al. (2012); colour indicating main type of obsidian (black=El Chayal; white=San Martín Jilotepeque; red=Ixtepeque) (Golitko et al. 2012)

2012, 509). The samples for these sites were then analysed with the techniques mentioned in the previous chapter that is common for Social Network Analysis. Furthermore, a so-called 'factions' method was employed to account for similar patterning amongst spatially close sites and groups them into factions although these do not necessarily represent political factions as well. All in all, Golitko and Feinman created four different networks. One each for the Classic, Terminal Classic, Early Postclassic and Late Postclassic (Golitko *et al.* 2012, 510–11). This thesis only looks at the results that emerged from networks regarding the Terminal Classic.

Several trends become evident when looking at the results of this network analysis. Compared to the previous Classic period, the factions differ considerably. During the Classic period, the grouping encapsulates three different factions that were based on the three main highland obsidian sites, El Chayal, San Martin Jilotepeque, and Ixtepeque (Fig. 4). Conversely, Golitko and Feinman argue that the Terminal Classic networks attained the best match when divided into five separate factions. Four of them represent the previously mentioned sources as well as sites that had a high representation of central Mexican sourced obsidian, while the fifth group includes sites that cannot be clearly assigned to any of the other factions (Fig. 5). Simultaneously the network appears to become less integrated.

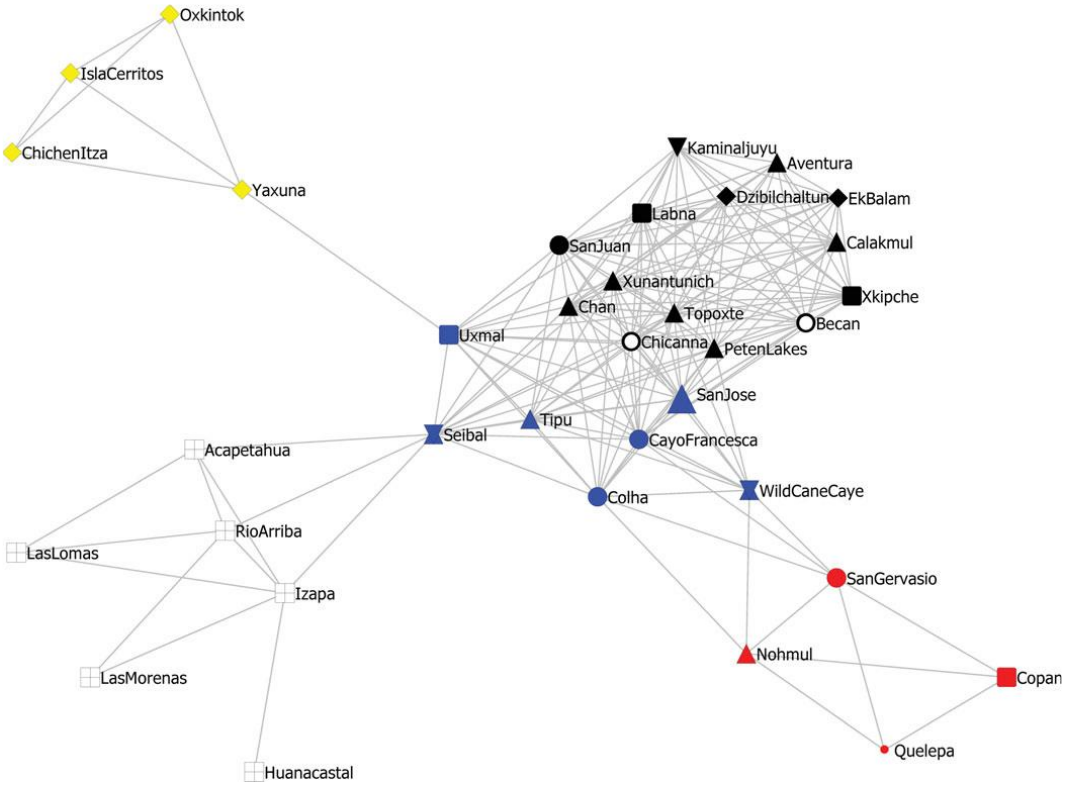

Figure 5: Terminal Classic Exchange factions as modelled by Golitko et al. (2012); colour indicating main type of obsidian (yellow=central Mexican; black=El Chayal; white=San Martín Jilotepeque; red=Ixtepeque; blue=unclear main source) (Golitko et al. 2012)

Even though the El Chayal based network of the lowlands stays highly connected, it decreases in size, and other factions such as Ixtepeque and San Martin Jilotepeque are only attached to it by eight edges in total (Golitko *et al.* 2012, 515). The system based on obsidian from central Mexico limits itself in Golitko and Feinman's model to the northern Yucatan and includes Chichen Itza and Isla Cerritos. It is only affixed to the rest of the network through a singular edge that stretches between Yaxuna and Uxmal. This becomes notable when considering that all sites in the northern Yucatan outside of the 'Chichen Itza cluster' are closely linked to the El Chayal networks centred around the Petén, while Uxmal, as a northern Yucatan site, not only serves as the previously mentioned connector but also appears to be well integrated into the fifth faction, which spatially concentrates in a very different location.

This last group is particularly noteworthy as it includes sites ranging from the Gulf coast of today's Belize, chiefly Chetumal Bay, into the Central Peten region and also involves Uxmal as the odd one out. Golitko and Feinman's analysis shows that all of these are characterised by an increase in Ixtepeque obsidian compared to the Classic and also appear to have a comparably larger percentage of central Mexican obsidian (2012, 512–14). Furthermore, due to their location, they all appear to have somewhat favourable access to the Gulf of Honduras or waterways leading to it. The correlation between this and the uptick in Ixtepeque obsidian not only signifies the increased importance of water-based exchange networks that were to be essential to Postclassic economies (McKillop 2005) but also fits into the changing nature of the Terminal Classic that impacted the availability of obsidian through inland routes (Golitko *et al.* 2012, 512). These changes are also represented in the reduction of the El Chayal network compared with the Classic period with some of them falling into the fifth faction during the Terminal Classic. It is especially noteworthy that most of the sites that do not establish transition into this fifth faction, do not appear in the record for the Postclassic period that has been used for this Social Network Analysis (Golitko *et al.* 2012).

While the first Social Network Analysis already includes a wide range of implications, Golitko and Feinman's more recent study (2015) also forwards several other valuable points due to the larger sample size of the research as well as its increased spatial and temporal focus. Some of those are briefly introduced here as they frame the research presented above.

Based on an assemblage of obsidian from a total of 242 sites across all of Mesoamerica that encompass a range from 900 BC to AD 1520, Golitko and Feinman aim

at establishing an economic narrative based on Social Network Analysis on a pan-Mesoamerican scale, rather than the very specific goal of the previously discussed study. For the Terminal Classic, which is here included in the Late Classic, obsidian from 99 sites was considered with 68 of these sites contributing at least 10 samples, making them statistically relevant (Golitko and Feinman 2015, 211). These were analysed in the same manner as above although Golitko and Feinman exchange the faction grouping method for a focus on visually representing link strength with splitting those into 'weak' and 'strong' links between nodes (2015, 214).

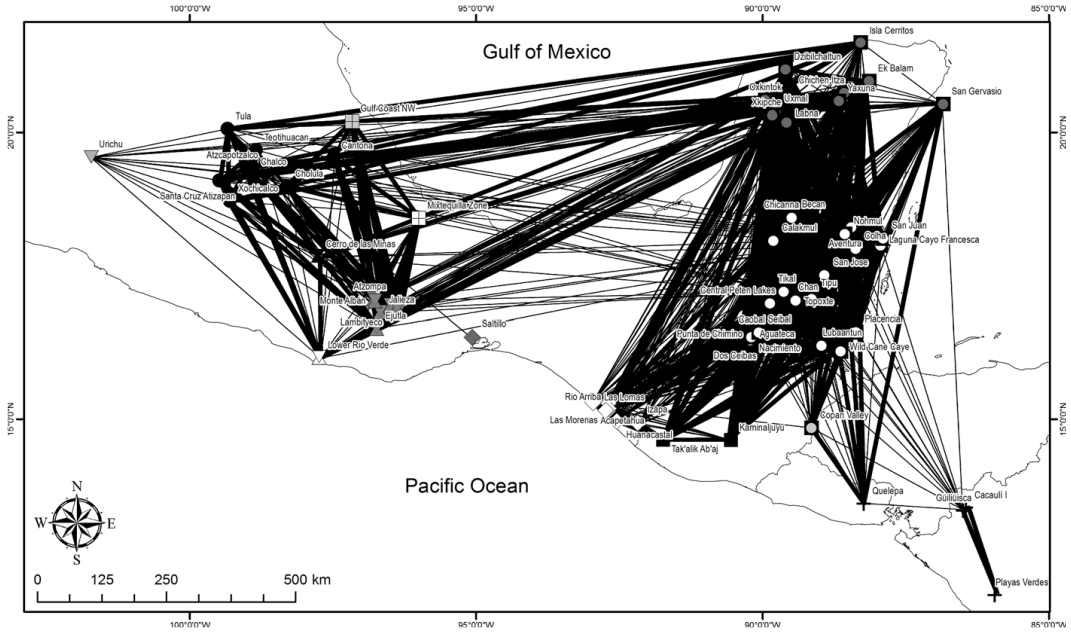

Figure 6: Network map or Terminal Classic obsidian exchange; edge thickness indicating strength of ties (Golitko and Feinman 2015)

Results for the Terminal Classic contribute to the main points of the previous study by identifying Chichen Itza's positioning in the network. For eastern Mesoamerica, this is particularly interesting as it puts Chichen Itza into a closer linkage with the central Mexican highlands than with any of the sites of that region. Nevertheless, it also shows stronger connectivity between sites along the Belizean Coast and the northern Yucatan that were already presented in the form of Uxmal's role in the solely eastern Mesoamerican network analysis (Golitko and Feinman 2015, 224). The shift of focus towards these coastal networks and away from the Pacific sites speaks for a substantial depletion of trade activity along the Pacific Coast. These trade routes were previously associated with the exchange between Teotihuacan and the Lowlands. Similarly to the inland routes mentioned earlier, the Pacific Coastal routes gave way for an increased activity along both Gulf coasts (Fig. 6) (Golitko and Feinman 2015, 214–15). Furthermore, on a pan-Mesoamerican scale, network integration reaches its highest degree up to that

point with a BR value of 72 compared to 51 during the Classic period (Golitko & Feinman 2015, 228).

The southern Lowlands

This systemic approach presents a very broad picture of changes to exchange networks in eastern Mesoamerica during the Terminal Classic. Large trends become evident from the presented result. Nevertheless, to fully understand the changing practices and the impact of both political changes and locational shifts, smaller-scale diversification must be considered. In this section, the thesis introduces three different case studies to accompany, contrast, and challenge the Social Network Analysis approach to this topic. These are divided into two regions, the Lowlands and the northern Yucatan. For the Lowlands, the Petexbatún region in today's Guatemala and the site of Nakum in the Petén are discussed. Secondly, the northern Yucatan portion will mostly concern itself with the site of Vista Alegre on the north-eastern coast of the peninsula.

Petexbatún

The Petexbatún region is a subregion of the larger Petén. Generally focused around the Petexbatún lake, it also refers to the slightly larger area that stretches from the sites of Ceibal to Dos Pilas (Fig. 7). The Pasión river connects it both to the Guatemalan highlands as well as to the Gulf of México through the Usumacinta river. The Petexbatún region is likely to have functioned as a major conduit of mobility and exchange during the

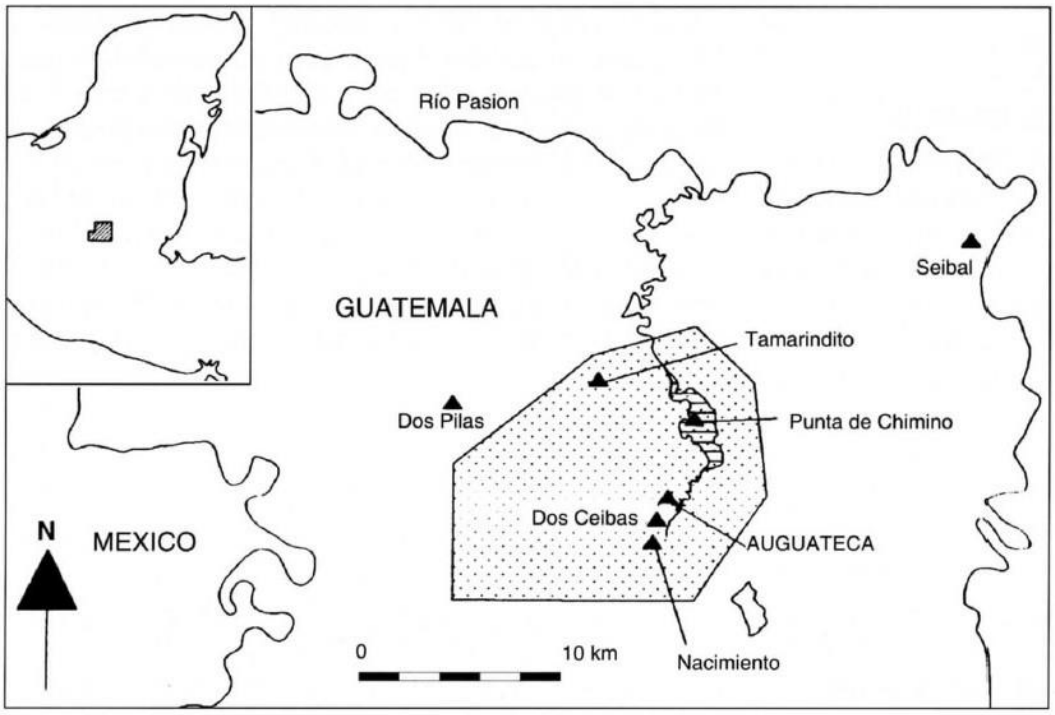

Figure 7: Map of the the Petexbatún region (Aoyama 2008)

Classic period as it was located close to the trade routes that are likely to have constituted the inland routes to Tikal from, for example, El Chayal (Demarest 2013).

One of the three sites of this region presented here was abandoned during the turmoil of the Terminal Classic. The centre of Aguateca, which was located just upstream from the Petexbatún lake, was burned down around AD 810. In turn, this led to the abandonment of the site by most of its elites (Inomata *et al.* 2004). Before its abandonment, it served as the main dynastic centre in the region for the late 8th and early 9th century following the earlier decline of Dos Pilas. During the same period, it was also fortified. Its defensible position was aided by the location of Aguateca on top of a 90-metre high escarpment (Aoyama 2008, 78; Inomata 2003).

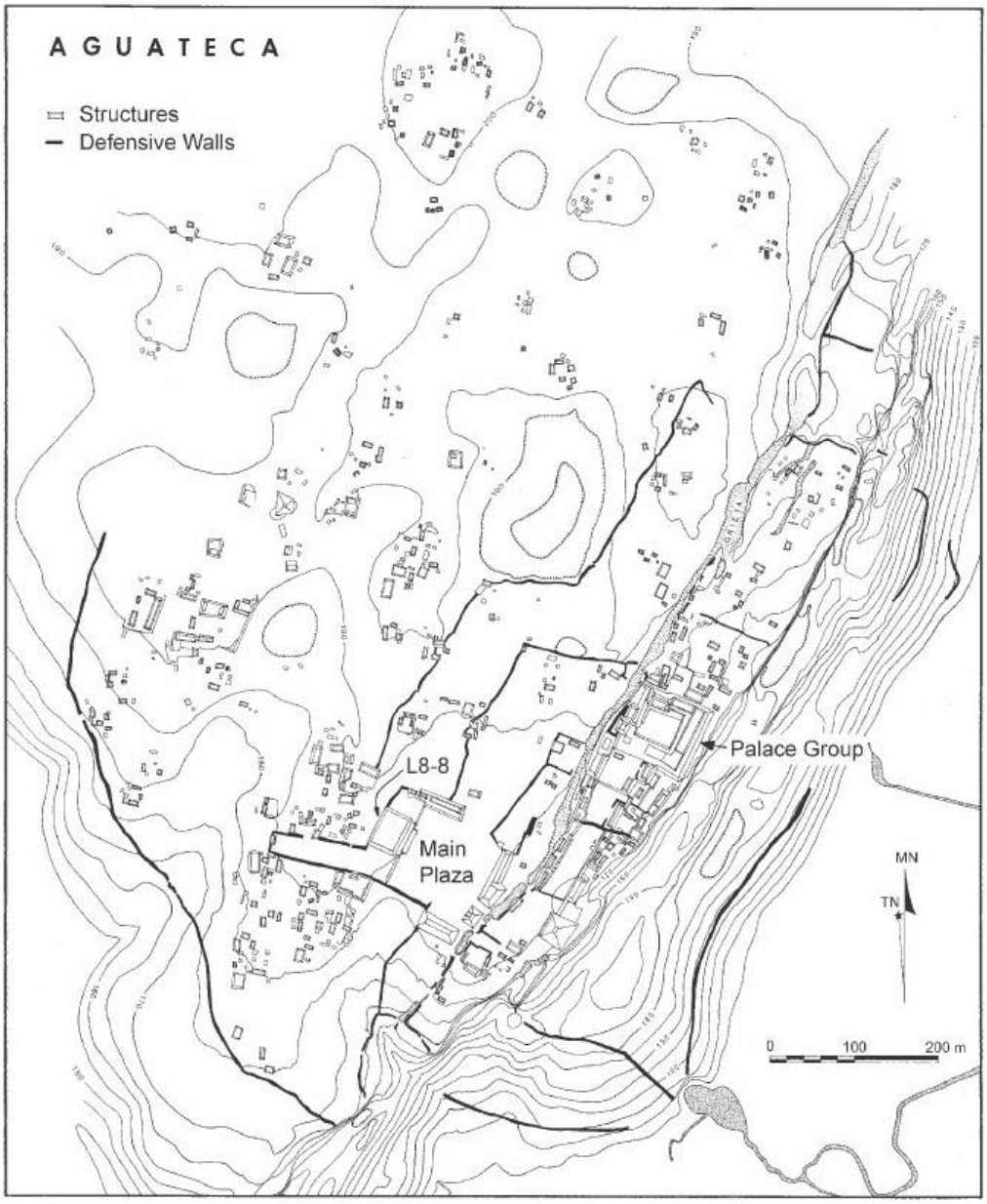

Figure 8: Site plan of Aguateca, Guatemala; indicating location of structure L8-8 and M structures (Palace Group) (Inomata et al. 2004)

The Terminal Classic record of this site can be divided into two different sections, one before and one after the destruction of the core area. While the pre-abandonment sections represent the Terminal Classic trading activity at Aguateca itself, the later finds do not represent economic activity at the site but were deposited by inhabitants of another site (Aoyama 2006, 29). The pre-destruction finds can be further subdivided into two parts, one from the elite residences and palace complex labelled M and the other from structures that may have formed a temple complex labelled L (Fig. 8).

For the M structures, table 3 shows that the overwhelming majority of obsidian comes from El Chayal (Table 3). The remaining 85 pieces were sourced from Ixtepeque or San Martin Jilotepeque (Aoyama 2006, 14). The inhabitants of larger complexes in the core area appear to have had better access to obsidian blades, which becomes clear from the higher distribution and size of obsidian artefacts in these quarters. These elites were probably the ruling class and elite scribes or artists that would have also administered the allocation of obsidian cores for blade production (Aoyama 2006, 15). No shift towards Ixtepeque obsidian that is known from other sites for this period is visible at this one.

	ECH	IXP	SMJ	Total
Amount	2084	59	26	**2169**
Percentage	**96,1%**	**2,7%**	**1,2%**	

Table 3: Origin of Obsidian at M structures in Aguateca (Aoyama 2006)

At the L structures, the picture is similar. They have been described as temple structures with the most complex one being L8-8, which might have been a tomb for the ruler of Aguateca. It was only partly constructed and remained unfinished as a result of the abandonment around AD 810. Nevertheless, most of the lithic artefacts found in the L structures come from structure L8-8, with 4,009 objects out of a total of 4,076. Compared to the M structures, obsidian is a relatively small component of the assemblage. While obsidian makes up 33.5% of the assemblage at these sites, it only makes up 7.3% at structure L8-8. This might have to do with the use of chert rather than obsidian tools during construction work (Aoyama 2006, 17–18). Similar to the obsidian found at the M structures, table 4 indicates that the overwhelming majority of obsidian from structure L8-8 comes from El Chayal with only one item of different origin (table 4). Furthermore, it appears that none of the objects were produced on-site. They were rather brought there for use in the construction of structure L8-8 which finally remained unfinished (Aoyama 2006, 18–19).

	ECH	SMJ	Total
Amount	158	1	**159**
Percentage	**99,37%**	**0,63%**	

Table 4: Obsidian sources at structure L8-8 in Aguateca (Aoyama 2006)

Even though Aguateca was abandoned during the first decade of the 9th century, obsidian artefacts dating to the second half of the 9th century were documented in a small deposit on the eastern side of the main plaza. This deposit was located in the vicinity of previously discussed structure L8-8 and comprised a total of 10 obsidian artefacts (Table 5). Unlike the previously discussed obsidian finds these included central Mexican obsidian. Table 5 shows that the record is still dominated by El Chayal obsidian. Nonetheless, three of them came from central México (Aoyama 2006, 28). They appear to have been brought to Aguateca by inhabitants of the nearby site of Punta de Chimino, who used them for some sort of activity around the main plaza (Aoyama 2006, 29).

	ECH	PC	ZRG	Total
Amount	7	2	1	**10**
Percentage	**70,00%**	**20,00%**	**10,00%**	

Table 5: Origin of obsidian at Aguateca (late 9th century deposit; structure L8-8) (Aoyama 2006)

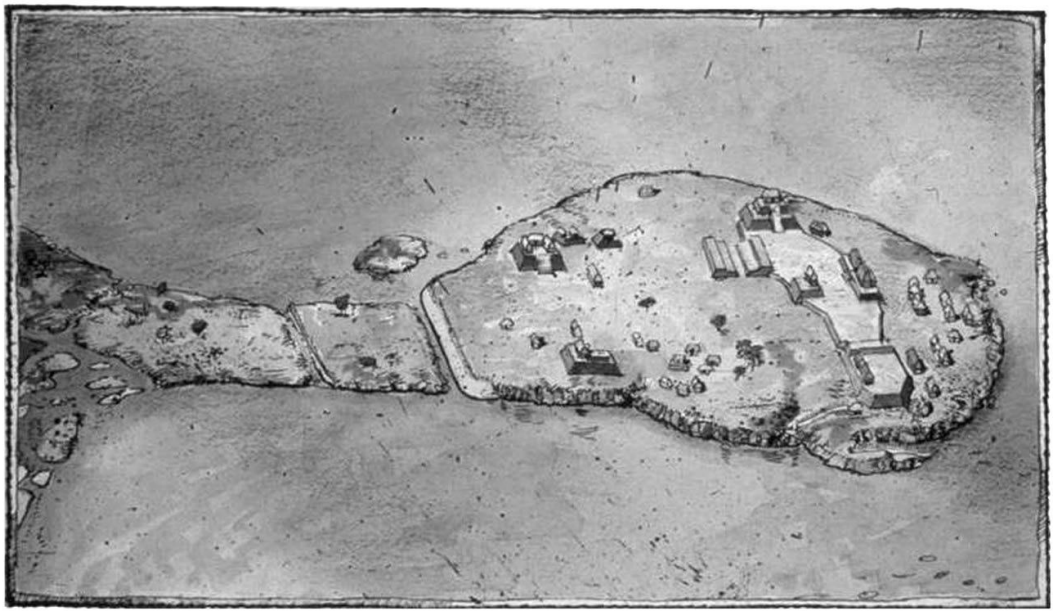

Figure 9: Artist impression of Punta de Chimino showing isthmus and defensive structures (Demarest 2013)

Punta de Chimino was one of the few sites in the Petexbatún region that did not experience abandonment during the turn of the 8th to 9th century but rather experienced a rise in population. It survived for almost another century, which in part had to with its very defensible location on a peninsula that was only connected to the mainland by a narrow isthmus (Fig. 9). Furthermore, the site was reinforced with walls and moats for better protection (Demarest 2013, 31). Despite being a much smaller site compared to Aguateca or Dos Pilas, its inhabitants imported obsidian from central México during the Terminal Classic. This becomes apparent from the rather high percentage of central Mexican obsidian found at the site (Table 6). Nevertheless, most of the obsidian here was

also sourced in El Chayal and a general decline in the volume of recovered material is also visible, over 2350 at Aguateca compared to a total of 64 obsidian artefacts at Punta de Chimino (Aoyama 2006, 29). Another point on the central Mexican obsidian at this site is their preparation technique that was used during production. The ground platforms are consistent with the techniques used in central México during the Terminal Classic. This could implicate two different ideas. Either the artefacts were imported as finished products or the knowledge of this preparation technique travelled along the same trade routes as the obsidian itself (Aoyama 2006, 29).

	ECH	IXP	PC	ZRG	UC	Total
Amount	52	2	7	1	2	**64**
Percentage	**81,3%**	**3,1%**	**10,9%**	**1,6%**	**3,1%**	
HL	**84,4%**		MX	**15,6%**		

Table 6: Obsidian sources at Punta de Chimino; denoting percentage of Highland and central Mexican sources (UC=Ucareo) (Aoyama 2006)

As the third and final site of the Petexbatún, Ceibal presents another relevant case study from this region which differs considerably in its situation during the Terminal Classic compared to the two previously introduced sites. As the largest site in the region, it is located about 20 kilometres northeast of the Petexbatún lake itself along the Pasión River (Aoyama 2017, 214). Ceibal was inhabited much longer than the previously mentioned Aguateca (Table 7) and experienced somewhat of a fluorescence while other centres in the region were abandoned. This has been attributed to the influx of people from other, declining sites (Demarest 2013, 41).

Site	**End of Terminal Classic inhabitation**
Aguateca	AD 810
Ceibal	~AD 889
Punta de Chimino	~AD 950

Table 7: Indication of abandonment in the Petexbatún during the Terminal Classic (Demarest 1997, 220; Inomata et al. *2004; 2017, 1296)*

Unlike the assemblage from Aguateca, obsidian at this site was recovered from a wide range of contexts that span from peripheral house mounds to elite residences and burials (Aoyama 2017, 214). In total 12,448 obsidian artefacts from Ceibal were analysed as part of this study (Aoyama 2017), the main bulk of which came from the late Middle pre-Classic. For the Terminal Classic, a total of 85 obsidian artefacts were examined to

	ECH	IXT	SMJ	UC	ZRG	ZCL	Total
Amount	73	6	2	1	2	1	**85**
Percentage	**85,9%**	**7,1%**	**2,4%**	**1,2%**	**2,4%**	**1,2%**	

Table 8: Origin of Obsidian at Ceibal (ZCL=Zacualtipán) (Aoyama 2017)

determine their source (Table 8). Similar to Aguateca, the majority of obsidian artefacts came from El Chayal with smaller amounts from the other two Guatemalan highland sources, Ixtepeque and San Martín Jilotepeque. Central Mexican obsidian artefacts were recovered from Terminal Classic contexts for the first time, apart from two artefacts of green Pachuca obsidian that were found in mixed contexts (Aoyama 2017, 217). Compared to the nearby site of Punta de Chimino, this is quite a limited number of artefacts from central México. The absence of Pachuca obsidian also differentiates Ceibal's from Punta de Chimino's assemblage. There is also a substantial difference in the knapping technologies that were employed at both sites. Ceibal's Terminal Classic obsidian has scratched platforms rather than ground platforms. The ground platforms became common during the Terminal Classic and are also seen in the obsidian found at Punta de Chimino (Aoyama 2017, 227–28). It appears that there was a substantial difference between in how these two sites engaged in economic interaction during this period.

Peten

The second regional case study discussed here will present obsidian records from the northern Petén lakes region with a focus on the intersite area between the sites of Tikal and Yaxha (Fig. 10). Although quite brief, this example adds a different regional perspective compared to the Petexbatún. Both the northern Petén lakes region and the

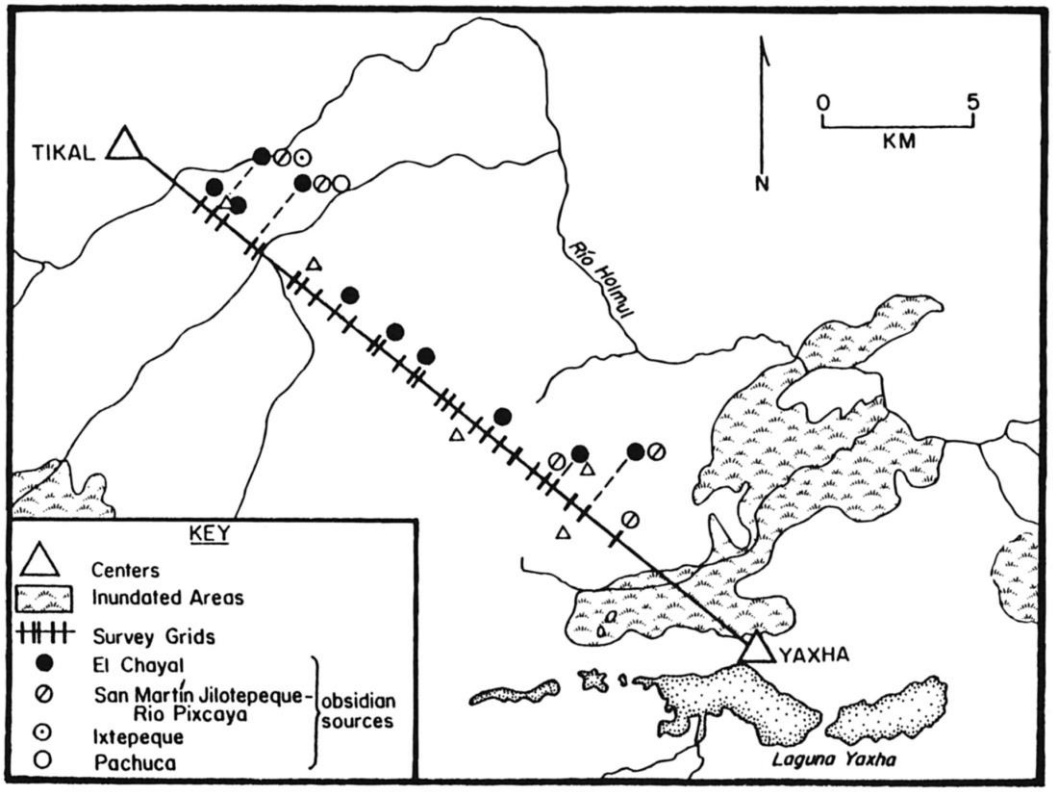

Figure 10: Map of the Tikal-Yaxha intersite region in the Petén lakes region (Ford et al. 1997)

Petexbatún form part of the larger Petén region. While environmentally speaking somewhat similar to the Petexbatún region, the northern Peten differs considerably in its access to waterways and where those reach the sea. Unlike the Petexbatún, the fluvial systems present in the region, for example, the Holmul River and Río Hondo, connect it to the Gulf of Honduras rather than the Gulf of México. Considering Golitko and Feinman's network analysis, this would mean that there should be a discernible increase in Ixtepeque obsidian.

Unlike the previously introduced obsidian assemblages, the samples presented here do not come from a core area of regional centres. They rather reflect everyday Maya that inhabited the land in between these main centres and would have mainly participated in subsistence economies like agriculture (Ford *et al.* 1997, 102). The two centres differ considerably as Tikal saw a major decline during the late 8th and 9th century while Yaxha appears to have seen a population influx during this period (Źrałka and Hermes 2012). However, occupation in the intersite area continued.

	ECH	IXP	SMJ	RM	PC	Total
Amount	44	2	15	1	1	**63**
Percentage	**69,8%**	**3,2%**	**23,8%**	**1,6%**	**1,6%**	

Table 9: Origin of Terminal Classic obsidian in the Tikal-Yaxha intersite region (RM=Rio Motagua) (Ford et al.1997)

In total 63 obsidian artefacts were recovered and analysed as part of Ford *et al.*'s study and represent the entire obsidian chronology of the area (Ford *et al.* 1997). The vast majority of these also came from El Chayal with smaller quantities from the San Martin Jilotepeque and Ixtepeque and only one example from the central Mexican site of Pachuca. While the temporal labelling and description of these are not fully coherent, there a few observations that can be made (Ford *et al.* 1997, 103). El Chayal obsidian dominates the Classic record but by the Terminal Classic, both Ixtepeque and San Martín Jilotepeque obsidian appear to have been imported as well (table 8). For the San Martín Jilotepeque obsidian, this means that it was reintroduced as it already formed the main bulk of pre-Classic artefacts. On the other hand, Ixtepeque is only present for the Terminal Classic and was also only found at one residence that might have been an elite residential unit (Ford *et al.* 1997, 109). The appearance of Ixtepeque obsidian during this time might have to do with the emergence of the neighbouring Nakum as an important trade centre on the Holmul river, even though the obsidian record from that site is rather scarce (Źrałka and Hermes 2012, 179).

The northern Yucatan

The preceding sections presented multiple case studies that can be put into the general category of the southern Lowlands region. During the Terminal Classic, the region was characterised by a wide range of transitions. The sites introduced in the case studies are good examples of this as many of them were in the process of experiencing extensive change, population shifts or abandonment. To contrast to this, the third and final case study will present the site of Vista Alegre on the north-eastern coast of the Yucatan.

Figure 11: Map of Vista Alegre in the Yalahau region of the north-eastern Yucatan (Glover et al. 2018)

Multiple factors make the site very suitable for this. Firstly, Vista Alegre was only excavated and intensively studied over the course of the last one and a half decades with the first excavations conducted in 2008 and 2011 (Glover *et al.* 2018, 5). As a result, the obsidian collection from Vista Alegre did not contribute to Golitko and Feinman's Social Network Analysis. Secondly, its isolated position over 40 kilometres from the next known coastal site and without much of a hinterland make it a prime example for coastal exchange. Due to this, Vista Alegre might have functioned as stopover point for seafaring travellers along the northern coast of the Yucatan rather than as a port of entry as it was also mostly surrounded by inaccessible wetlands (Fig. 11). Furthermore, it would have been the last such port along the northern coastline going eastwards (Glover *et al.* 2018, 1–2).

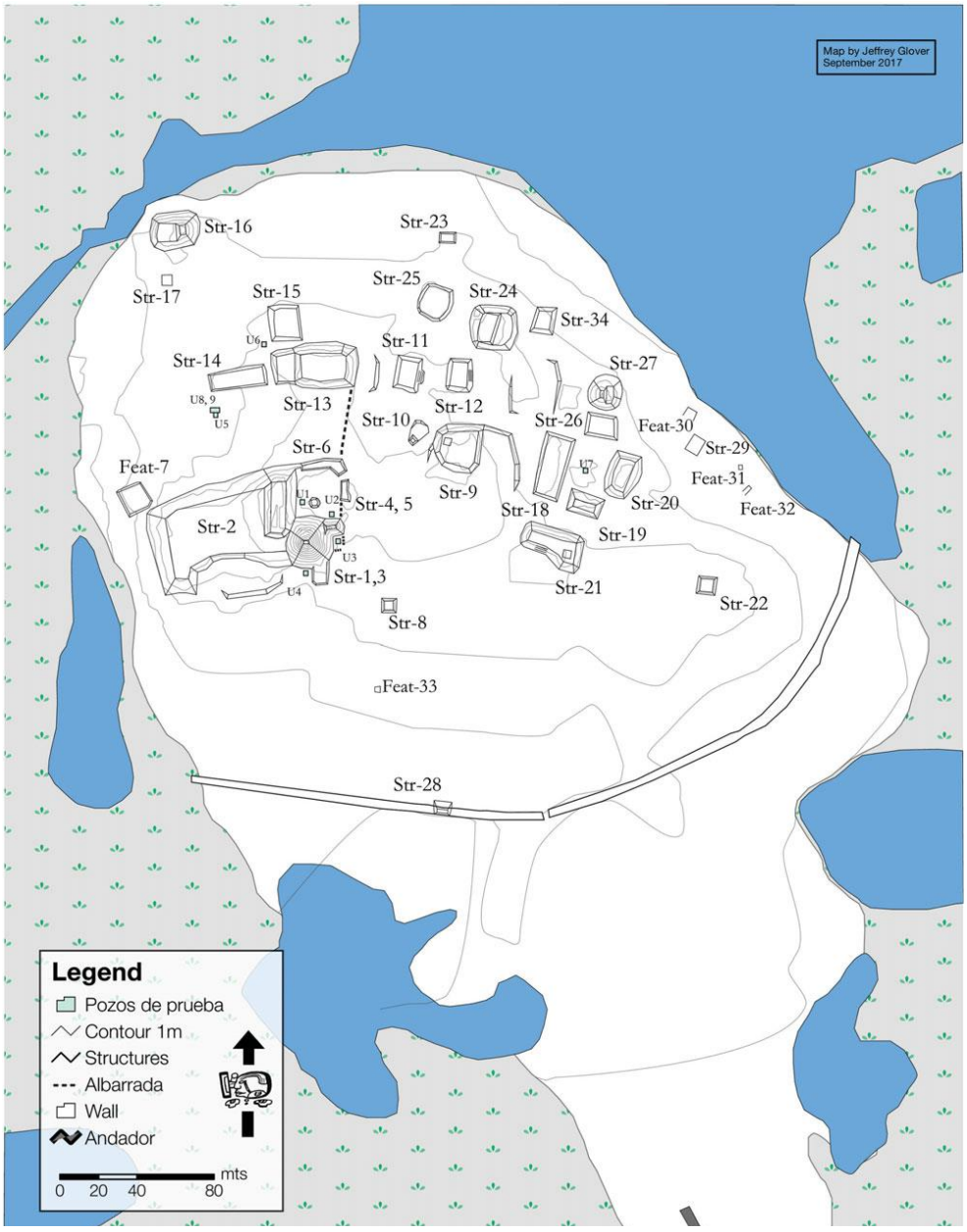

Figure 12: Site plan of Vista Alegre (Glover et al. 2018)

Located on a small inner-coastal island (Jaijel *et al.* 2018, 4), Vista Alegre experienced multiple lifecycles throughout its inhabitation that included phases of population and depopulation (Table 10). One such period of depopulation occurred during the 8th century and was followed by increased habitation that continued into the Terminal and Postclassic periods. In total, about 40 structures were unearthed at the site. The most notable ones include an 11-metre-high pyramid that offered uninterrupted views of the coastline as well as a 400-metre-long wall that separates the peninsula from the mainland (Fig. 12). While obsidian artefacts were recovered for most periods, the majority of these came from the highest excavation levels that represent Terminal Classic and Postclassic contexts (Glover *et al.* 2018, 2–6).

Vista Alegre Chronology	**Dates**
Vista Alegre I	800/700-400BC
Depopulation	400-75BC
Vista Alegre IIa	75BC-AD400/450
Vista Alegre IIb	AD400/450-700
Depopulation	AD700-750/800
Vista Alegre IIIa	AD750/800-850/900
Vista Alegre IIIb	AD850/900-1050/1100
Vista Alegre IV	AD1100-1550

Table 10: Chronology of Vista Alegre inhabitation (Glover et al. 2018)

As part of Glover *et al.*'s study, a total of 154 obsidian artefacts from Vista Alegre were analysed for their provenance. Of these 154 samples, 132 were finished blades. This makes it possible that Vista Alegre was a consumption site rather than one engaged in the production of finished tools. Nevertheless, it is not clear whether obsidian was traded as finished products or as production cores (Glover *et al.* 2018, 11). This can be compared to, for example, Aguateca, a site where cores were imported and manipulated in workshops on site (Aoyama 2006, 14). As mentioned above, the chronological integrity of the artefacts is mostly established through their context. However, all except one proximal blade fragment also show ground platforms: the technology that was common from the Terminal Classic onwards. Another aspect arising from the context of the recovered obsidian is its distribution across the site. Most artefacts were found in the proximity of the harbour, while the central plaza area yielded the least examples. This might be an indicator for the sites primary function as a trading and stopover port (Glover *et al.* 2018, 12).

	ECH	ICP	PC	ZRG	UC	ZCL	Total
Amount	9	94	16	2	32	1	**154**
Percentage	**5,8%**	**61,0%**	**10,4%**	**1,3%**	**20,8%**	**0,6%**	
HL	**66,9%**	MX	**33,1%**				

Table 11: Origin of Terminal Classic obsidian at Vista Alegre; denominating percentage of southern Highland and central Mexican obsidian (Glover et al. 2018)

Sources from both central Mexico and the Guatemalan highlands were identified for the obsidian assemblage at Vista Alegre (Table 11). Two of these sources were from Guatemala and four from central Mexico. The majority of the Guatemalan sample is from Ixtepeque with only a small number of El Chayal artefacts. Similarly, there are two clear main sources for central Mexican obsidian. Ucareo is the most common followed by Pachuca obsidian with both of them making up 21% and 10% of the total record correspondingly. Glover notes that this is a somewhat similar ratio to the one at Chichen Itza at 30% Ucareo and 22% Pachuca (Glover *et al.* 2018, 12). This might be debatable as central Mexican obsidian appears to be much more common there compared to Vista Alegre.

When considering Vista Alegre as part of larger coastal networks it takes a position as a type of economic watershed in west-east connectivity due to its nature as stopover point on the edge between the northern and eastern coast of the Yucatan. It can be connected to eastern Yucatan coastal sites like Wild Cane Cay due to the prevalence of Ixtepeque obsidian that was traded in increased quantities along those routes during the Terminal Classic. Wild Cane Cay saw an 800% increase in obsidian during that period of which 70% came from Ixtepeque (Glover *et al.* 2018, 13; McKillop 1989). Secondly, the comparably high percentage of obsidian from central México ties it into networks with Chichen Itza and its port of Isla Cerritos. When studied in this context, Vista Alegre appears to have been positioned on a gradient between these and the eastern Yucatan coastal sites in terms of central Mexican obsidian ratios (Glover *et al.* 2018, 14).

Data in short

The Social Network Analyses show clear trends in the obsidian record of the Terminal Classic. Compared to the Classic period, the number of factions increases from three to five with the overall record appearing to become more diversified as well as clearer separated. Especially the El Chayal network decreases, while the network factions indicating overlap or prevalence of Ixtepeque and central Mexican increases. Chichen Itza and the Northern Yucatan take a more central role in the proposed networks and trade appears to shift away from the Pacific Coast towards the Gulf of México and the Gulf of

Honduras. Overall, network integration increases throughout all of Mesoamerica compared to the Classic period. This speaks for the highest trade activity up to that point.

In a different manner, the case studies have shown the variety of the Terminal Classic obsidian record. Connected to both the Gulf of México and the southern Highland obsidian sources, all three introduced sites of the Petexbatún region have very different obsidian assemblages. Aguateca was dominated by El Chayal obsidian without any central Mexican examples before its abandonment. The obsidian was found in deposits from contexts of elite residences and a possible temple complex. After its abandonment, people from Punta de Chimino probably deposited obsidian in Aguateca that included specimens from central México. At Punta de Chimino itself the Terminal Classic record also included central Mexican obsidian at a rather high percentage. Lastly, Ceibal only had a small number of central Mexican obsidian while also dominated by El Chayal examples. In all of these Petexbatún cases there is also a decrease in size of obsidian assemblages visible when compared to pre-abandonment Aguateca. In the Petén lakes region, the obsidian record is somewhat unclear, but the simultaneous demise of some sites and the rise of new trade centres speak for changing economic activity in the area. At the same time, the port of Vista Alegre experienced resettling and increased trade activity during the Terminal Classic. The obsidian record is diverse and puts Vista Alegre into an intermittent position between the Ixtepeque focused eastern coast of the Yucatan and Chichen Itza due to the similar obsidian ratios. The question remains how these case studies tie into the concepts and results of Golitko and Feinman's Social Network Analyses.

Diversified 'Internationalisation'

While the previous chapter established both the Social Network Analyses and the case studies as separate entities, the following will aim at uniting them into one coherent narrative that can successfully answer the initially stated research question. To achieve this goal, the chapter is subdivided into four parts, one per case study. They examine the increased diversification in obsidian exchange during the Terminal Classic and discuss the influence that the transitions of this period had on that type of exchange. To structure the approach, the thesis will start from the questions that arise from the Social Network Analyses and compare them to the case studies. In this, they are also put into context with the main research question of the thesis. In the end, the thesis gives a compact compilation of the findings as an answer to the aforementioned research question.

A View on Social Network Analysis

The results of Golitko and Feinman's Social Network Analyses appear to paint a clear picture of eastern Mesoamerican economic changes during the Terminal Classic in an almost linear but staged capacity. While the faction model of the first analysis allows for some insight into regional variation, the overall notion of economic change in the eastern Mesoamerica in stages rather than through transition that cannot be exactly pinpointed remains. In the analysis, the Terminal Classic takes an almost interim stage between the Classic and post-Classic.

The increase in factions from three during the Classic to five during the Terminal Classic period speaks for increased network decentralisation on an overarching level. They argue for a decrease in network hierarchy as a precursor for the post-Classic highly internationalised trade of obsidian in eastern Mesoamerica (Golitko and Feinman 2015, 215). New networks, built on obsidian from central México, emerge in northern Yucatan in relation to the rise of Chichen Itza. El Chayal networks that were mostly inland-based are in decline and coastal and fluvial sites along the eastern coast see an increased use of Ixtepeque obsidian, which becomes the most traded obsidian from any signature outcrop in Guatemala. Furthermore, the degree of connectivity and thus traded material increases significantly to the highest degree up to that point (Golitko and Feinman 2015, 228). This would suggest that eastern Mesoamerica was becoming increasingly globalised rather than experiencing a 'valley' of interaction. All of the changes, which become visible in the Social Network Analyses, represent overall shifts in eastern Mesoamerica. Nevertheless, they do appear to only partly account for the bigger picture. The question remains how these changes manifested themselves on a smaller scale.

A case-based Discussion

Petexbatún

The Petexbatún of the Terminal Classic was a region of intensive turnaround, abandonment, and creation of new ties. Particularly the increased defensive nature of the three sites presented earlier, Aguateca, Punta de Chimino, and Ceibal, speaks for the challenging nature of the environment in the region (Demarest 2013). Nevertheless, the people inhabiting these sites were successful in participating in some type of obsidian exchange. While the records of both Aguateca and Ceibal suggest that these sites did not directly engage in emerging networks connecting them to either central Mexico or the trade routes of Ixtepeque obsidian, they continued to a certain degree in the distribution of El Chayal obsidian.

Both sites did not see their demise at the hand of the collapse of trade routes that would have also carried this type of obsidian but rather other factors as, for example, warfare in the case of Aguateca. At all three sites, the continuation of trade connections might have to do with the favourable location along the Pasión river that would have allowed for comparably easy trade along its route that also connected to the El Chayal region. While both sites were ultimately abandoned, this would have allowed the Petexbatún to sustain these trade routes for a longer period than in regions further north as trading would have included the traversing of exceedingly rugged terrain. Due to the transitionary stage that many sites would have found themselves in, it would have been arduous to also sustain such trade routes for many Lowland sites.

It appears that the abundance of obsidian at the Petexbatún sites was more related to the sites' advantageous regional location. This is also discernible through the Social Network Analysis and the shrinking size of the El Chayal network in it (Golitko *et al.* 2012, 515). However, it does not affirmatively represent the increasing diversity of possible trade connections and obsidian record between different sites. The data from Punta Chimino makes this evident when looking at it as the outlier among the Petexbatún sites.

	ECH	IXP	SMJ	PC	ZRG	UC	ZCL	**Total**
PrA AG	2242	59	27	0	0	0	0	**2328**
PoA AG	7	0	0	2	1	0	0	**10**
PUC	52	2	0	7	1	2	0	**64**
CB	73	6	2	0	2	1	1	**85**
%	**95,5%**	**2,7%**	**1,2%**	**0,4%**	**0,2%**	**0,1%**	**0,0%**	
% - PrA AG	**83,0%**	**5,0%**	**1,3%**	**5,7%**	**2,5%**	**1,9%**	**0,6%**	
HL total	**99,3%**		**MX total**	**0,7%**				
HL - PrA AG	**89,3%**		**MX - PrA AG**	**10,7%**				

Table 12: Data for obsidian source in the Petexbatún; denominating total percentage of southern Highland (HL) and central Mexican obsidian (MX) and percentage without pre-abandonment Aguateca (PrA AG=pre-abandonment Aguateca; PoA=post-abandonment Aguateca; PUC=Punta de Chimino; CB=Ceibal) (Aoyama 2006; 2017)

In contrast to the obsidian from Ceibal, Punta de Chimino's assemblage includes central Mexican obsidian of a considerable amount (Table 12) (Aoyama 2006, 29). Furthermore, due to the similarities in platform preparation technology between Punta de Chimino and central Mexico, the obsidian must have been a contemporary import during the Terminal Classic. This is significantly different from the few central Mexican obsidian pieces at Ceibal that show traces of a different platforming technology. One possible explanation for this phenomenon is that the obsidian artefacts at Ceibal were reused tools, simply deposited in a Terminal Classic context. Similar cases are known from other sites that did not partake in emerging long-distance trading networks. One example would be the site of Chunchucmil in the northern Yucatan (Magnoni 2008, 364).

Returning to Punta de Chimino, there could be several explanations as to why the people of this site were able to engage in long-distance exchange with central México. The Pasión and Usumacinta rivers enabled river-based transport of goods from the Gulf of México. This would have constituted an easier route compared to land-based trade through the rugged landscape of the Lowland region. Combined with the relative stability of Punta de Chimino during the Terminal Classic as a result of its defensive location and the probable influx of people from surrounding sites that would have brought a variety of personal knowledge and connections, it is likely that Punta de Chimino engaged in a profound exchange with central Mexico. However, only in combination, the somewhat stable social environment and availability of river-based transport as a major factor would have allowed this type of interaction.

When considered under the same factors as Punta de Chimino, the dichotomy between Punta de Chimino's and Ceibal's obsidian records creates a conundrum. Both sites had a similar locational advantage, saw an influx of people during the Terminal Classic and were relatively defensible (Demarest 2013, 31). There could be two different explanations for this. Firstly, the arrival of specific people at the two sites. People with differing agencies. As an invisible mechanism, agency directly influences structure (Joyce

and Lopiparo 2005, 365), in this case the difference between the obsidian records at two fairly similar sites. It is the direct representation of actors, which could be individuals but also objects (Pitts and Versluys 2021, 367), with their own agency in the context of the past (Joyce and Lopiparo 2005, 368). In general terms, the idea of agency could explain the dichotomy in obsidian records through the different ways the people of Punta de Chimino and Ceibal approached economic participation in a challenging time. This might have been based on personal connections of people arriving at these sites with differing intentions. For example, while the inhabitants of Punta de Chimino attempted to broaden their trading activities in a time of extensive turn around by engaging in long-distance exchange that would have brought obsidian and other commodities, the people of Ceibal may have relied on existing networks and even reused material to stabilise their situation. Conversely, a certain degree of hierarchy must have persisted in both cases to create the safety nets that allowed both sites to flourish during the Terminal Classic to a certain degree. Both approaches appear to have work for some time but in the long run, sites were unable to survive and were abandoned during the 10th century (Aoyama 2017, 228; Demarest 2013, 31).

Overall, the Terminal Classic obsidian record of the Petexbatún area speaks for the fragmentation of trading networks even on a regional level. With less dominating large centres, the trade of obsidian becomes more decentralised and diversified. Even in this rather disadvantageous region, land-based trade declines in popularity, which can be seen in both the overall declining numbers of obsidian and the number of El Chayal especially. Trade along river routes becomes more popular and allows for the import of central Mexican obsidian but no considerable rise in Ixtepeque obsidian can be observed. In all this, the variation between different sites existing in similar circumstances could be explained by varying agencies of individuals at these sites, although future research is needed to make the picture clearer.

Petén

The previously presented case study of the northern Petén lakes regions shows a similar trajectory to Terminal Classic obsidian exchange in the region as the one for the Petexbatún. Although the case study here is more limited in scale, it shows the increased fluvial trading activity towards the Gulf of Honduras as well as aspects of offsite obsidian procurement compared to the Petexbatún, where all case studies came from onsite contexts.

There are multiple similarities between both regions, like their proximity to waterways connecting them to possible trade networks and sources, El Chayal and the Gulf of México for the Petexbatún and the Gulf of Honduras for the Peten. Nevertheless, they diverge in access to these sources and routes. The Petén lakes region had better access to the Gulf of Honduras through a multitude of fluvial systems. This is also represented in the Social Network Analysis for this region, grouping it in part with sites along the Belizean coast (Golitko *et al.* 2012, 515). The trade would have involved Ixtepeque obsidian that was trafficked through maritime routes (Glover *et al.* 2018, 2). Furthermore, the region makes up the overlap between most of the different networks in Golitko and Feinman's analysis with some of the factions that they identified as disappearing during the following period, for example the El Chayal cluster, and some gaining in size, such as the one involving Ixtepeque obsidian. This also reflects the general turnaround in the region clearly as the changes in political pre-eminence and the crumbling of hierarchies would have opened new opportunities for other actors like Nakum as a trading centre on the Holmul river. However, to a certain degree, the narrative in this region might have been different for the nonelite population. While Ixtepeque obsidian is only found at an elite site in the Yaxha-Tikal intersite region, El Chayal obsidian makes up a majority of the obsidian (Ford *et al.* 1997, 109).

One possible reading is that there was no immediate change in trading patterns but rather a transition that is less clear-cut than it might seem from a solely systemic approach. Individual elite actors might have already participated in emerging Ixtepeque obsidian networks, while El Chayal obsidian was still available for consumption but most probably in a reduced capacity due to the land-based manner of its trading routes. Yet, it does not become clear from this case study how quickly the transition to water-based trade occurred and how involved common people were. Despite this, it becomes clear that the Petén experienced a diversification of obsidian trade with material from old and new sources. This was aided by political turmoil that allowed new sites to occupy hierarchical spaces, enabling them to participate in new long-distance networks. In comparison to the Petexbatún, there is less of an 'internationalisation' of the obsidian record visible. 'Internationalisation' is referring to the appearance of central Mexican obsidian in this case. For the Classic period, Mexican obsidian would have arrived in the region mostly by land and through Tikal's connections with central México (Moholy-Nagy 1999). The shift to water-based exchange and the decline of Tikal would have not aided an increase in more 'international' obsidian.

Vista Alegre and the northern Yucatan

Vista Alegre is a clear indicator for this rise in water-based exchange that goes hand in hand with the emergence of Chichen Itza as a major centre in the northern Yucatan.

While most Mexican obsidian of the Classic period was found in Tikal, Chichen Itza and its port of Isla Cerritos have much higher frequencies of Mexican obsidian during the Terminal Classic. This is also reflected in each of them forming their own faction in Golitko and Feinman's network analysis. Furthermore, most of these sites as well as the ones in the 'overlap faction' also show high frequencies of Ixtepeque obsidian (Golitko *et al.* 2012, 512–15). This indicates the rise of water-based modes of exchange that already influenced the previous example. What remains uncertain is how they directly overlapped.

The case study of Vista Alegre cannot only clarify aspects of this overlap but also show how the overall political change and locational shift led to the repopulation of the site. Firstly, it was directly impacted by the emergence of circum-peninsula exchange during the Terminal Classic that would have carried Ixtepeque obsidian westward and Mexican obsidian eastward. Without the change towards these modes of trade, the inhabitation of Vista Alegre does not have much merit in the middle of a wetland. Secondly, its location as the final stop along the northern coast of the Yucatan was crucial to enabling this type of trade in the first place. Thus, it both contributed and profited from the Terminal Classic transition.

Moreover, Vista Alegre's obsidian record itself puts it in a notable position, when seen in context with Golitko and Feinman's Social Network Analyses. Situated in the middle on a gradual transition in Ixtepeque to central Mexican obsidian ratios along the northern and eastern coast of the Yucatan, Vista Alegre not only functions as a stopover but also as a physical marker for the rise of water-based exchange. Different network factions did not function on their own or are separate entities connected through a limited number of ties. They are rather an amalgamation of overlapping spheres of different raw materials that were transported through coastal seafaring. As said above, this is visible in the form of obsidian ratios when situating Vista Alegre as a third location in between Isla Cerritos and Wild Cane Cay (Glover *et al.* 2018, 13). Thus, these separate networks cannot be seen disjointedly but rather as part of a growing eastern Mesoamerican globalised world that is based on rising interconnectivity and the involvement of a multitude of actors, in this case, for example, Chichen Itza, seafaring Maya traders or the people of

Vista Alegre. Furthermore, the sites' apparent lack of production workshops also speaks for this increased connectivity with almost specialised trading ports. All in all, this would also clearly put the establishment of circum-Yucatan trade to an earlier starting point that can only be theorised through Social Network Analysis (Glover *et al.* 2018, 2).

An Answer in short

To answer the main research question set out at the beginning of the thesis, the locational shifts and regional political changes of the Terminal Classic had a profound impact on distribution and procurement of obsidian but were, in turn, also heavily influenced by changes in the trading networks themselves. The overall impacts of these changes are recognisable through the use of Social Network Analyses. They show the shift towards Ixtepeque and central Mexican obsidian in certain regions with both being associated to maritime trade. Furthermore, the reduction in the distribution of El Chayal obsidian becomes recognisable as it was a mostly land-based traded material. The case studies also create a clearer regional perspective of these changes, though. These changes are not clear-cut in terms of the Lowlands declining and the northern Yucatan and coastal sites thriving. Especially in terms of the Lowlands, there is significant variation among sites from Ceibal engaging in old networks, Punta de Chimino exploring new options and the northern Petén lakes region seeing abandonment and emergence at practically the same time. Lastly, the nature of water-based interaction becomes clearer through the smaller lens of Vista Alegre, putting not just itself but all of eastern Mesoamerica during the Terminal Classic into an increasingly globalised world that saw diversified internationalisation of obsidian exchange.

Conclusion

During the Terminal Classic obsidian exchange in eastern Mesoamerica is in a state of transition. While Social Network Analysis allows fostering a larger scale understanding of Terminal Classic obsidian exchange, only the analysis of separate case studies makes it possible to create a picture of how regional political changes and locational shifts directly impacted the procurement of obsidian at specific sites and, in turn, how they impacted the people that inhabited these sites. Only in combination, both larger-scale research like Social Network Analysis and regional case studies can contribute to forming a clearer understanding of Terminal Classic obsidian exchange.

Through the use of Social Network Analysis, aspects such as the commencing shift from El Chayal in favour of Ixtepeque obsidian, the increased importance of water-based and maritime trade, and the rise of Mexican-obsidian-based exchange became clear. Furthermore, it showed that these Terminal Classic shifts in trading networks might be the cornerstone that the highly internationalised trade of the post-Classic period would be built on. This became also visible through the increased connectivity shown by the Social Network Analysis. Nevertheless, regional shifts only became clearly visible through case studies that showed the diversity of ways in which individual sites of different regions dealt with the unique political changes they faced in an increasingly globalised Mesoamerican world.

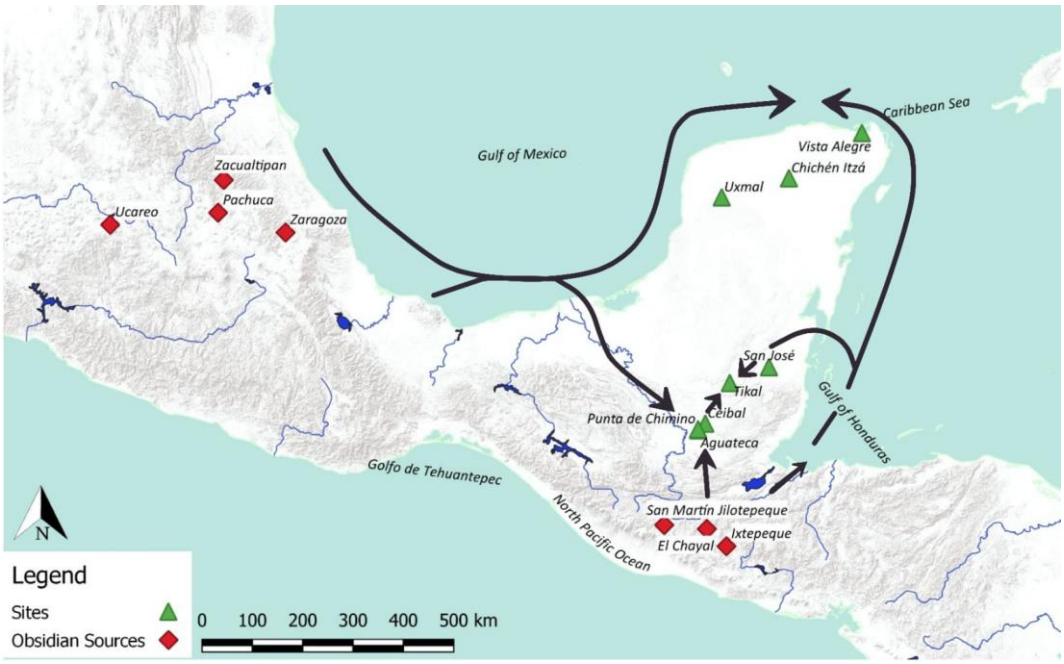

Figure 13: Map showing the possible Terminal Classic trade routes discussed by this thesis

Of the case studies, Punta de Chimino, Ceibal, and Aguateca showed variations that resulted from local turmoil during the Terminal Classic. These ranged from Aguateca being abandoned but then revisited by the people that might have left the site behind, Punta de Chimino trying to engage in new trading networks and opening up to long-distance exchange, and Ceibal attempting to find stability in a time of transformation through engagement in old networks. Furthermore, the case study from the Petén indicated that abandonment and emergence of new centres did not cancel each other out but rather happened simultaneously, while still engaging in emerging obsidian trade networks (Fig. 13). Lastly, Vista Alegre gave a clearer insight into the nature of maritime and water-based obsidian exchange and its overlapping nature in an increasingly globalised Mesoamerican world. While the case-studies themselves were varied and suggested a multitude of different regional shifts, they cannot fully encompass the totality of Terminal Classic shifts. Due to the plurality of regional transitions during this period, the thesis was not in a position to discuss all different regions and left out aspects such as the southern Highlands, other parts of the Lowland region apart from the Petexbatún and northern Petén lakes as well as inland sites in the northern Yucatan.

All in all, this thesis showed that the research question is best answered through a clear and direct engagement with localised conditions, while keeping large scale-perspective in mind. This comparative approach led to a variety of answers. In answering the question, the regional political changes and locational shifts of the Terminal Classic that impacted the exchange of obsidian appeared very similar to the overall complexity of localised developments during the Terminal Classic period. The Terminal Classic Maya population of eastern Mesoamerica was uniquely adapting the varying shifts on a regional level while partaking in an extending globalised world characterised by a range of different actors.

Future research into the field of obsidian exchange discussed could further consider the importance of localised perspectives on the matter while engaging with the backdrop of a larger scale theoretical frameworks such as globalisation theory or Social Network Analysis. While a conclusive answer to the nature of Terminal Classic obsidian exchange specifically and interaction more generally remains outstanding, a diverse approach that combines a multitude of different angles can lead to more clarity that can further help the knowledge of how interaction impacted the transitions of the Terminal Classic.

Abstract

The Terminal Classic period in eastern Mesoamerica is an era of extensive change and turnaround. Political changes and locational shift heavily contributed to this overall notion, while they were also impacted by their environments. This thesis looks at one of these changing aspects in the form of obsidian exchange.

As interaction is the realm in which humans adapt and change, studying economic exchange contributes to the overall understanding of the Terminal Classic as a part of interaction studies. Main different frameworks for studying interaction and exchange have been employed throughout archaeology, many global and some local. This thesis combines these approaches and uses a comparative method to merge aspects of Social Network Analysis as well as site and region-based case studies. In reflecting on two Social Network Analyses conducted by Golitko and Feinman through the lens of case studies in from the Petexbatún, northern Petén lakes region, and the northern Yucatan, the thesis tries to understand the impact of the aforementioned changes.

Through the comparative approach, it shows the diversity of ways sites and their people adapted to their changing environments during the Terminal Classic on an economic basis. Water-based modes of exchanging obsidian became increasingly more popular, while in-land-based types of transportation declined due to the higher effort. Many sites had to adapt in different ways, something that becomes visible on both a macro- and micro-regional scale. The growing importance of coastal sites in combination with more fluvial and maritime trade, led to a shift away from El Chayal obsidian, towards central Mexican and Ixtepeque variants. As a result, port sites, like Vista Alegre, were repopulated, while new trade centres emerged on river shores, such as Nakum. In the Petexbatún region, the access to fluvial systems did not necessarily correlated with the engagement in emerging networks, which might be related to varying agencies.

Only through an approach that values larger- and smaller-scale research, the nature of changing economic interaction during the Terminal Classic can become clearer.

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Figures

Tables