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Household Economies and Socioeconomic Integration: An Analysis of Obsidian Artifacts from Coba, Quintana Roo and Yaxuna, Yucatan, Mexico

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HOUSEHOLD ECONOMIES AND SOCIOECONOMIC INTEGRATION: AN ANALYSIS OF OBSIDIAN ARTIFACTS FROM COBA, QUINTANA ROO AND YAXUNA, YUCATAN, MEXICO

by

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ABSTRACT

Using Handheld XRF (X-Ray Fluorescence), this thesis explores how household economies at two Maya archaeological sites, Coba and Yaxuna, differed during a period of expansion and integration from the Early to Late Classic transition period (A.D. 500-750/800). Previous research suggests that during this time, Yaxuna was under the direction of Coba, however, due to the lack of household archaeology at both sites, how the bridging of these two centers impacted households and their domestic economies remains unknown. A compositional analysis of 1,186 obsidian artifacts recovered by the Proyecto de Interacción Política del Centro de Yucatán and the Proyecto Sacbé Yaxuna-Coba suggests household groups at Coba and Yaxuna had differential access to obsidian sources throughout the Classic period. While Coba and Yaxuna both exploited obsidian sources consistent with the overarching trend of obsidian consumption in the Classic period Maya lowlands, residents at Yaxuna exploited a greater diversity of obsidian sources. This variation is similar to that found at other Classic period centers of the northern lowlands. Yaxuna's greater access to obsidian sources may not only be related to its role in widespread trade networks from the Middle Formative into the Classic periods, but also to Coba's interest and incorporation of the site. This research is the first to explore household consumption of obsidian during the Early to Late Classic periods at Coba and Yaxuna, therefore contributing an essential bottom-up approach to understanding the socioeconomic relationship between these two centers during a period of expansion and integration.

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CHAPTER 1: INTRODUCTION

Archaeological studies of pre-Columbian Mesoamerican economies have often employed methods of provenance determination to explore the dynamics of consumption, production, and distribution (e.g., Braswell 2003; Golitko et al. 2012; Golitko and Feinman 2015; Moholy-Nagy et al. 2013). Obsidian has become one of the most common units of analysis analyzed in provenance studies due to its occurrence in a relatively limited number of geological contexts and its typically uniform chemistry within particular outcrops (Ferguson 2012). X-Ray Fluorescence (XRF), in particular, has proven to be a valid sourcing technique in obsidian provenance studies, as it is able to differentiate numerous geochemical source groups in Mesoamerica (e.g., Cecil et al. 2007; Drake 2009; Frahm 2013; Moholy-Nagy et al. 2013; Millhauser et al. 2011).

Considering the utility of obsidian in provenance studies, geochemical compositional analysis of this material provides a valuable gateway for the study of household and regional economies in pre-Columbian Mesoamerica and is especially appropriate for exploring the economic impacts of the socioeconomic integration of Coba and Yaxuna. Using Handheld XRF, I conducted an obsidian sourcing analysis of 1,186 obsidian artifacts recovered from household groups at Coba, Quintana Roo and Yaxuna, Yucatan, two Maya archaeological sites located in the northern Yucatan Peninsula (**Figure 1**). Obsidian material from 12 Mesoamerican sources provided by the University of Missouri Research Reactor (MURR) was also assayed and used to form a source library. Additionally, bivariate and ternary scatterplots were utilized as statistical methods for determining similarities between source samples and the sourced data from Yaxuna and Coba.

Because this research is the first to explore household consumption of obsidian at Coba and Yaxuna during a period of expansion and socioeconomic integration, the primary objectives of this study were to determine if the presence of sourced obsidian differed between household groups at the two sites and how these sourcing results compared with Classic period patterns of obsidian consumption in the Maya lowlands. In addition, this sourcing analysis was used to test hypotheses concerning the socioeconomic integration of Coba and Yaxuna during the Early to Late Classic periods. The patterns of obsidian consumption that have emerged from this sourcing analysis suggest that while Coba and Yaxuna both exploited obsidian sources consistent with the overarching trend of Classic period obsidian consumption, residents at Yaxuna exploited a greater diversity of sourced obsidian material than those at Coba. The variety of obsidian material within the Yaxuna households more closely resembles that found at other Classic period centers of the northern lowlands such as Uxmal and Dzibilchaltun and not at Coba. Yaxuna's greater access to obsidian sources may not only be related to its role in widespread trade networks from the Middle Formative into the Classic periods, but also to Coba's interest and incorporation of the site.

Figure 1: Locations of Yaxuna and Coba in southeastern Mexico (illustrator S. Miller).

<u>Coba and Yaxuna</u>

The Late Classic period (A.D. 600 – 900) in Mesoamerica is often regarded as a time when many Classic Maya polities in the southern and central lowlands reached their apogee. However, several polities in the northern lowlands saw continued growth and expansion during and following this period into the Postclassic, including the largest Late Classic polity in the northern lowland region, Coba. In fact, Coba resembles sites in the Late Classic Petén, such as Tikal and Calakmul, in many ways. Beginning in the seventh century A.D., Coba experienced substantial population growth and the construction of an unprecedented amount of monumental architecture and stelae in the site core (Shaw and Johnstone 2001; Stanton and Freidel 2005; Stanton et al. 2010). Most importantly, during this period the rulers of Coba undertook a

construction program of the longest Maya *sacbe* – or raised stone causeway –constructed in the Maya world. The causeway extended 100 km west into central Yucatan, terminating at the site of Yaxuna. Although likely multifunctional, it has been argued that this main causeway served to physically integrate numerous nearby communities into Coba's sphere of influence, including Yaxuna (e.g., Ambrosino et al. 2003; Loya González and Stanton 2013; Shaw and Johnstone 2001; Stanton and Freidel 2005).

Based on the archaeological patterns identified at Coba and Yaxuna, questions concerning the nature of the relationship between the two polities have emerged (e.g., Ambrosino et al. 2003; Loya González and Stanton 2013; Stanton and Freidel 2005). Researchers have generally proposed a relationship in which Yaxuna was to some degree subordinate to (Ambrosino et al. 2003; Loya González and Stanton 2013; Shaw 1998; Stanton et al. 2010) or directed by Coba in an effort to control inland trade routes (Shaw and Johnstone 2001; Stanton 2012). These arguments have largely drawn from ceramic evidence, as well as architectural and minimal iconographic evidence (e.g., Ambrosino et al. 2003; Loya González and Stanton 2013; Guenter 2014). Lithic evidence, however, has yet to be examined in regard to this relationship but can potentially provide important details of household consumption. A study of obsidian consumption over time may help reveal the continuities or changes in long-distance trade relations in regard to before and after the *sacbe* construction.

It should also be noted that the archaeological evidence that has led to these conclusions has largely been recovered from the monumental or core areas from both sites. As a result, how the bridging of these two centers impacted domestic life in these communities remains unknown. However, the lack of household archaeology at both sites has provided the opportunity for a smaller scale study of such integration. So far, the ceramic evidence is indicative of a significant

change in trade following the construction of the causeway (Loya González and Stanton 2013; Shaw and Johnstone 2001; Suhler et al. 1998) and these same mechanisms may have impacted the trade and consumption of obsidian as well. However, studies of obsidian consumption at Coba and Yaxuna have not focused on the impacts of integration, nor have they extensively studied consumption within the household (Braswell and Glascock 2007; Nelson et al. 1977). Without a greater understanding of the households of both sites, interpretations of domestic and regional economies remain limited. Because of this, the problem I address in this thesis concerns the lack of previous research that has investigated the domestic economies of Coba and Yaxuna by using the sourcing of obsidian artifacts recovered from these residential contexts to test hypotheses concerning the economic integration of Yaxuna and Coba during the Early to Late Classic transition period.

Study of Maya Lowland Obsidian Trade

The Classic-period Maya of the southern and northern lowlands exploited three major Guatemalan obsidian sources - El Chayal, Ixtepeque, and San Martin Jilotepeque - located in the southern highlands of Mesoamerica and modern-day Guatemala. In addition, the Classic Maya exploited several sources located in the eastern and western Sierra Madre mountain range located in modern-day central Mexico. These sources include Cerro Varal, Ucareo, Otumba, Zaragoza, Paredon, Tulancingo, Pachuca, and Zacualtipan (**Figure 2**). Provenance studies of obsidian from the northern Maya lowlands have revealed an overarching trend of Classic-period consumption and distribution (e.g., Braswell 2003; Braswell and Glascock 2007; Braswell et al. 2011; Hutson et al. 2006; Nelson et al. 1977, 1983; Varela Torrecilla and Braswell 2003). Studies from Xkipche, Oxkintok, and Chunchucmil in Yucatan and Edzna in northern Campeche indicate that

El Chayal makes up the largest represented source of total obsidian from these sites (Braswell et al. 2011; Hutson et al. 2006; Nelson et al. 1977; Varela Torrecilla and Braswell 2003). Braswell and Glascock's (2007:26) comprehensive analyses of obsidian samples from sites in the Puuc region, Northern Plain, Yucatan Interior, and Northern Quintana Roo suggest that throughout the Early and Late Classic periods, nearly all obsidian consumed in the northern lowlands originated from the El Chayal source. From northern Quintana Roo, Glover et al.'s (2018) analysis showed the majority of obsidian at Vista Alegre came from Guatemalan sources, specifically El Chayal during the Terminal Classic occupation. Around the same time at Isla Cerritos, El Chayal seems to have been consumed in smaller amounts, while Ucareo obsidian dominates the assemblage (Andrews et al. 1989; Braswell 1997).

Contrary to the patterns present in the northern lowlands, evidence from Colha and Nohmul, Belize suggest increasing popularity of Ixtepeque in the Late Classic, which eventually dwindled into the Postclassic period (Dreiss et al. 1993; Hammond, Nievens, and Harbottle 1984). These results generally fit with Hammond's (1972) early trade model for Classic Maya obsidian distribution. In his bimodal distribution of Guatemalan obsidian, Hammond (1972:1093) proposed Ixtepeque obsidian was transported via the Rio Motagua to the Caribbean and then up the Belize-Yucatan coast, while El Chayal reached the Maya interior lowlands via the Usumacinta and Sarstoon basins. Braswell's (1997) analysis of several sites in the northern lowlands also suggests Ixtepeque found in the northern lowlands was likely transported along a coastal route, as much of this material is restricted to the Eastern Cehpech sphere at sites such as Xelha and San Gervasio. In addition, the lack of Ixtepeque and Mexican obsidian at sites in the Western Cehpech (Yaxuna, Xkipche, Ek Balam) indicate that these sites may not have had the same access to the Gulf or Caribbean coast routes and instead obtained the bulk of obsidian

material from El Chayal through an overland route. Fernando Robles (2006) has since refined the Cehpech and Sotuta ceramic spheres of this region of the northern lowlands, however, the obsidian patterns found in Braswell's (1997) analysis remain significant to this research. West of the peninsula, a similar argument has been made for the use of Gulf maritime trade networks in the Late Classic period (Braswell 1997, 2003; Golitko et al. 2012; Golitko and Feinman 2015). Braswell (1997:597) has inferred that the lack of Mexican obsidian in the Puuc and Campeche regions, located between Chichen Itza and the Isthmus of Tehuantepec, indicates a sea route that bypassed the Western Cehpech sphere. In addition, greater connectivity measured through social network analysis likely represents the increasing role of maritime transport during the Late Classic, as there is a dominant link between the Gulf and Yucatan while Pacific coastal settlements are relatively isolated (Golitko et al. 2012; Golitko and Feinman 2015). Some coastal sites deviate from these general patterns, however. At Moho Cay, a small island located at the mouth of the Belize River, only a single sample that originated from the Ixtepeque source was found (Healy, McKillop, and Walsh 1984). McKillop and Jackson (1988:140) argue instead that while Ixtepeque and San Martin are present at both site types, El Chayal was likely the major source consumed by both the inland and coastal Classic Maya.

The results from the provenance studies of the northern lowlands, illustrated in **Figure 3**, have important implications for the study of obsidian from Yaxuna and Coba, as they are similar to the source attributions made through this analysis. The obsidian material from Coba and Yaxuna is dominated by El Chayal obsidian, resembling assemblages from the above-mentioned studies of surrounding Classic period sites of the northern lowlands. However, considering these patterns of obsidian trade, especially those observed along the Belize-Yucatan coast, I originally hypothesized that Coba's likely control of northern Caribbean coastal trade through its port of

Xelha may archaeologically manifest itself through a greater presence of Ixtepeque obsidian than would be expected for two inland northern lowland centers. Of the obsidian samples collected from early contexts at Xelha, less than a quarter originated from the El Chayal source, while nearly three quarters came from the Ixtepeque source (Braswell 1997; Braswell and Glascock 2007:Figure 7). Despite having a port under its control, Coba did not experience an increase in imported obsidian from the Ixtepeque source, as it comprises less than 2% (n=7) of the total site assemblage analyzed through this research.

Figure 2: Map of primary Mesoamerican obsidian sources used in this study and mentioned in the text (adapted from Martindale Johnson [2016:Figure 4-1]).

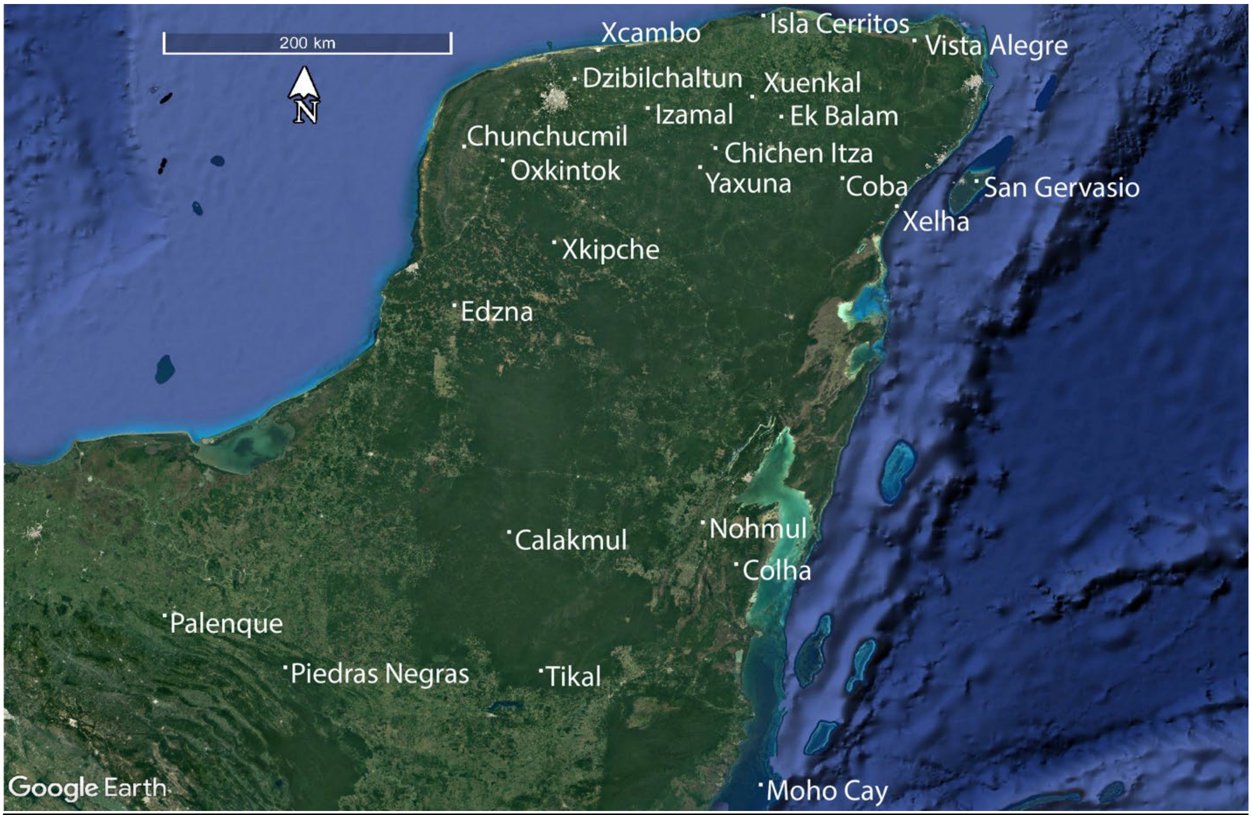

Figure 3: Map of Classic and Terminal Classic period obsidian provenance studies mentioned in the text.

<u>Research Question and Hypothesis</u>

In addressing the lack of previous research that has investigated the residential areas of Coba and Yaxuna, the primary goals of this thesis were to determine if the presence of sourced obsidian differed between household groups at the two sites and how these sourcing results compared with Classic period patterns of obsidian consumption in the Maya lowlands. In addition, this sourcing analysis was used to test hypotheses concerning the socioeconomic integration of Coba and Yaxuna during the Early to Late Classic periods (A.D. 500-750/800).

The principal question of this research asked does the presence of sourced obsidian differ between household groups at Coba and Yaxuna? In addition, drawing from previous studies of both sites, why might there be differences or similarities between household obsidian material? These questions concern how household-level practices and economies of Coba and Yaxuna differed during a period of expansion and integration from the Early to Late Classic periods. By forming a general site comparison of the sourced obsidian artifacts from residential contexts at both sites, it is possible to identify if household economies at both sites may have negotiated the socioeconomic change that was created and followed by the construction of the causeway during the early Late Classic period (A.D. 600-700).

Contents of Study

The following chapter, Chapter 2, is a background on the archaeology of Coba and Yaxuna, as well as on the subfield of household archaeology in Mesoamerica. Chapter 3 discusses the background and application of XRF methods in Mesoamerica, as well as the methodology and theory of Handheld XRF. In addition, Chapter 3 describes the statistical methods used in the analysis of this research. Chapter 4 is a presentation of the results of Handheld XRF and statistical analyses. This chapter also includes a discussion of how the source attribution results from Yaxuna and Coba compare to those from other sites in the northern lowlands and what this may suggest for the Yaxuna-Coba relationship. Finally, Chapter 5 presents the conclusions made about the consumption and distribution of obsidian at Coba and Yaxuna during the Early to Late Classic periods.

CHAPTER 2: BACKGROUND

Archaeological Research of Coba and Yaxuna

Coba is a large-sized civic center located in the western corner of the Yucatan peninsula in the state of Quintana Roo, Mexico. This region of Mexico is considered to be part of the Maya lowlands, which also encompasses the remainder of the Yucatan Peninsula, northern Guatemala, and Belize (Sharer and Traxler 2006:42). The particular geographic subarea of this part of the Maya lowlands is known as the northern lowlands, which transitions north of the El Mirador Basin.

The site of Coba consists of a large urban epicenter comprised of palaces, plazas, and temples, as well as several outlying residential groups and more than 50 intrasite *sacbeob* (Folan et al. 1983). The landscape surrounding Coba is dotted with Lakes Coba and Macanxoc, cenotes, and *aguadas*. Previous investigations have shown occupation at the site extended from the Late Preclassic to the Terminal Classic period, in addition to a later Late Postclassic settlement (Loya González and Stanton 2013). At its height in the Late Classic period (A.D. 600-900), Coba was the capital of the largest Late Classic polity and potentially most important political power in the northern lowlands (Guenter 2014). Settlement studies indicate that both the size and probable population reflect the immensity of the site (Folan et al. 1983; Folan et al. 2009; Stanton et al. 2020). **Figure 3** visualizes a structure count density analysis of LiDAR data with the highest values at Coba, corresponding to the substantial public architecture at the site. Covering a vast 63 km^2, Folan et al. (2009:60) suggest a figure between 20,000 and 60,000 as a conservative estimate for the Late Classic Coba population, a figure that is unparalleled in the region. Moreover, data from an off-mound test-pitting program in residential groups during the Proyecto

Sacbe Yaxuna-Coba 2015 and 2016 field seasons confirm the Late Classic period was indeed the largest period of occupation at Coba (Magnoni et al. 2015, 2016; Robles 1990).

Located 100 km to the west is the site of Yaxuna, a second order center situated in the middle of the state of Yucatan (**Figure 4**). The site core is comprised of three large acropolis groups, temples, an E-group, instrasite causeways, and a ballcourt (Stanton et al. 2010). Mamom-style ceramics place the earliest occupation of the site within the middle Formative period (700/650-350 B.C.) (Stanton 2005). The features of the site core, especially the large triadic acropolis groups, E-Group, and broad causeways suggest the site was one of the largest in the northern lowlands during the late Formative period (Loya González and Stanton 2013:28). Towards the end of the Formative period and again in the final phase of the Early Classic, or Yaxuna IIb (A.D. 550-600), there appears to have been a substantial decline in population and monumental construction. This decline was immediately followed by the construction of *Sacbe* 1 to Coba at approximately A.D. 600 (Stanton et al. 2010). Of most concern to this thesis is the Late Classic occupation at Yaxuna, which is marked by the construction and use of *Sacbe* 1, and possible integration within Coba's sphere of influence.

The numerous causeways within and emanating from Coba have intrigued early explorers and researchers since the site's initial exploration in the late nineteenth century. The Yaxuna-Coba causeway, or *Sacbe* 1, in particular has engaged researchers' attention since professional archaeology began in the Maya lowlands (Bennett 1930; Villa Rojas 1934; Thompson et al. 1932). Although Bennett (1930) was the first to publish his recording of the causeway, Villa Rojas (1934) with the Carnegie Institution of Washington was the first to accurately map and describe the causeway in the 1930s, as shown in **Figure 5**. The length of the causeway and its potential connection to Chichen Itza sparked interest among the Carnegie archaeologists. After

learning of the causeway's terminus at Yaxuna and not Chichen Itza, investigations at Yaxuna began. Ceramic data revealed that Yaxuna had both early and late occupations, leading Brainerd (1958) and Thompson et al. (1932) to believe that the causeway could provide a link between the chronological sequence of Chichen Itza and the Classic-period Peten sequence of Uaxactun, especially since Coba exhibited similarities in architecture, iconography, and hieroglyphs to sites in the southern lowlands.

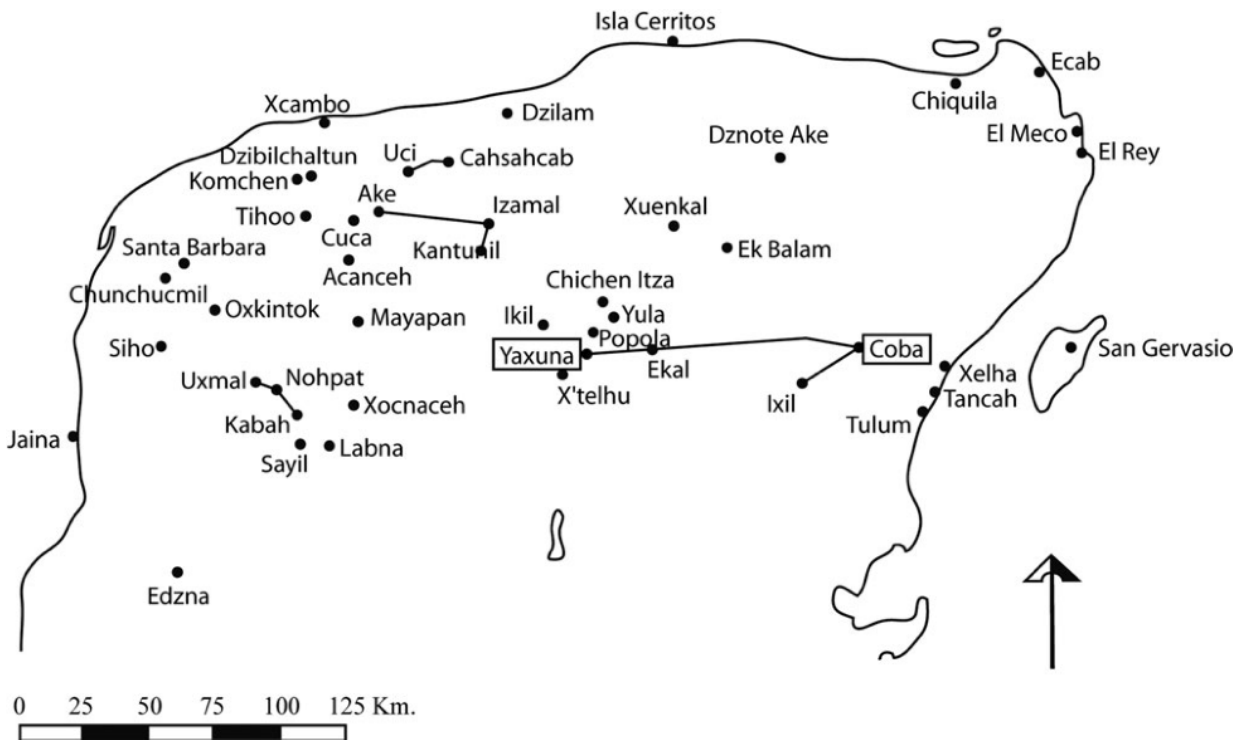

Figure 4: Location of Coba, Yaxuna, and *Sacbe 1* in the northern Yucatan peninsula (Stanton and Ardren 2016).

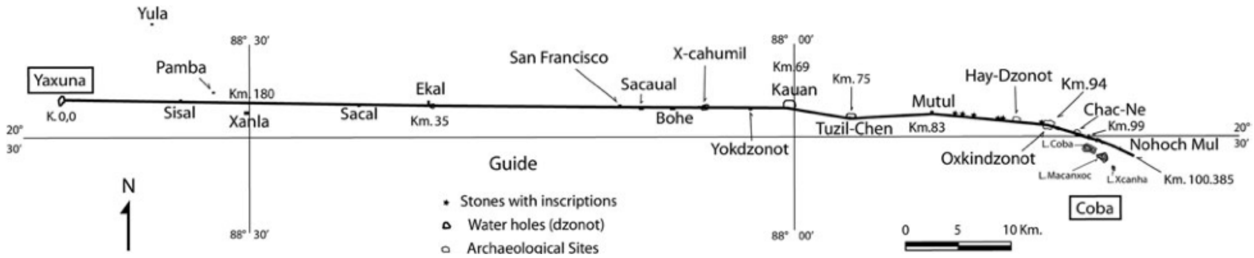

Figure 5: Map of *Sacbe 1* (redrawn from Villa Rojas 1934) (Stanton and Ardren 2016).

While investigations of the causeway, Yaxuna, and Coba did little to clear up the chronological placement of Chichen Itza, they did shed light on the magnitude of Coba and the complexity of its causeway system. Eventually, decades later several projects began systematic research of Coba. In 1974, Benavides (1976) and Robles (1990) began to map the primary *sacbeob* of Coba's *sacbe* system. The authors believed *Sacbe* 1 joined the northern interior of the Yucatan Peninsula to the east coast, as well as the northern to southern lowlands through Coba. At around the same time Benavides and Robles began research, the Coba Archaeological Mapping project was underway. The purpose of the project was to better understand the distribution of household groups and their relationship to the monumental architecture and causeway system at the site (Folan et al. 1983; Folan and Stuart 1974). The project directed significant attention toward the intrasite linear features in Zone 1, their morphological differences, and how these delineated household compounds. *Solares*, or yard areas, and spaces associated with subsistence-related activities such as kitchen gardens, orchards, milpa plots and agricultural terraces were analyzed to reconstruct the size and composition of Maya households in Late Classic Coba (Fletcher 1983). While only 33% of the entire site was mapped, the research from the Coba Archaeological Mapping project did make known Coba's development

into the only large urban center in northern Quintana Roo during the Classic period (Stanton and Ardren 2016).

Following Folan et al.'s (1983) research of Coba, opportunities for household archaeology of the site arose. Manzanilla and Barba (1990) expanded upon their investigations through intensive research of two houselots in the eastern part of the site. Their excavations and geochemical testing of activity areas within these groups was pioneering as it employed a relatively underused methodology to household studies. However, similar follow up studies of domestic groups have yet to be conducted, resulting in a limited understanding based on just these two houselots. A few years later, Con Uribe and Martinez Muriel (2002) revisited the site, but their research focused on investigations of the monumental groups. Thus, until the Proyecto de Interacción Política del Centro de Yucatán (PIPCY) began preliminary work, no residential groups had been explored since Manzanilla and Barba's (1990) investigation.

Similarly, a relatively limited number of residential structures at Yaxuna have been extensively excavated and reported. During the first systematic research by the Selz Foundation Yaxuna Archaeological Project directed by David Freidel and Tomas Gallareta Negron in 1986, residential investigations were limited to the excavation of a large residential structure. The 5E-73 Complex was investigated in order to inform researchers of the evolution of an elite residential group through time at Yaxuna (Stanton et al. 2010:61). Architectural evidence was suggestive of a potentially hostile relationship between Coba and Yaxuna during the Late Classic. Justine Shaw's (1998) dissertation research consisted of a completion of the previous settlement study and reviewed in detail the residential excavations carried out between 1989 and 1993. Nevertheless, these excavations were limited to a relatively small number of test pits (Stanton and Ardren 2016). As a result, prior to the onset of the Proyecto Sacbe Yaxuna-Coba

(PSYC) under the direction of Dr. Travis Stanton, Dr. Traci Ardren, and Dr. Aline Magnoni, only three household groups have been extensively excavated and reported (Stanton et al. 2010).

While there is still much to be learned from the residential areas of Coba and Yaxuna, several studies have elucidated a possible relationship between the two Late Classic polities (Ambrosino et al. 2003; Freidel 1992; Loya González and Stanton 2013; Shaw and Johnstone 2001; Stanton and Freidel 2005; Stanton et al. 2010; Suhler et al. 1998). Earlier explanations of the construction of *Sacbe* 1 were centered around a theme of defense and fortification from the Itza state (Braswell 1997; Freidel 1992). Freidel (1992) originally believed Yaxuna served as an intermediary outpost between Coba and the Puuc cities, however, it is now widely understood that the main occupation and expansion of Chichen Itza dates to the Terminal Classic period (around A.D. 800), later than the Late Classic construction of the causeway. In addition, architectural evidence from Yaxuna suggests a temporal disjunction between the period of Coba's influence (A.D. 600-700/750) and the first appearance of traits associated with Chichen Itza at Yaxuna (post A.D. 900) (Stanton and Ardren 2016:7).

While an alliance between Yaxuna, the Puuc cities and Coba against Chichen Itza is not strongly supported, an unequal power dynamic between Coba and Yaxuna seems to be evidenced by the ceramic data from both sites. Investigations of the locally produced ceramic type, Arena Red, indicate Yaxuna had limited trade with other polities. Specifically, Yaxuna appears to have been a loci or the locus of Arena Red production. This type was primarily exported east along *Sacbe* 1 towards Coba, however, it is found across the Yucatan Peninsula as well (Loya González and Stanton 2013; Shaw and Johnstone 2001; Suhler et al. 1998). Loya González and Stanton (2013) argue the ceramic evidence may represent Yaxuna paying tribute to Coba or some form of economic relationship between the two sites. In either of these situations, the

authors stress that Yaxuna may have been subordinate in some ways, but not in entirety. Similarly, Shaw and Johnstone (2001:12) argue for a disruption in both local and long-distance trade. When comparing the Yaxuna III (A.D. 550-650) to the Yaxuna II (A.D. 250-500) ceramics, the Late Classic appears to not only have the fewest ceramic types, but also the most limited trade. While Arena Red is found in low frequencies at several sites like Acanceh, Chunchucmil, and those within the Greater Coba polity, Coba's most common type, Batres, is found in insignificant amounts at Yaxuna, suggesting a nonreciprocal trade relationship. Moreover, a major diagnostic type of the Late Classic northern lowlands, Chablekal Fine Gray, is present at sites such as Coba and Dzibilchaltun. However, this type has never been identified at Yaxuna, suggesting residents may not have been participating in this widespread ceramic sphere (Stanton et al. 2010:41).

Monumental architecture, or the lack thereof, has been cited as evidence in further support of the hypothesis that Yaxuna may have been subordinate to Coba. During the time when much of Coba's site core and stelae were constructed, in addition to *Sacbe* 1 (i.e. A.D. 600 – 700/750), Yaxuna exhibits little evidence for any construction of monumental architecture. Notably, a residential structure that was constructed during this time, the Xkanha Acropolis, was built in a distinctive east coast style following the termination of the Teotihuacanoid patio-quads from the Early Classic (Ambrosino et al. 2003). In addition, modifications to existing Early Classic structures were made. Structure 5E-75 was completely razed and reoriented towards the north where a stairway was constructed on top of Early Classic stucco melt, suggesting a gap between the Yaxuna's Early Classic occupation and Coba's construction. The authors argue this gap may have related to Coba's seize of Yaxuna during the Late Classic period. Similarly, Structure 5F-3 was raised one meter, resurfaced and reoriented to the east, facing the terminus of

Sacbe 1 (Shaw and Johnstone 2001). In fact, an Early Classic building that formed the terminus of *Sacbe* 1, Structure 6E-13, was also reoriented during the construction of *Sacbe* 1 (Ardren 2003). Stanton and Freidel (2005:238) argue Late Classic reinterpretations of Yaxuna's geomantic plan suggest integration within Coba's political network. Specifically, long term plans of a series of Formative period causeways that once formed a cosmogram of the site seem to have been neglected by Late Classic construction, including *Sacbe* 1. Contrary to these ideas, Shaw (1998:7) argues the community of Yaxuna did not experience a Late Classic hiatus, but instead remained a strategically valuable site. Rather than construct monumental and residential structures, labor was redirected towards the construction of *Sacbe* 1 possibly under the direction of Coba. Loya González and Stanton (2013) add that it is unlikely Coba and Yaxuna were at odds during this time, as members of both communities would have likely had to have participated in such a monumental construction project.

Moreover, warfare and/or conflict may be evidenced at Yaxuna by a carved monument, one that is associated with the only public buildings from the period of causeway construction. Much of the text on the monument is eroded and there are no legible emblem glyphs, however, the final clause contains a *ch'ak* glyph, suggesting a conquest event referencing the incorporation of Yaxuna into Coba's power base (Stanton and Ardren 2016:7). In addition, important dates from monuments have informed our understanding of Coba's political history. These dated monuments span almost two centuries, beginning with Stela 6 (A.D. 613) and ending with Stela 20 (A.D. 780). Most of these come from the Macanxoc Group and are associated with Ruler B, the queen who held the *kaloomte'* title (Guenter 2014). Interestingly, her reign lasted from A.D. 640-681, which is the time period that aligns with that which archaeologists have dated the construction of the Yaxuna-Coba causeway (Shaw and Johnstone 2001; Stanton and Freidel

2005; Suhler et al. 1998). This concurrence has been cited as another line of evidence supporting the incorporation of Yaxuna into Coba's power base (Guenter 2014). Ambrosino et al. (2003:117) also argue iconographic data found along panels on the causeway impart a sense of "decisive subordination." In addition to possible written records of warfare, evidence of ritual termination deposits throughout Yaxuna's occupation have led some scholars to argue for the presence of warfare (Ambrosino et al. 2003) or at least the suffering of a major defeat at various points in Yaxuna's political history (Ardren 1999; Freidel, Suhler, and Cobos Palma 1998). During the Late Classic in particular, the Xkanha Acropolis was built following the termination of Teotihuacanoid patio-quads from the Early Classic, as previously mentioned. The main patio-quad also had partial ceramics vessels smashed on the interior floor, then blanketed by a sterile soil to cover the ritual debris (Ambrosino et al. 2003:117). Around the same time, Stela 1 on the North Acropolis seems to have been moved from a prominent to more concealed location (Ambrosino et al. 2003).

The archaeology of Coba and Yaxuna has yielded several lines of evidence (i.e., ceramics, monumental architecture, iconography, ritual termination deposits) that point to the integration of Yaxuna into Coba's sphere of influence during the Late Classic period (e.g., Ambrosino et al. 2003; Freidel 1992; Loya González and Stanton 2013; Shaw and Johnstone 2001; Stanton and Freidel 2005; Stanton et al. 2010; Suhler et al. 1998). While limited obsidian provenance research has been done at both sites (Braswell and Glascock 2007; Nelson et al. 1983), no studies have applied such research to understanding the Late Classic period of integration and expansion, nor have they studied the impacts on household lithic consumption. For this reason, the large sample size of obsidian artifacts analyzed in this thesis research

complements the previous studies at Coba and Yaxuna, as well as adds to interpretations of the Yaxuna-Coba relationship during the Early to Late Classic transition.

Household Archaeology

As the "primary production and consumption units in society" (Hirth 2009:1), households have been increasingly explored in order to build a more complete picture of the ancient Maya (e.g. Hendon 1996; Kovacevich 2015; Robin 2003; Santley and Hirth 1993; Sheets 2000; Wilk and Ashmore 1988). This effort to gain a more holistic understanding of the social processes within ancient Mesoamerica contrasts the tradition of archaeological research that heavily focused on only a small segment of society, the elite (Lohse and Valdez 2004; Marcus 1995; Webster and Gonlin 1988). In fact, studies of commoners or the non-elite within a society are especially appropriate for understanding the interaction between the individual and the social structure, as the ability of any individual to assert their agency in any given situation is constrained by the broader circumstances surrounding them (Bourdieu 1977; Robin 2003). This approach is especially relevant to this study of household economies, as households at Yaxuna likely would have negotiated with and been constrained by Coba. It is fitting that understandings of such social processes have largely derived from archaeological data recovered through household archaeology, indicating these forms of data serve as sensitive indicators of daily social practices (Wilk and Ashmore 1988).

Since its inception, household archeology has proven to be a productive approach. During the late 19th century, the foundation of household archaeology was established by Edward Herbert Thompson's (1886; 1892) study of ancient house mounds surrounding Yucatecan centers. His effort was in response to Lewis Henry Morgan's (1877) unilineal cultural

evolutionary model, which proposed the concept of Ethnical Periods, or stages of cultural development that corresponded to specific technological discoveries and inventions. Based on this model, Morgan (1877) argued that the ancient Maya had not reached the stage of 'civilization,' as he believed they did not have true cities with urban residential areas outside the ceremonial center. In order to test this idea, Thompson documented residences and housemounds outside the site centers, arguing for evidence that the Classic Maya did in fact have true cities. Following Thompson, household studies became increasingly popular among archaeologists. However, it was not until Gordon R. Willey's seminal work in the Belize Valley region that archaeologists began to seriously consider the importance of households and residences in order to truly understand ancient complex societies (Willey et al. 1965).

Following Willey's work, household archaeology largely developed from settlement archaeology, which studies the distribution of traces of human activities across the landscape (Wilk and Ashmore 1988:7). As settlement archaeology developed throughout the 1960s, the importance of understanding the entirety of ancient communities was realized. Household archaeology was particularly important in the movement beyond cultural-historical and typological-chronological analyses of archaeological material. In effort to bridge the mid-level theory gap, archaeologists began to confront behavioral and processual questions through the archaeology of households. This was particularly true under the systems-theory framework, which emphasized the complex organization of a site, including activity areas and how these fit within sites of different size and function. Archaeological approaches during this period were also largely concerned with the role of the household as a measurable socioeconomic unit of the greater community (Allison 1999), which allowed for the calculation of mean family size and therefore total population (e.g., Folan et al. 1983; Kolb 1985). Prior to the PSYC investigations

of Coba, the vast majority of household research at the site was conducted under this particular approach (Folan and Stuart 1974; Folan et al. 1983).

As the forerunner of household archaeology, Kent Flannery (1976:16), was the first to embark on the study of "the early Mesoamerican house" as a meaningful unit of analysis. Following Flannery (1976), Wilk and Rathje (1982:618) were one of the earliest researchers to propose the definition of the household as "the level at which social groups articulate directly with economic and ecological processes." They argued that although household size and form vary greatly, these differences "relate systematically to the kinds of functions the household performs" (1982:631). Moreover, because the household was perceived as a strategy for meeting the functional requirements of society, it was also believed to have served as an instrument for adaptation.

As household archaeology developed into its own subfield distinct from settlement archaeology, the focus shifted from formal and functional studies of settlements to the actual human behavior that created the material remains of settlement (Wilk and Ashmore 1988:11). Several authors (Brumfiel 1992; Hendon 1996:48) have mentioned that previous interpretations through the ecosystem approach (e.g., Wilk and Rathje 1982), which viewed the household as an adaptive mechanism, resulted in a "concept of the household as an irreducible entity whose structure and activities are the result of external environmental and social conditions." Contrary to this interpretation, household studies largely shifted in focus to the "symbolic dimension" of the household, or what members of a domestic group do and the meaning assigned to their actions (Hendon 1996:46). Rather than view the household as reactive to external large-scale factors, individual action and agency became an important approach to household studies.

The development of household archaeology has been largely influenced by practice, a symbol of anthropology that emerged during the 1980s. Generally, the study of practice is the study of anything people do (Ortner 1984:149). It also incorporated a range of interrelated interests including practice, praxis, action, interaction, activity, experience and performance (1984:144). Approaches from practice theorists such as Bourdieu (1977) and Giddens (1984) were incorporated into archaeological studies in effort to bridge the divide between the large, external social structures referred to above (i.e., Wilk and Rathje 1982) and the practice or action of the individual by demonstrating the recursive relationship between the two (Robin 2002). Since then, many recent and modern approaches of ancient households have applied practice-based approaches to varying extents (e.g. Hendon 1996, 1999, 2002; Robin 2002).

Through the use of a more micro-level analysis, household archaeology has opened doors for the study of various aspects of ancient everyday life including gender (e.g., Tringham 1991), social identity (e.g., Hendon 1999), and power (e.g., Hutson 2002) among many others. By addressing these smaller-scale questions, household archaeology is in turn able to inform us about the larger social processes of a society. Like household archaeology, the study of gender relations has been equally dismissed in the history of archaeological research, as such questions have been viewed as "untestable" or "marginal" (Conkey and Spector 1984; Tringham 1991:98). In order to confront the genderless prehistory archaeologists have created, Tringham (1991) and Robin (2002) have emphasized gendered relations of everyday life by understanding how the built environment can be used to reconstruct these relations. Both Kovacevich (2016) and Ardren et al. (2016) take engendered approaches to ancient Maya household craft production. Archaeological evidence suggests that contrary to earlier ideas of removed specialized production from the household in state-level political systems (Childe 1950), specialized jade

production at Cancuen took place in both elite and non-elite domestic settings, where men, women, and children participated (Kovacevich 2016). Similarly, during a period of economic transformation, Ardren et al. (2016:110) argue Xuenkal's domestic economies increased the production of several craft goods to meet changing economic and political demands, bearing some of the greatest demands of the Terminal Classic Itza polity. Although other productive categories of data can aid in the study of gender among the ancient Maya (e.g., Joyce 2002; Looper 2002), archaeological studies of the household have the potential to reveal how gender structured political and economic relations within and beyond the residential context.

Studies of power are often characterized by top-down approaches centered around elite domination and social control, generally dismissing the ability of commoners (Joyce et al. 2001). However, critiques of this approach have led to a reconsideration of the concept. More nuanced perspectives of power consist of relationships beyond those characterized by domination or social control, as power is something that is socially negotiated by all members of society. Accordingly, dominant ideologies develop only through the "interaction of people of different social positions such as elites and commoners, women and wen, urban and rural dwellers, and people of the core and periphery" (Joyce et al. 2001:347-348).

Hutson (2002) incorporated this approach to power by inferring different mediums of dominance and resistance by examining the natural and built environment of Monte Albán. Similar to Tringham's (1991) and Robin's (2002) work, Hutson (2002) argued the purposeful presence and location of monumental architecture throughout the city legitimated and strengthened the status of the few powerful actors. In addition, simultaneously changing patterns of domestic architecture was a strategy deployed by the subordinate population to resist, yet also fuel the dynamic relation between these groups of people. Likewise, in studying the collapse of

the Rio Viejo polity, Joyce et al. (2001) argue studies of the Classic to Postclassic transition in Mesoamerica have failed to consider the agency of commoners, instead prioritizing explanations of warfare or environmental degradation. Contrary to this trend, the authors argue that commoners' participation in resisting and rejecting the ruling institutions is evidenced by Early Postclassic commoner occupation of the acropolis, dismantling of public buildings, and reuse of carved stone monuments for utilitarian purposes (2001:372). Coba and Yaxuna during the Early to Late Classic periods also serve as an excellent case study for applying a bottom-up approach to understanding power and resistance. Despite several lines of evidence that suggest Coba's integration of Yaxuna during the construction of *Sacbe* 1 (e.g., Ambrosino et al. 2003; Ardren 1999; Loya González and Stanton 2013; Shaw and Johnstone 2001; Stanton et al. 2010), the results of this sourcing analysis suggest the residents of Yaxuna established their own, distinct identity during this period. The divergent patterns of obsidian consumption in households at Coba and Yaxuna provide a useful look into the political impacts of subordination on economics. Households, as evidenced by these studies, provide excellent contexts for filling the gaps in archaeological studies of power, domination, and resistance in the past.

Social identity, in addition to power and gender, has been documented as an aspect of ancient everyday life that can be studied through household archaeology. Because archaeological research has largely privileged the study of elite identity and material culture, discussions of commoners and the negotiation of their own identity are less common. Blackmore (2007:159) points out that this dismissal of commoners as active agents ignores "the diversity of identities and statuses that existed, thereby removing any possibility of commoner agency, let alone political or social action." However, with increasing attention toward the everyday life experience of the ancient Maya, household research has begun to illuminate social identity in the

past (e.g., Blackmore 2007, Hendon 1999). Based on evidence from the Northeast Group at the site of Chan, Blackmore (2007; 2011) argues ritual played a critical role in the negotiation and establishment of neighborhood identities throughout the site's occupation. While residents of NE-1 held historical authority and identity that did not require overt public performance, the residents of NE-3 did exactly that in order to legitimate themselves as newcomers within the neighborhood. Hendon's (1999) investigations of domestic space at Uaxactun indicated that during the consolidation of centralized political authority in the Late Preclassic period, differences in domestic architecture were reflective of the concurrent formalization of group ritual practice. Hendon (1999:119) argues these differences in domestic space grew increasingly important in maintaining the social identity of the residential group. Trachman (2007) follows a similar line of reasoning, arguing that three households at the site of Dos Hombres exhibit differences in architecture as well as other material culture and ritual as expressions of social identities. As the authors above have highlighted, sociopolitical change can significantly impact changes or continuities in social identity formation. Likewise, it appears such change spurred by Coba's socioeconomic integration of Yaxuna impacted household identity at the site as previously mentioned. A continuation of diverse obsidian source consumption from previous periods may have served as a way for residents of Yaxuna to distinguish themselves from the economic practices of Coba. Future research may find that social identity also archaeologically manifests itself through evidence of unprecedented practices such as household ritual and mortuary practices (Stanton and Ardren 2016:8).

Household studies of economics (Hirth 1998; Manahan et al. 2012; Masson and Chaya 2000; Sheets 2000) in particular are incredibly pertinent to the study of the household economies of Coba and Yaxuna. The patterns observed from economic activity at the household level aid in

making inferences about the larger, more regional-scale economic dynamics such as those that characterized the relationship between Late Classic Coba and Yaxuna. For instance, investigations of four households at Ceren, El Salvador revealed evidence for three categories of economic activity, the most important being the vertical economy. Overall, Sheets (2000) concluded that while households were dependent on the local elite for certain items, those items are outnumbered by items produced within the household or obtained via horizontal exchange. This particular study is relevant to the study of Coba and Yaxuna as it provides insight into the varying economic levels of activity within a political and economic hierarchy of polities, which may have been the case at Coba and Yaxuna. The identification of marketplaces in ancient Mesoamerica is another focus of research that has been applied to ancient domestic economies. Of the primary approaches used to identify marketplaces in the archaeological record (i.e. the configurational, spatial, and contextual approaches), Hirth's (1998) distributional approach aims to characterize marketplace exchange through the composition of domestic assemblages and whether or not these assemblages resemble the expected outcome of market exchange. It is important to note that Hirth's (1998) approaches inherently assume that varying organizations of economy will produce distinguishable artifact patterns. The distributional approach was applied to the site of Xochicalco, where Hirth (1998) argues markets are evidenced by a homogenous distribution of imported ceramics and locally made obsidian tools. Since then, Hirth's (1998) distributional approach has been adopted by archaeologists throughout Mesoamerica, including Masson and Freidel (2012) at Tikal and Mayapan, Chase and Chase (2014) at Caracol, and Braswell and Glascock (2002) at Chichen Itza.

While such approaches have been adopted throughout Mesoamerica, ample debate still exists regarding whether or not markets were in fact part of the Classic Maya economy (e.g.,

Braswell 2010; Braswell and Glascock 2003; Carrasco Vargas et al. 2009; Masson 2002; Masson and Freidel 2012). During the Contact period, it is well-known that the Maya had a complex organization of local and regional markets with several types of merchants, characteristic of a highly commercialized and international Late Postclassic economy (Masson 2002). Evidence of such is largely drawn from ethnohistoric accounts that mention the presence of market exchange at numerous sites throughout the Maya lowlands (Masson and Freidel 2012; Tozzer 1941). However, scholarly discourse is largely concerned with the time depth of ancient Maya markets. The Postclassic period is widely known as a time of an international, mercantile economy, however, did this form of exchange, or a precedent, exist during the Classic period? Many have suggested that roots of such a complex economy trace back to the Classic period (e.g., Blanton et al. 1993; Freidel 1981; Dahlin and Ardren 2002). In addition to Hirth's (1998) criteria, Classic Maya art, hieroglyphic inscriptions, and geochemical soil analyses have all been cited as evidence for Classic period market exchange (Carrasco Vargas et al. 2009; Coronel et al. 2015; Dahlin et al. 2010; Houston et al. 2006; King 2015).

In addition to the time depth of markets, many scholars question who was in control of market exchange and to what degree? Understanding the economic organization of the ancient Maya is grounded in a variety of theoretical constructs. Wells (2006) provides a useful overview of the two main theoretical approaches to prehispanic Mesoamerican economies: political economy and agency approaches. Wells (2006:267) characterizes the political economy framework as one that is used to "explain the role of elite in expropriating resources from the broader population through manipulation of the social and demographic environments." A well-known model that falls under the political economy approach is world-systems theory, or the core-periphery model initially proposed by Rathje (1971). The core-periphery model describes

today's capitalist economy in terms of integrated networks consisting of cores and peripheries. Rathje applied this concept to the origin and development of the ancient Maya. Essentially, ancient Maya society was able to successfully develop in the resource-deficient southern lowland core due to the procurement and distribution of household essentials such as mineral salt, obsidian, and hard stone from the resource-abundant highland periphery (Rathje 1971; Wells 2006:274). Alternatively, agency approaches focus more on the social aspects of the economy in order to infer how power was negotiated and contested. Contrary to the agents in political economy models, which are theorized as being competitive and manipulative for personal gain, agency models focus less on the individual agent and more on the process of "structuration," or the ways structure and agency act recursively over time (Wells 2006).

This identification of marketplace exchange, its time depth, and how it was overseen are especially relevant and important to an understanding of Late Classic Coba. Evidence of marketplace activities has already been documented at Coba (i.e., Coronel et al. 2015). Specifically, chemical residues of phosphorus and zinc suggest the exchange of foodstuffs and mineral workshop items that may have been marketed at Plaza H at Coba. Previous studies have shown that source attribution can aid in establishing patterns that may shed light on possible changes in access to non-local goods (Moholy-Nagy et al. 2013). Similarly, the sourcing results of this study may lead to a second line of evidence for potential marketplace activity at Coba. Evidently, household studies are incredibly important to an understanding of these sites as they are what inform us about the larger social and economic processes of Coba and Yaxuna during this period of expansion and integration.

CHAPTER 3: MATERIALS AND METHODOLOGY

XRF Background and its Use in Mesoamerica

Since its development in the early 20th century, X-ray spectroscopy has proven useful in understanding the behavior of elements. In 1909 Charles Barkla discovered a relationship between X-rays that radiated from a sample and the associated atomic weight. A few years later Henry G.J. Moseley numbered the elements by observing the connection between electron transitions and atomic numbers (Moseley 1913). He later laid the foundation for the identification of elements in X-ray spectroscopy by establishing the relationship between frequency and the atomic number. In the 1950s and 1960s, various types of X-ray spectrometers were developed and the value of their application in archaeology and geoarchaeology was quickly realized. Edward Hall's (1960) wavelength XRF on Imperial Roman coinage was one of the earliest applications of XRF in archaeology. Shortly thereafter, the first XRF spectrometric analysis of New World obsidian was published by Jack and Heizer (1968).

The physics behind XRF is based on the principles of interaction between electron beams and X-rays with samples. X-rays are a short wavelength (high energy-high frequency) form of electromagnetic radiation. When the atoms that comprise geological materials interact with radiation that is high energy and short in wavelength, they become excited. These atoms then undergo the process of ionization as they acquire a different charge based on whether they gain or lose an electron (Shackley 2011). If the radiation results in the dislodging of an inner shell electron, an outer shell electron will replace it. The energy that is released from the dislodging of the inner shell electron is of lower energy than the X-rays and is called fluorescent radiation, or fluorescence. When electrons are ejected from the shell of an atom and are then replaced, these transitions are read by the S1XRF software as K through O lines (Shackley 2011:16-17). Using

non-destructive XRF, only the K and L lines are measurable, however. These transitions correspond to the orbit or shell from which the original electron was dislodged. For instance, the K line transition is where the K electron is ejected from the atom and is replaced by an L line electron. The X-rays of highest intensity from these transitions are called alpha (α) transitions. This transition is the most frequent and easily measured, producing what is known as the Kα peak. Additionally, K line transitions are representative of the elements with mid atomic (Z) numbers, which are those most often used to differentiate obsidian sources. Because these energy differences between electron shells are fixed and known, the fluorescent radiation that each element gives off can be measured and used to detect the amount of an element within the sample (Shackley 2011:16). In this thesis, the elements Manganese (Mn), Iron (Fe), Zinc (Zn), Gallium (Ga), Rubidium (Rb), Strontium (Sr), Yttrium (Y), Zirconium (Zr), and Niobium (Nb) are most important in making Mesoamerican obsidian source attributions (Ferguson 2012).

Following Jack and Heizer's (1968) initial analysis of obsidian in Mesoamerica, obsidian has become one of the most common units of analysis in this part of the world for several reasons. Though there are a large number of potential sources of obsidian in both central Mexico and the Guatemalan and Honduran Highlands, these sources are relatively limited. In addition, obsidian exhibits a typically uniform chemistry within these particular outcrops (Ferguson 2012), and these chemical characteristics have been intensively studied for decades, providing both a chemical and visual standard for modern provenance studies (Braswell et al. 2000; Cobean 2002; Glascock 2002; Glascock et al. 1998). In addition, obsidian is also one of the most prominent archaeological materials, having served as a primary raw material for making tools for thousands of years in Mesoamerica (Golitko and Feinman 2015). Thus, obsidian and its analysis through

handheld XRF is particularly appropriate and suitable for archaeological provenance studies, although there are limitations (e.g., Drake et al. 2009; Ferguson 2012; Nazaroff et al. 2010).

Due to its wide utilization and prominence throughout ancient Mesoamerica, obsidian can be particularly useful in household studies. In addition to its prominence, obsidian artifacts preserve extremely well, allowing for a better representation of the contexts from which they are recovered (Ferguson 2012). Many investigations of household economies through obsidian analysis are geared towards identifying types of production, distribution, and consumption (e.g., Braswell and Glascock 2003; Hutson 2012; Moholy-Nagy et al. 2013; Masson and Freidel 2012). At Chichen Itza, Braswell and Glascock (2002) argue obsidian from the site was distributed through administered market exchange based on Hirth's (1998) set of criteria for identifying forms of exchange. Similarly, obsidian artifacts from Tikal suggest that Classic-period consumers obtained their obsidian primarily through marketplace exchange (Moholy-Nagy et al. 2013; Masson and Freidel 2012). The distribution of obsidian artifacts, in addition to other lines of evidence, also suggest the presence of market exchange at Chunchucmil (Hutson 2012). The identification of market exchange is especially relevant and important to an understanding of the economy of Late Classic Coba. As Masson and Freidel (2012:462) have noted, tracing the exchange of non-local, distantly derived goods is essential for identifying not only market exchange networks, but also the geopolitical factors that impacted them. Both the quantity and diversity of goods, especially obsidian, recovered from households at Coba and Yaxuna can aid in establishing patterns that may add to our preexisting knowledge of the potential role of market exchange (Coronel et al. 2015).

As noted above, how and why economies changed during times of sociopolitical change can be informed by provenance studies of obsidian (e.g., Gotliko et al. 2012; Golitko and

Feinman 2015; Hammond et al. 1984; Masson and Chaya 2000). The Late to Terminal Classic transition, also known as the Classic Maya 'collapse,' provides an excellent case study. Investigations indicate that patterns of obsidian supply shifted significantly, possibly due to the growing role of coastal trade, thereby affecting the depopulation of several southern lowland polities (Gotliko et al. 2012; Hammond et al. 1984). Masson and Chaya (2000:138) demonstrate that sociopolitical change in Postclassic Mesoamerica can also be informed by household assemblages. The authors argue the high densities of obsidian recovered from household contexts at Laguna de On in the late Postclassic period represents a "temporal episode" that may correlate to the late rise of Highland Guatemala Quiche polities. On a much larger scale, Golitko and Feinman (2015) examine household economies over broad spatial and temporal contexts through the use of social network analysis. The authors investigated obsidian assemblages from throughout Mesoamerica between 900 B.C. to A.D. 1520. Their analyses suggest that the ancient Mesoamerican economy was dynamic and generally not highly centralized over time. During the Late Classic in particular, the authors note the apparent degree to which the linkages are oriented towards the northern Yucatan. They suggest this unprecedented connectivity reflects an increase in maritime transport and overland travel through highland Oaxaca (2015:225). Similarly, Aoyama (2017) performed a diachronic analysis of obsidian artifacts from Preclassic to Classic period Ceibal. Source attributions (made visually), as well as morphology, suggested interregional obsidian exchange rather than long-distance exchange was more economically significant in the rise of political complexity at Ceibal.

Similar to the studies mentioned above, source attributions made for the obsidian assemblages of Coba and Yaxuna can aid in understanding how people's lives changed over the course of the construction of *Sacbe* 1 and the political and economic expansion that may have

followed. For instance, future research examining the variation in sourced obsidian may suggest household consumption and production increased in order to meet new demands of the Coba state, either at Yaxuna, Coba, or both. Variation may also indicate whether the same pressures were imposed on households at both sites.

Methods and Materials

The sourcing data presented in this thesis comes from a total of 1,186 obsidian artifacts analyzed through a Bruker Tracer-III SD Handheld XRF Spectrometer at the University of Central Florida's Mesoamerican Archaeology Lab from February to September 2019. This sample represents 69% of the 1,698 obsidian artifacts that make up the total Coba, Yaxuna, and subsidiary site assemblages excavated over the course of several field seasons (2009-2018) by the Proyecto de Interacción Política del Centro de Yucatán (PIPCY) at Yaxuna (Stanton and Ardren, n.d.) and the Proyecto Sacbé Yaxuna-Coba (PSYC) at Coba and surrounding sites (Magnoni, Stanton, and Ardren, n.d.)

The remaining 532 samples from the total obsidian assemblage from the PSYC and PIPCY projects were excluded from analysis due to inapplicability to this thesis research. Operations that did not contain household contexts, as well as artifacts excavated from any one of the numerous subsidiary sites along *Sacbe* 1 or in the surrounding area such as Ikil, Joya, X-Panil, Cacalchen, Aktun Kuruxtun, Aktun Jip, and Ceh' Yax were not included, as this thesis focused only on the Coba and Yaxuna site assemblages. Additionally, samples that were excavated from household contexts at Coba and Yaxuna but were not firmly dated to the Early to Late Classic transition were excluded in order to ensure an equal comparison of excavated

contexts at Coba and Yaxuna. Thus, Operation 161 at Yaxuna and Operation 1 at Coba are broadly compared due to their domestic contexts and chronological placement.

Almost half of the total sample, n=690, was excavated from Operation 161 at Yaxuna. Operation 161 was conducted over two field seasons and consists of two sub-operations: Operation 161A, or Structure 5E-110 in 2016, and 161B, or Structure 5E-112 in 2017 (**Figures 6-7**). Group 5E-110 is located in the southern area of Yaxuna's sitecore, a short distance from the E-Group (i.e., Middle Preclassic architectural type thought to have been used as solar observatories and civic spaces [Doyle 2012]), southwest of *Sacbe* 1's western terminus (**Figure 8**). In addition to the location of the structure, excavation was chosen here based on ceramic surface collections in 2014, which confirmed the Early to Late Classic occupational timeline under investigation at Yaxuna.

Figure 6: Map of Yaxuna, including locations of *Sacbe 1*, Str. 5E-110, and Str. 5E-112 (illustrator S. Miller).

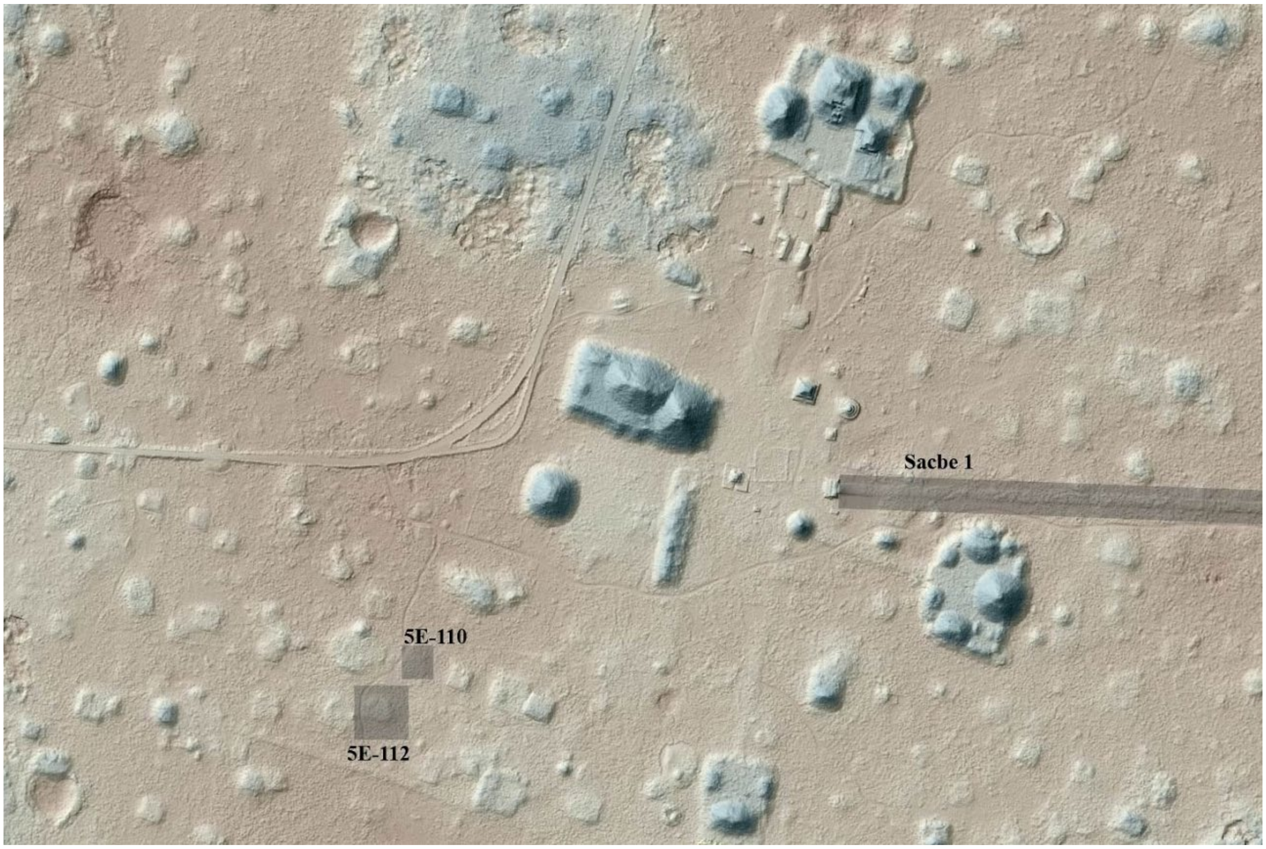

Figure 7: Lidar map of Yaxuna, including locations of *Sacbe 1*, Str. 5E-110, and Str. 5E-112 (illustrator S. Miller).

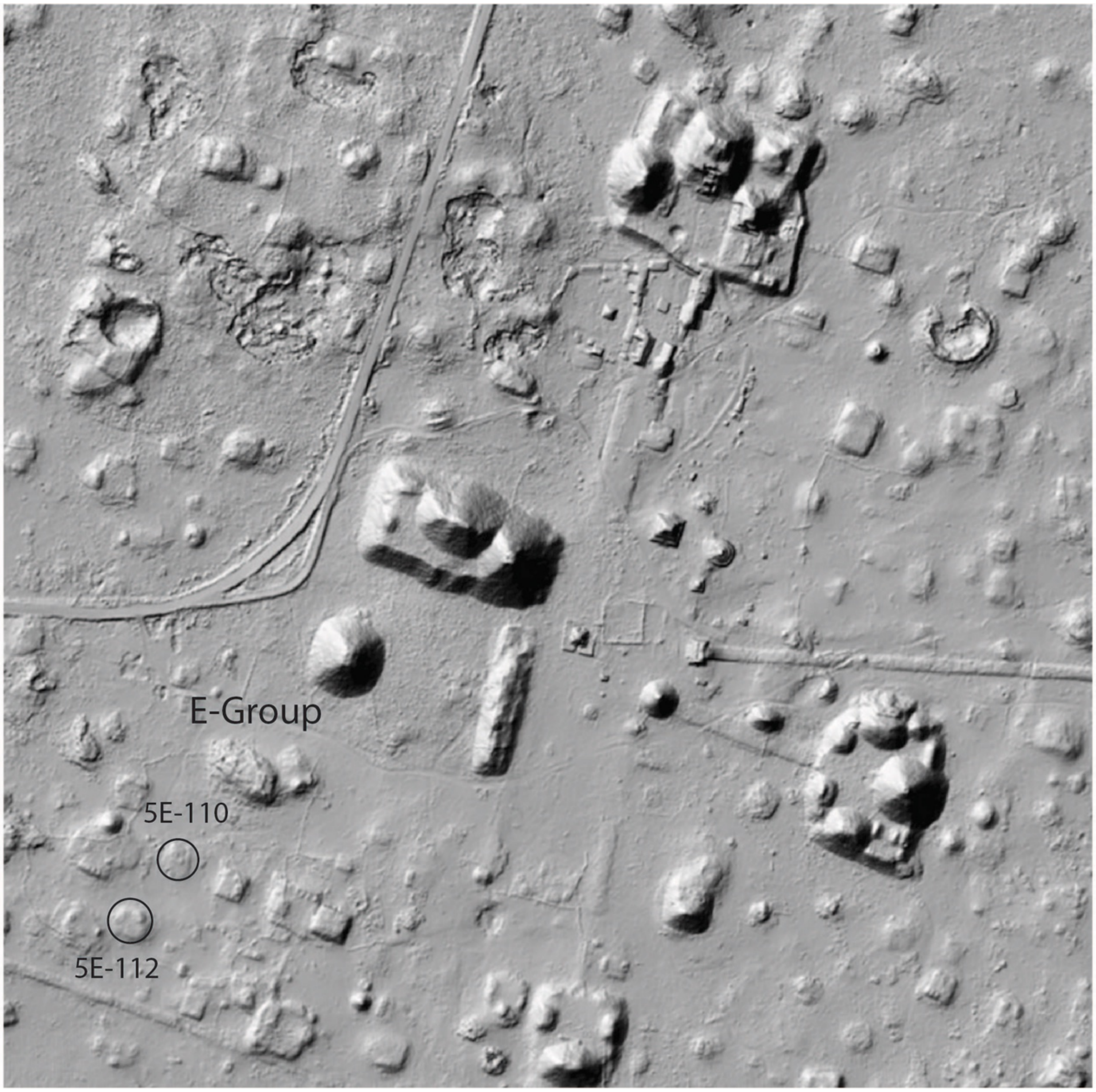

Figure 8: Hillshade image of central Yaxuna, including locations of the E-Group and Strs. 5E-110 and 5E-112 (adapted from Stanton et al. [2020:Figure 3])

Group 5E-110 was originally a basal platform that was eventually displaced into three structures, named 5E-110a, 5E-110b, and 5E-110c. These three structures were organized around an open courtyard to the east and west (Stanton and Ardren, n.d.). The Platform 5E-110

measures 22 meters on its east-west axis and 28 on its north-south axis (616 m^2). Within this area, 2x2 m units were established and extended two meters beyond the perimeter of the platform in each direction. Of the total area, 53% was excavated, resulting in total horizontal exposure of 160 m^2.

Group 5E-112 is southwest of Group 5E-110 and is located in the same general area of Yaxuna's sitecore (**Figure 9**). It is interesting that the obsidian material recovered from 5E-112 far exceeds the total recovered throughout the entirety of Yaxuna's archaeological history. It also exceeds the amount of material recovered from Operation 1 at Coba. This has been considered either a reflection of the unique level of craft specialization within the structure or of an imbalance in sampling methods, as most excavations at the site have been in monumental contexts (Stanton and Ardren 2020). In addition to Group 5E-112's location, excavation was chosen based on the potential for intact stratigraphic domestic deposits that date to before and after the construction of *Sacbe* 1. Chronological data from 5E-112 was acquired through surface collection of ceramics conducted in 2014 and through an off-mound 2x2m test-pit excavated in 2016 (Stanton and Ardren, n.d.).

The main structure of 5E-112 measures 26 meters on its north-south axis and 36 meters on its east-west axis (936 m^2), with a 4x4m auxiliary structure to the southwest of the platform. Of the 936m^2, approximately 26% was excavated, specifically (124) 2x2m units for a total horizontal exposure of 248m^2 illustrated in **Figure 10**. The specific areas of focus within the group were the circulation space, patio, and superstructure. Units were placed where stones on the surface indicated the presence of buried walls of domestic structures. Once these were revealed, additional 2x2m units were placed adjacent to continue the horizontal exposure of the

features. All soil was screened through ¾ inch mesh screens and artifacts were placed in plastic bags labeled according to provenience and excavation process (Stanton and Ardren 2020).

Slightly under half of the total sample (n=496) was excavated from Operation 1 at Coba. Operation 1 consists of one household group (Group 1) located in the northern zone of the site and is located directly off the northern exposure of *Sacbe* 1 as it traverses through the city in the direction of Nohoch Mul, the tallest temple complex in the northern lowlands (**Figures 11-12)**. Group 1 is enclosed by an *albarrada*, a low external wall often used to delineate space, and has nine associated structures. The *albarradas* allowed for a clear distinction of the spatial limits of the household group compared to that of Yaxuna. Similar to Strs. 5E-110 and 5E-112, Group 1 was chosen for excavation based on the potential for intact stratigraphic domestic deposits that data to before and after the construction of *Sacbe* 1, as well as its location relative to Coba's site core and its accessibility. Chronological data for Group 1 was acquired through two off-mound 2x2m test-pits excavated in 2015 (Stephanie Miller, personal communication 2019).

The house-lot of Group 1 measures 100 meters on its north-south axis and 60 meters on its east-west axis (6,000 m^2). Over the course of six weeks in 2018, a total of (123) 2x2m units were excavated, resulting in 246m^2 of horizonal exposure, proportionate to the excavated area of Str. 5E-112 at Yaxuna. Due to its large size, Operation 1 was subdivided into four sub-operations, Operation 1C, 1D, 1F, and 1G, each with different goals (**Figure 13**). Sub-operations 1A and 1B were (2) 2x2m test excavations conducted previously in 2016 inside Group 1. Operation 1C conducted in 2018 focused on the circulation space between *Sacbe* 1 and the main platform of the group, in addition to an area of the northern exposure of *Sacbe* 1. Operation 1D conducted in 2018 refers to the complete exposure of one smaller domestic structure. Operation 1F conducted in 2018 refers to the excavation area of a patio off the northeast corner of two

vaulted structures, in addition to an adjoined domestic structure. Finally, Operation 1G, also excavated in 2018, targeted the main patio group of Group 1, lending to a comparison between the activity areas in and out of the main platform space (Stephanie Miller, personal communication 2019).

Figure 9: Close up Str. 5E-110 and Str. 5E-112 in Yaxuna (illustrator S Miller).

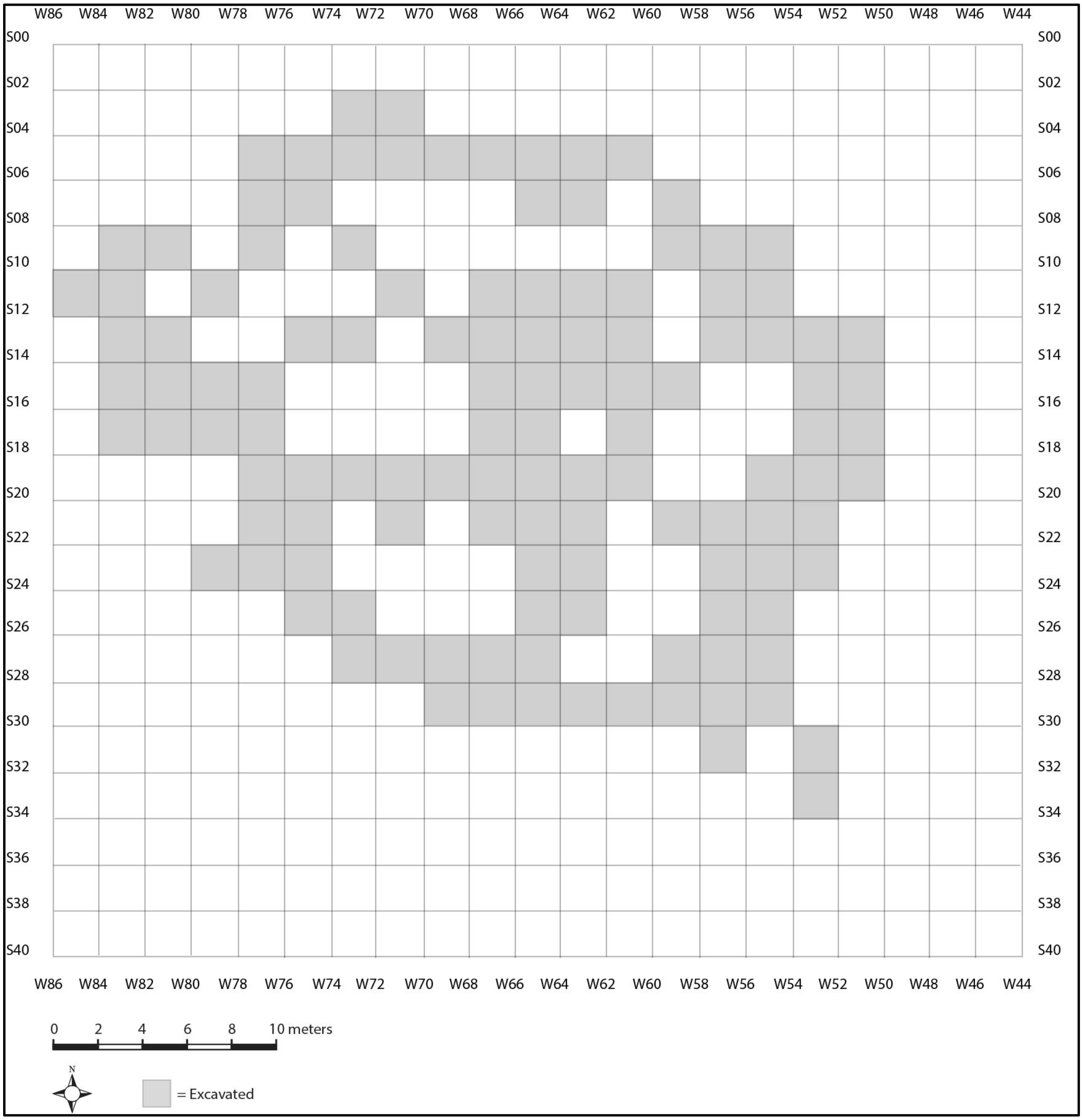

Figure 10: Excavated areas of Str. 5E-112 (illustrator S Miller).

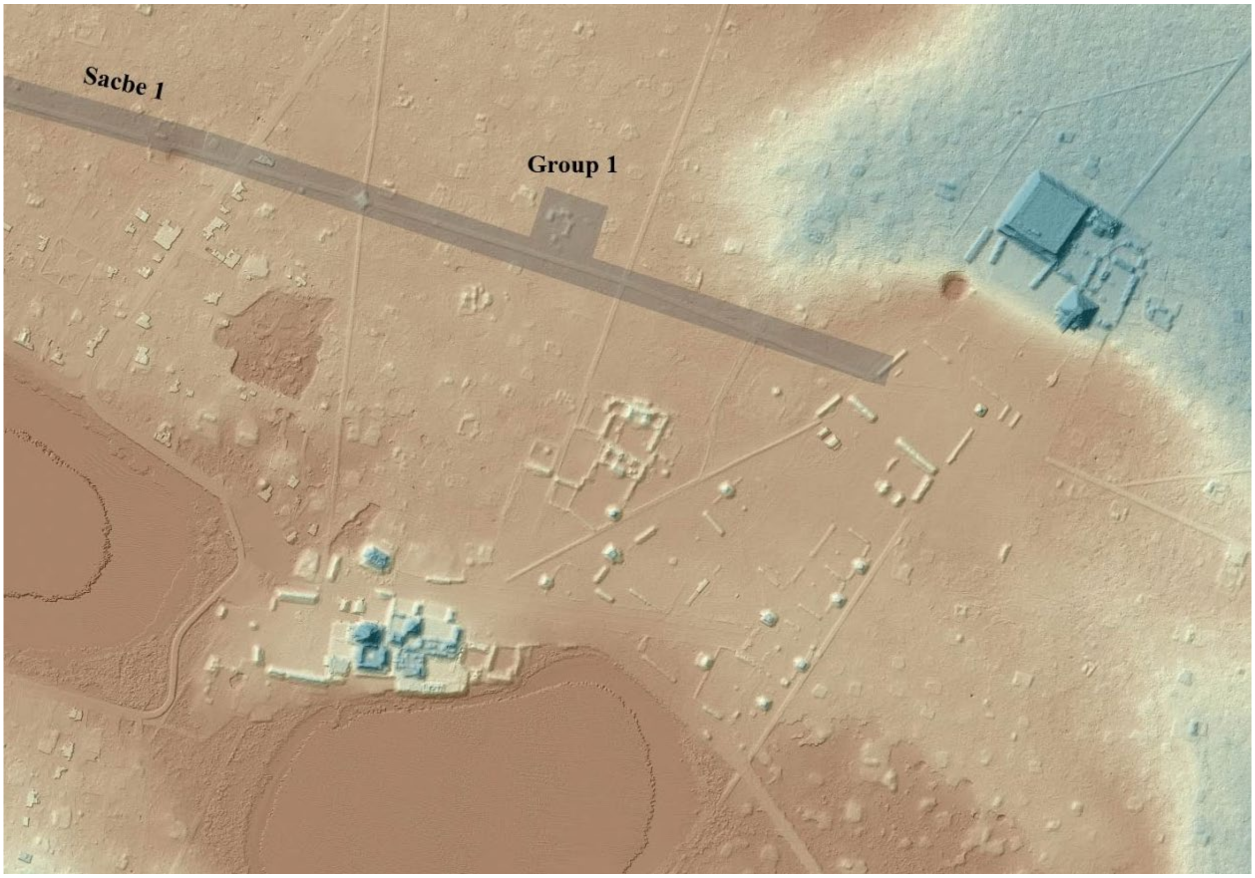

Figure 11: Lidar map of Coba's site center, including the locations of *Sacbe 1* and Group 1 (illustrator S. Miller).

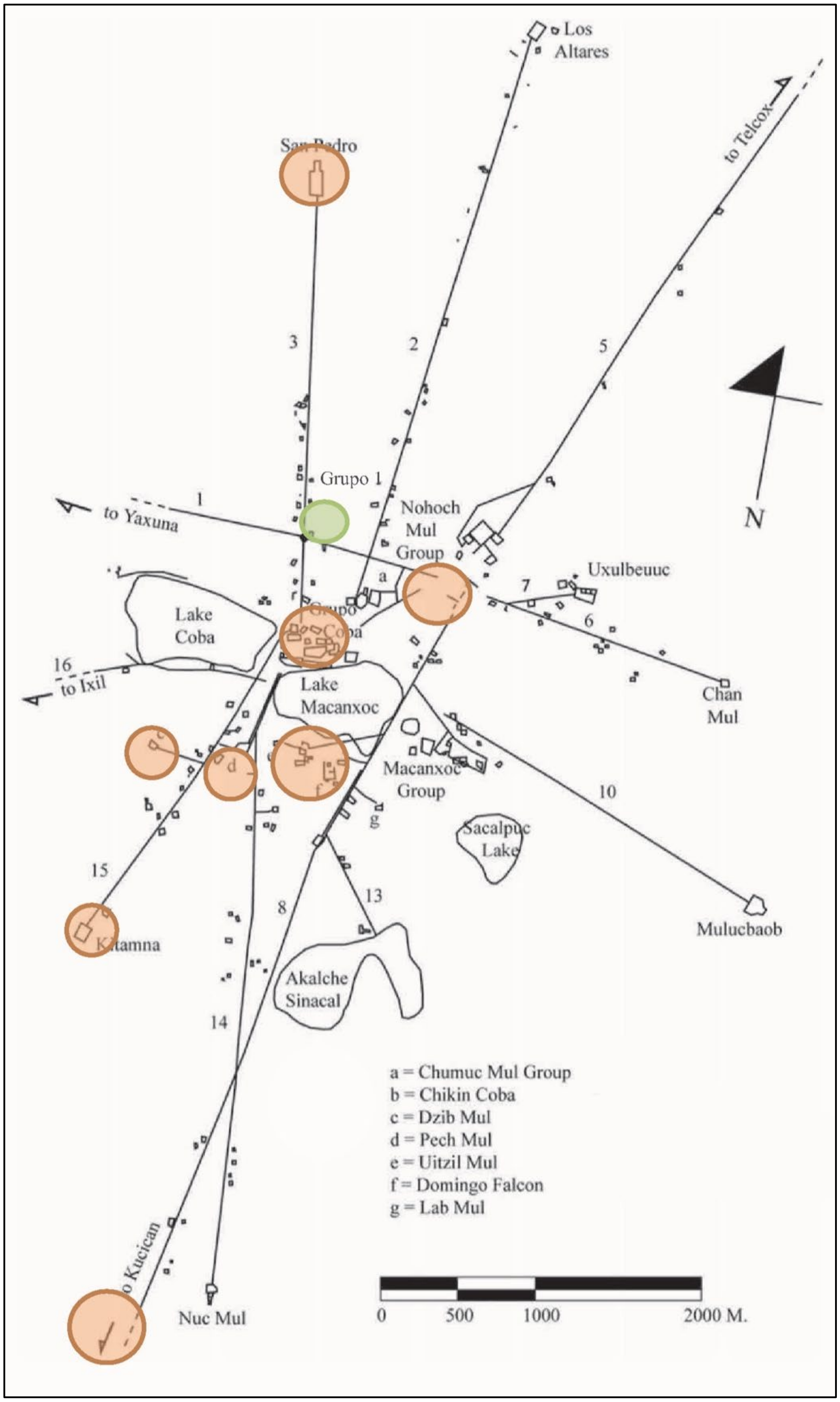

Figure 12: Location of Group 1 at Coba in relation to monumental groups at the site (Magnoni, Stanton, and Ardren n.d.)

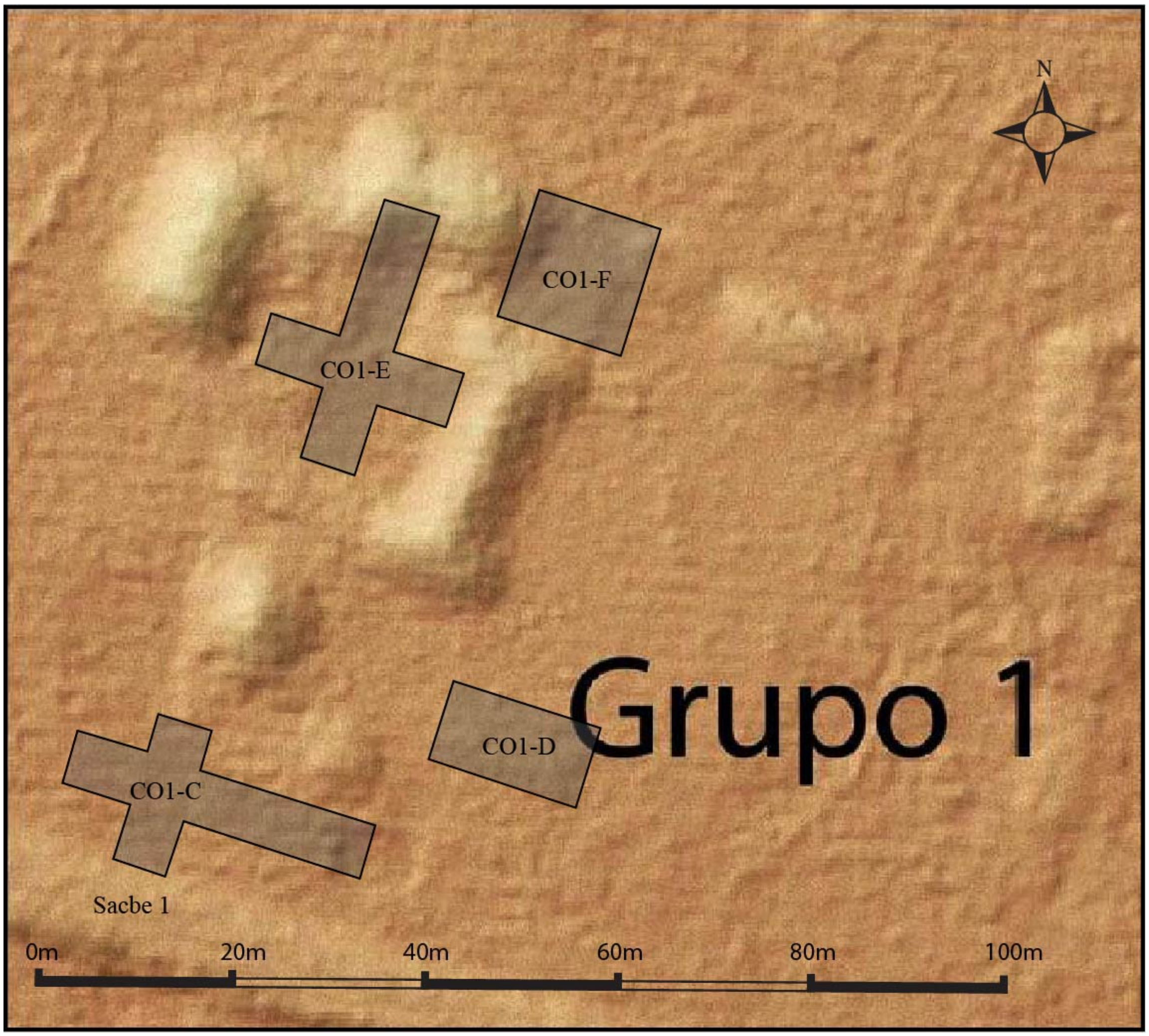

Figure 13: Map of sub-operations 1C-F within Group 1 at Coba (illustrator S. Miller).

All obsidian artifacts were scanned using a Bruker Tracer-III SD Handheld X-Ray Fluorescence Spectrometer located at the University of Central Florida's Mesoamerican Archaeology Lab. The pXRF uses Energy Dispersive X-ray Fluorescence (ED-XRF) to assay each sample and was equipped with rhodium target tube. Samples were assayed for 90 seconds, at 40.00 kV max voltage and 25.00 μA, without a vacuum, and using a green filter (0.006" Cu,

.001”, .012 Al) provided by Bruker. These particular settings are recommended to measure elements Fe to Mo, which are of most interest when sourcing obsidian. In order to ensure a level of consistency between scanning sessions, every time the instrument was powered on, a known geological sample, USGS standard RGM-2, was assayed. Quantitative calibrations to parts per million (PPM) counts were then generated using the GL1 calibration macro in Microsoft Excel developed by Bruker. The protocol uses data from 40 obsidian samples in order to include the range of variation in geochemical composition. Prior to scanning, samples were prepared by cleaning the flattest possible surface that would face the X-ray beam with isopropyl alcohol. While it has been stated that unwashed surfaces have no effect on the results of XRF analysis, samples were minimally prepared to ensure consistency (Shackley 2011).

One hundred and thirteen source samples provided by University of Missouri Research Reactor (MURR) were utilized in the analysis of this thesis project. These samples represented sources from throughout Mesoamerica, including El Chayal, Guatemala (n=12), Ixtepeque, Guatemala (n=10), San Martin Jilotepeque, Guatemala (n=9), Zaragoza, Puebla (n=11), Paredon, Puebla (n=7), Otumba, Mexico (n=11), Sierra de Pachuca (n=10), Tulancingo, Hidalgo (n=9), Zacualtipan, Hidalgo (n=8), Ucareo, Michoacan (n=10), Cerro Varal, Michoacan (n=10), and La Union, Honduras (n=6) (**Table 1**). In an effort to ensure internal consistency, all source samples were assayed on the same instrument, for the same duration of time, and under the same settings as the samples from Yaxuna and Coba.

Table 1: Summary PPM data for all source samples scanned with Handheld XRF (modeled after Martindale Johnson 2016:Table 4-1).

Source Sample	**Reference Library**	**N**		**Mn**	**Fe**	**Zn**	**Ga**	**Th**	**Rb**	**Sr**	**Y**	**Zr**	**Nb**	**Present at Yaxuna**	**Present at Coba**
Cerro Varal	MURR	10	mean	326	6415	44	11	11	95	58	19	96	13	×	×
			σ	41	1000	6	3	1	5	4	1	4	1		
			min	265	5673	33	7	9	87	54	16	91	12		
			max	386	9132	51	18	16	105	66	21	106	15		
El Chayal	MURR	12	mean	548	5674	58	17	10	136	131	18	104	9	✓	✓
			σ	62	328	9	1	1	6	7	1	5	1		
			min	462	5112	41	15	8	122	115	16	98	8		
			max	653	6136	73	21	13	144	142	21	115	12		
Ixtepeque	MURR	10	mean	332	7750	57	15	6	90	130	17	148	8	✓	✓
			σ	51	387	15	2	1	4	7	2	7	1		
			min	237	6842	40	12	4	80	112	14	128	7		
			max	396	8219	93	19	10	95	137	21	156	10		
La Union	MURR	6	mean	298	6659	49	16	11	123	40	20	136	13	×	×
			σ	32	83	4	1	1	2	2	2	3	1		
			min	264	6582	45	14	10	121	37	18	133	12		
			max	334	6814	57	20	13	128	43	24	141	15		
Otumba	MURR	11	mean	332	7861	60	18	9	113	115	21	131	12	✓	×

Source Sample	Reference Library	N		Mn	Fe	Zn	Ga	Th	Rb	Sr	Y	Zr	Nb	Present at Yaxuna	Present at Coba
			σ	51	275	4	2	1	3	3	1	2	1		
			min	264	7269	54	14	8	108	109	19	127	11		
			max	437	8308	68	23	12	119	120	25	135	14		
Pachuca	MURR	10	mean	940	14212	216	23	18	188	3	104	857	85	✓	×
			σ	78	796	15	2	3	8	0	4	36	4		
			min	842	12920	189	20	13	177	2	96	794	79		
			max	1135	16059	248	27	24	207	5	113	938	94		
Paredon	MURR	7	mean	316	7648	76	19	15	155	5	46	191	38	×	×
			σ	55	383	10	2	2	9	1	3	10	3		
			min	261	6985	56	17	13	142	5	43	175	36		
			max	429	8285	88	24	20	172	7	54	210	45		
San Martin	MURR	9	mean	512	7197	52	17	8	102	162	14	102	7	✓	✓
			σ	115	3704	12	2	1	4	8	1	3	0		
			min	424	5363	33	15	7	94	147	12	98	6		
			max	800	16811	77	21	11	109	173	17	110	9		
Tulancingo	MURR	9	mean	351	15997	181	23	11	118	13	86	636	44	✓	×
			σ	42	381	13	1	1	2	1	2	24	2		
			min	314	15318	165	20	10	114	12	84	619	41		
			max	434	16689	210	25	14	123	17	90	677	48		

Source Sample	Reference Library	N		Mn	Fe	Zn	Ga	Th	Rb	Sr	Y	Zr	Nb	Present at Yaxuna	Present at Coba
Ucareo	MURR	10	mean	146	6434	49	17	13	136	10	22	105	12	✓	✗
			σ	22	150	6	2	1	5	0	1	6	1		
			min	120	6212	37	12	10	121	9	19	86	11		
			max	185	6658	59	19	15	141	11	24	109	16		
Zacualtipan	MURR	8	mean	152	9049	55	20	32	264	32	44	197	17	✓	✓
			σ	51	352	8	1	3	8	1	2	5	1		
			min	63	8568	41	19	26	255	31	40	189	15		
			max	235	9628	67	22	36	276	36	48	206	19		
Zaragoza	MURR	11	mean	205	8233	63	19	17	130	26	31	177	15	✗	✓
			σ	44	501	12	1	2	8	2	4	8	1		
			min	125	7163	32	16	11	116	21	28	156	14		
			max	302	9368	81	22	22	150	31	44	190	19		
RGM-2	USGS	1	mean	214	11599	61	16	13	129	85	21	179	9	-	-
(measured)			σ	53	321	8	2	2	12	9	1	18	1		
			min	105	10831	40	13	8	102	66	17	137	6		
			max	297	12250	74	23	20	149	101	25	210	11		

Statistical Methods

Following previous studies of obsidian source attribution (e.g., Moholy-Nagy et al. 2013; Martindale Johnson 2016; Nazaroff et al. 2010; Stroth et al. 2019), this thesis utilizes biplots and ternary plots through SAS JMP Pro 12 as statistical methods for visualizing XRF results. Specifically, these methods are useful in determining the association between source samples provided by MURR and the sourced data from Yaxuna and Coba. Biplots provide a graphical method for depicting the relationship among two variables, i.e., two elements used to differentiate geochemical sources. Data were collected for nine elements (Mn, Fe, Zn, Ga, Rb, Sr, Y, Zr, and Nb), however, analyses at the Kα1-line for Sr, Zr, and Rb were used to attribute artifacts to geochemical sources using biplots and ternary plots. These particular elements have been used in previous provenance studies (e.g., Moholy Nagy et al. 2013; Nazaroff et al. 2010) and have proven to be more indicative of the differences between Mesoamerican obsidian sources compared to other elemental combinations.

Initially, the source sample data was organized, depicting just the 95% confidence ellipses of the 113 samples from MURR (**Figure 14**). Following this preliminary organization, the sample data from Yaxuna and Coba were plotted on numerous biplots according to the elemental ratios chosen, along with the 95% confidence ellipses created from the source data. From there, a series of steps were taken using four plots to attribute source data to each source ellipse and are further outlined below (**Figures 16-19**). It should be noted that biplots specifically examine the relationship between the parts per million (PPM) concentrations of selected elements. These PPM concentrations are obtained through empirical calibration methods such as

Compton normalization, which uses known standards to calibrate the XRF results. Because photon counts vary from device to device, and are therefore qualitative data, calibration methods allow for the analysis of quantitative data through PPM concentrations. In other words, the calibration process transforms the qualitative spectral data, which are the actual number of photons counted by the XRF for a given element, into quantitative synthetic units, i.e., PPM concentrations (Ferguson 2012; Martindale Johnson 2019). This process, however, may not normalize all elements equally. In addition, a large variance in the PPM concentrations of a single geochemical source may result due to small, thin samples that do no read correctly, increasing the difficulty of assigning samples to sources using the biplots. These samples do not meet the infinite thickness assumption, which is the point at which primary X-rays are completely absorbed by the sample. Such samples that are less than infinitely thick have an incomplete absorption of primary X-rays, generating lower element peak intensities. Furthermore, infinite thickness varies according to the element in question. For example, zirconium requires an energy of 15.78 keV and an optimal depth of 3840 µm, or 0.384 cm (Drake 2018:Table 1). Error may also be introduced when small, thin samples are smaller than the detection window on the XRF instrument (Davis et al. 1998; Hughes 2010).

As a result, an additional method for assigning sources and visualizing results, known as ternary or triangle plots, was utilized to verify the source assignments made using the biplots. Unlike biplots, ternary plots utilize the raw, uncalibrated peak counts or peak intensities to assign samples to sources. Peaks are representative of the X-rays that fluoresce after the electrons of a sample have been initially excited by the primary X-ray beam. The peaks appear over a given energy spectrum at energies unique to each element in the sample (Davis et al. 1998:160). The counts or intensities are calculated from the narrow slices of a specific peak (Martindale Johnson

2019). It is important to stress that peak counts are different from PPM concentrations in that they are completely unaltered since they do not undergo the calibration process. However, similar to PPM concentrations, peak counts vary based on the instrument being used (resolution) and the density of the artifact. That is, small, thin artifacts will result in not only low PPM concentrations, but also lower peak counts than an artifact that covers the entire detection window.

Following collection of the peak counts, the data is then transformed into percentages of a total using three elements. For example, the 12 Mesoamerican obsidian sources and their 95% confidence regions were plotted in **Figure 15** using the percentages of Zr, Sr, and Rb. These percentages were obtained by taking the peak count data of each element and dividing it by the sum of all three elements. The same process was taken to create the 95% confidence regions surrounding the 12 sources. These regions had to be constructed using ggtern, a ternary diagram plotting software for the R Statistical Programming Language (Hamilton 2018; Hamilton and Ferry 2018). Similar to the process of constructing biplots, once the confidence regions were constructed based on the source sample data, the Yaxuna and Coba data were plotted on the same diagram and sourced based on their distribution on the plot relative to the confidence regions. Once source groups were identified and selected based on the ternary plot, how these reflected on both a variety of PPM and peak count ratio plots determined the source attribution.

Because artifacts exhibit greater diversity than the source samples due to differences in sample size (i.e., source library group [n=113] versus sample of artifacts [N=1186]), artifacts will fall outside the 95% confidence ellipses and confidence regions even though they belong to a source. Small, thin artifacts are especially prone to this because the PPM concentrations and peak counts of these are not reflected by the of the large, infinitely thick source samples used to

construct the 95% confidence ellipses and regions. Artifacts (n=7) that were distinct from the groups or fell between two groups on a biplot were both examined through a ternary plot and inspected visually. Following these methods, these artifacts were determined unassigned. All other artifacts were attributed to an obsidian source or were considered not obsidian (n=9) for reasons outlined below.

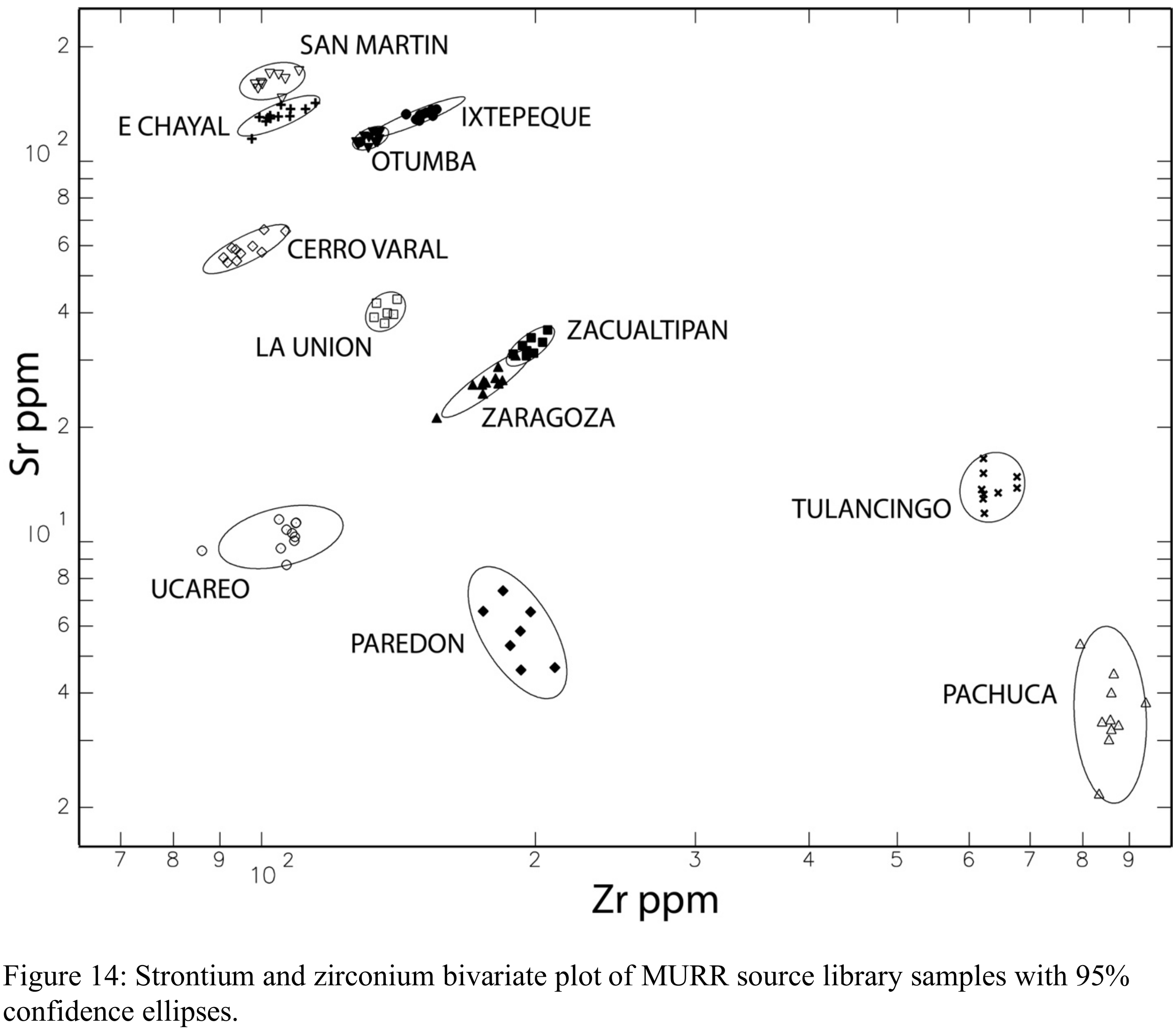

Figure 14: Strontium and zirconium bivariate plot of MURR source library samples with 95% confidence ellipses.

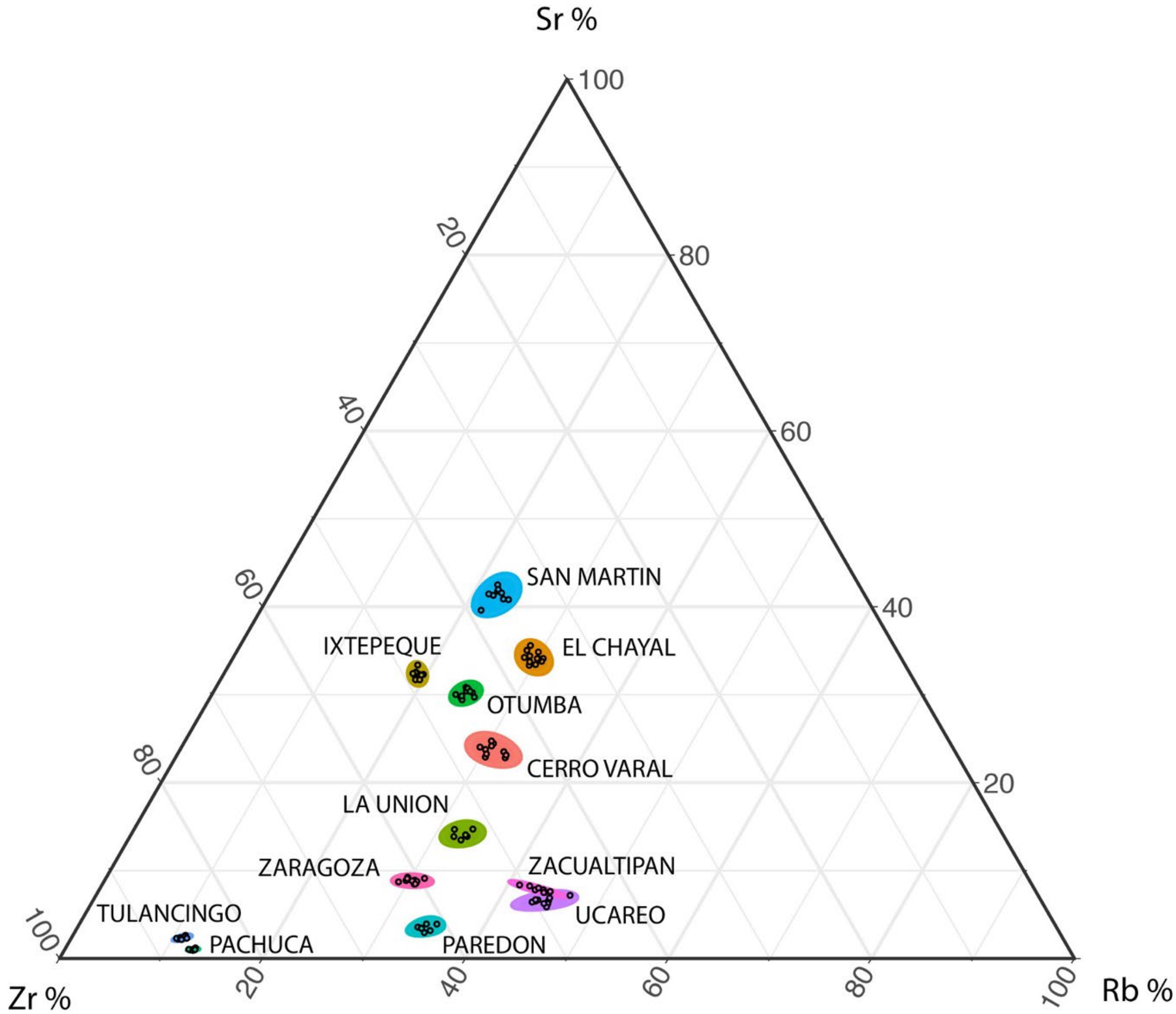

Figure 15: Zirconium, strontium, and rubidium ternary plot of MURR source library samples with 95% confidence ellipses.

CHAPTER 4: RESULTS AND DISCUSSION

Source Attributions

The results of the XRF and statistical analyses suggest that during the Early to Late Classic transition, both Coba and Yaxuna exploited multiple obsidian sources. The major pattern inferred from the results is that a greater variety of known obsidian sources was consumed at Strs. 5E-112 and 5E-110 within Operation 161 at Yaxuna than was at Group 1 within Operation 1 at Coba. This pattern remained consistent through a series of bivariate and ternary plots, each with different elemental variables (Sr, Zr, Rb) that best discriminate against Mesoamerican obsidian sources.

Figure 16 shows a Zr and Rb bivariate plot that illustrates the obsidian source distributions for the Yaxuna and Coba obsidian artifacts. This particular biplot was the first to be examined due to the distinct appearance of three sources, Pachuca, Zacualtipan, or Tulancingo. In addition, these sources have clear separation from one another and the rest of the sample. Artifacts were then sourced according to their distribution on the plot relative to the source data. One artifact, however, did not distinctly group with Zacualtipan or Zaragoza in the following plot and was therefore separately labeled and considered unassigned.

The same process was followed for the remainder of the sources. A Sr and Zr biplot, shown in **Figure 17**, was chosen next as it most clearly represented five sources, Ucareo, Paredon, La Union, Zaragoza, and Cerro Varal. Two of the remaining four sources, Otumba and Ixtepeque, were represented in a Zr and Rb biplot shown in **Figure 18**. Compared to other element combinations, these two sources were the most discrete in a Zr and Rb plot. Finally, a fourth biplot (**Figure 19**) using Rb and Sr was constructed to represent the two remaining sources of the source library, El Chayal and San Martin Jilotepeque. Variation within each

source is evident, however, six artifacts in particular did not group with either source. These are separately labeled in **Figure 20** and marked in **Figure 21** and were considered unassigned to either source.

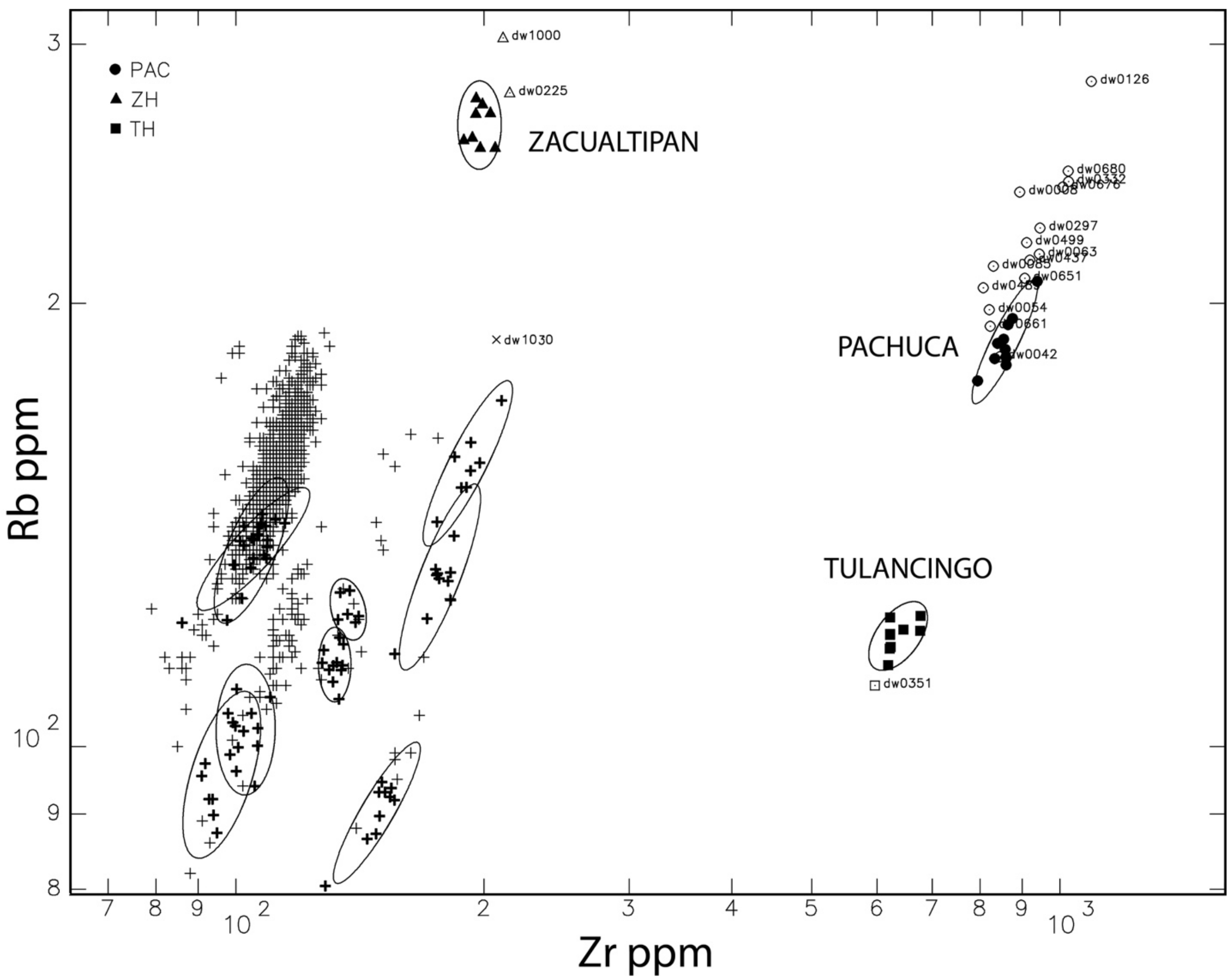

Figure 16: Zirconium and rubidium bivariate plot of Yauxua and Coba obsidian artifacts emphasizing Zacualtipan, Pachuca, and Tulancingo source ellipses.

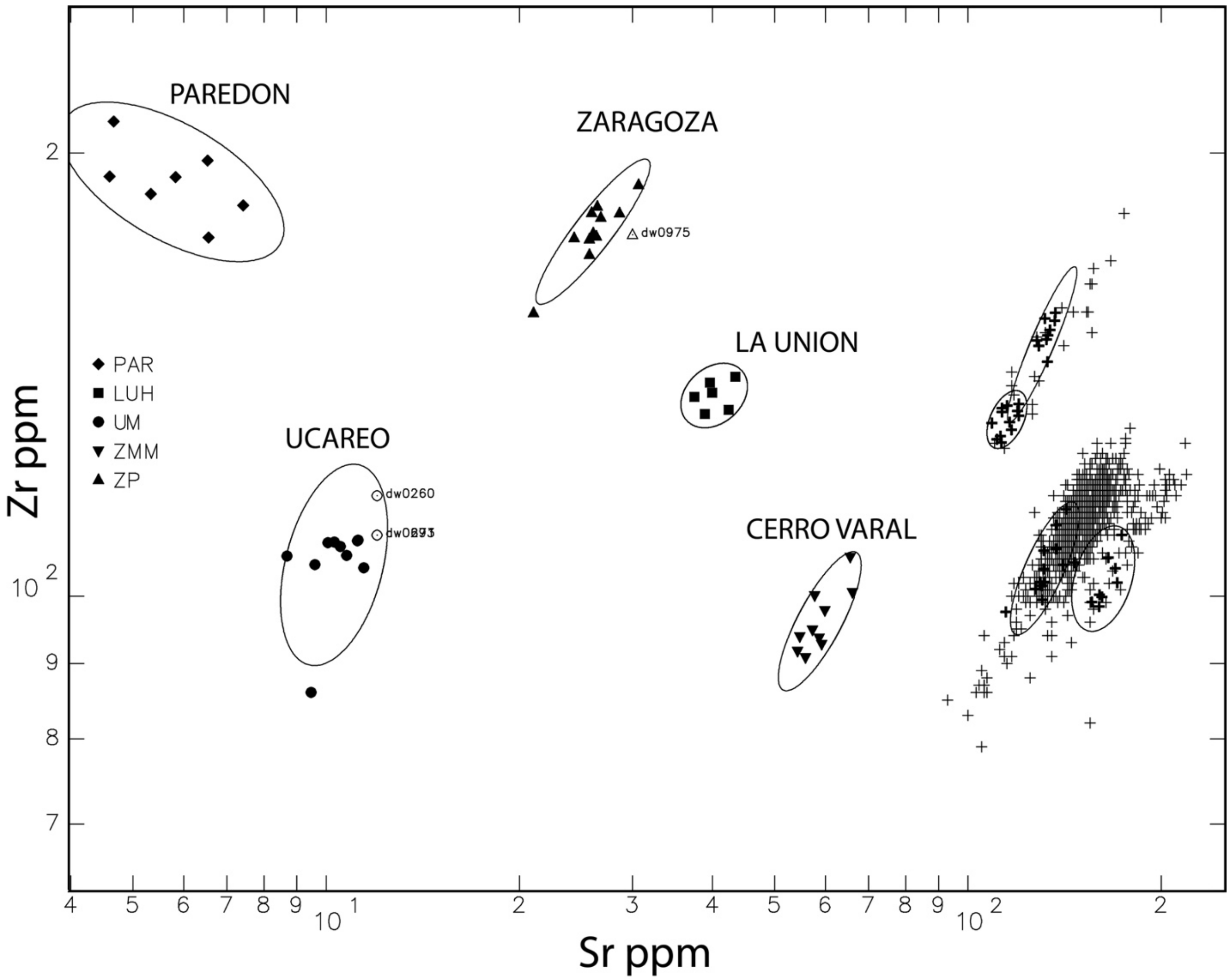

Figure 17: Strontium and zirconium bivariate plot of Yauxua and Coba obsidian artifacts emphasizing Paredon, Zaragoza, Ucareo, La Union, and Cerro Varal source ellipses.

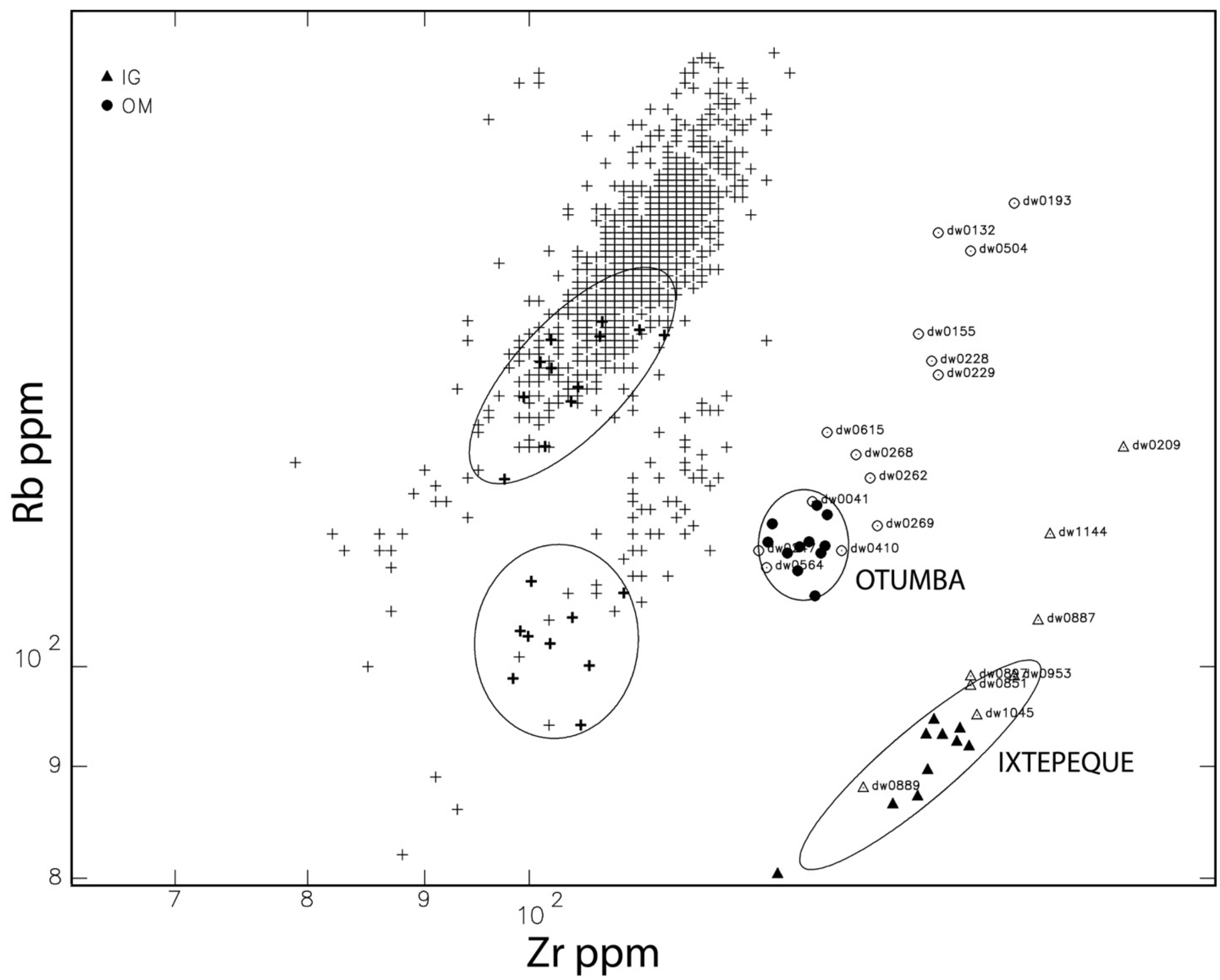

Figure 18: Zirconium and rubidium bivariate plot of Yauxua and Coba obsidian artifacts emphasizing Otumba and Ixtepeque source ellipses.

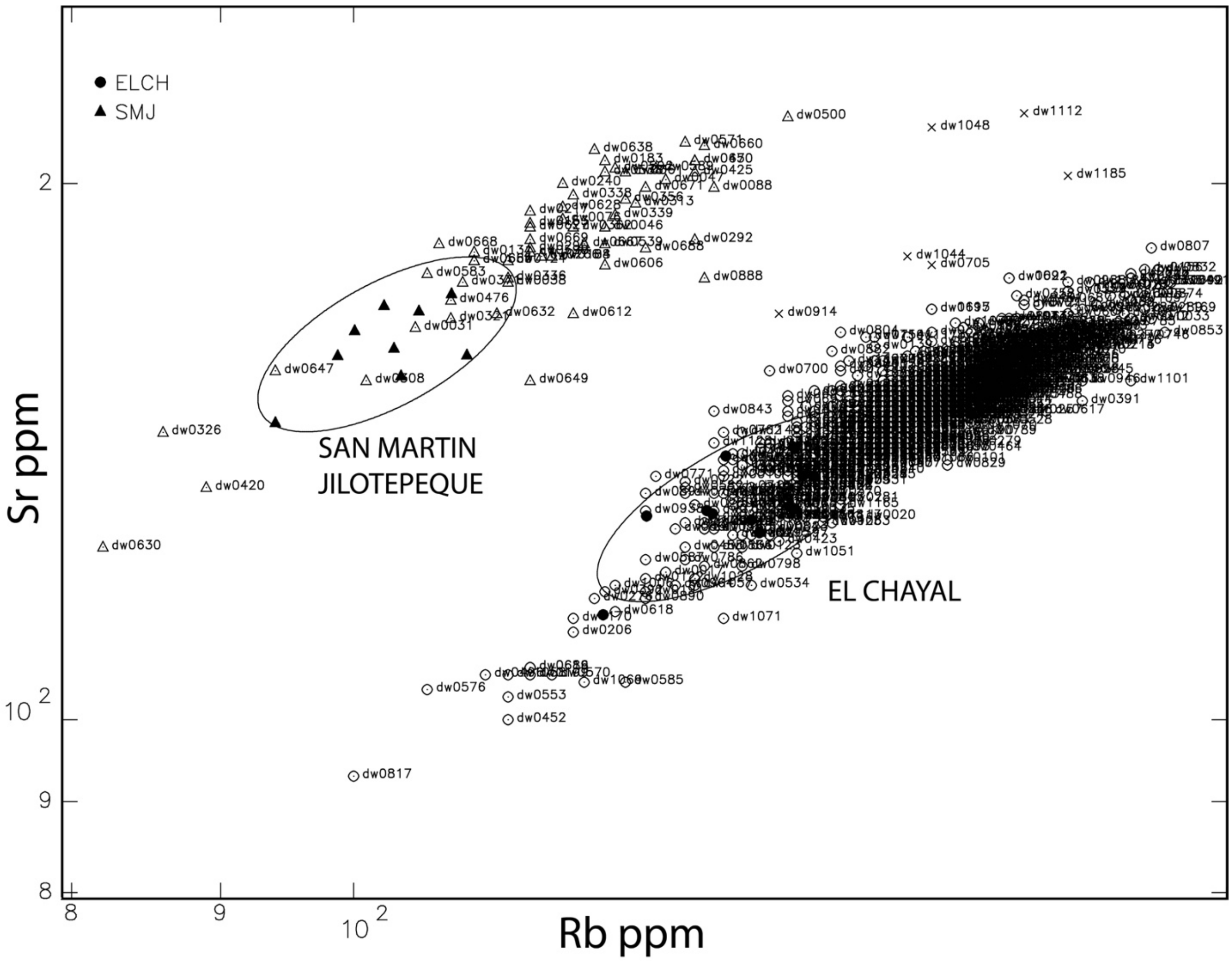

Figure 19: Rubidium and strontium bivariate plot of Yauxua and Coba obsidian artifacts emphasizing San Martin Jilotepeque and El Chayal source ellipses.

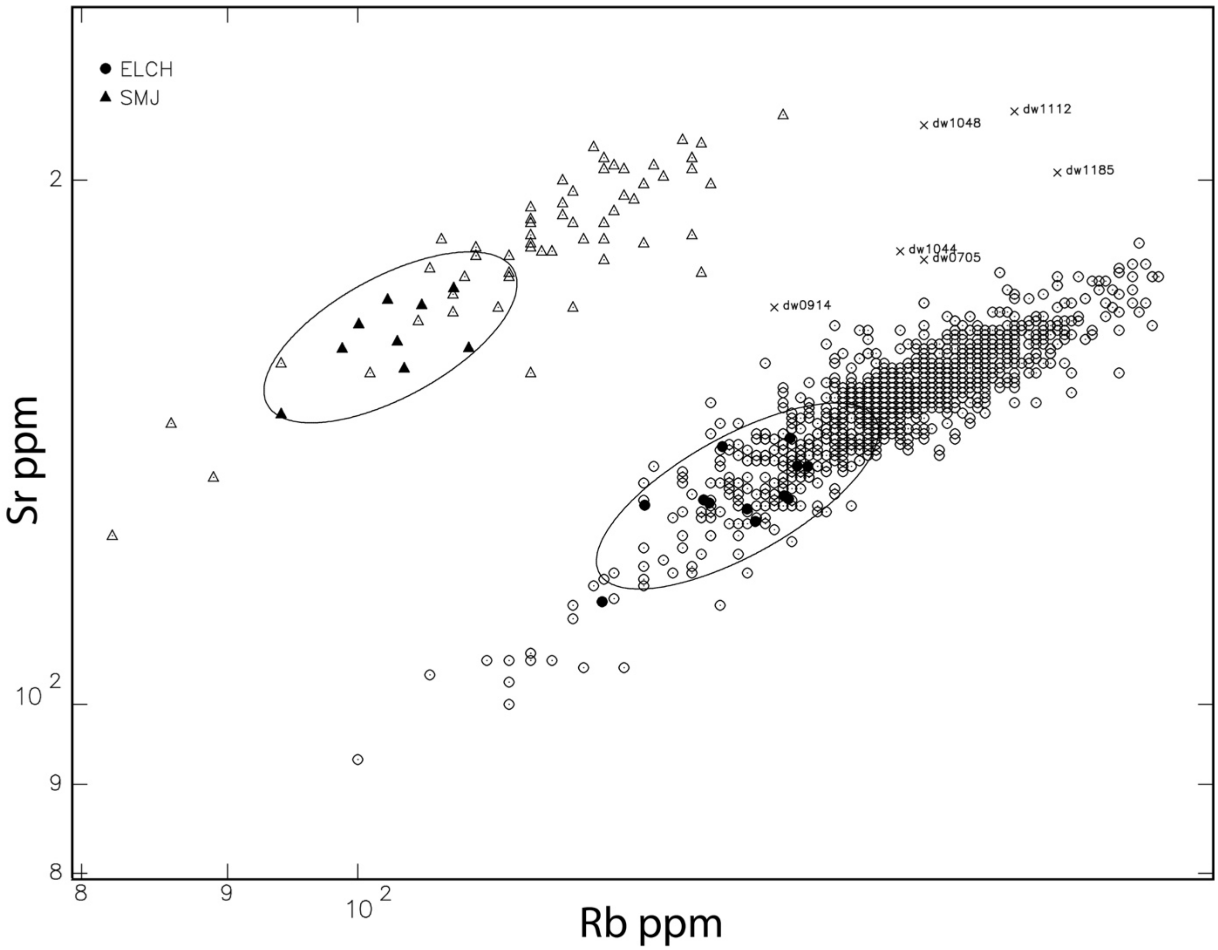

Figure 20: Rubidium and strontium bivariate plot of Yauxua and Coba obsidian artifacts emphasizing the six unassigned artifacts.

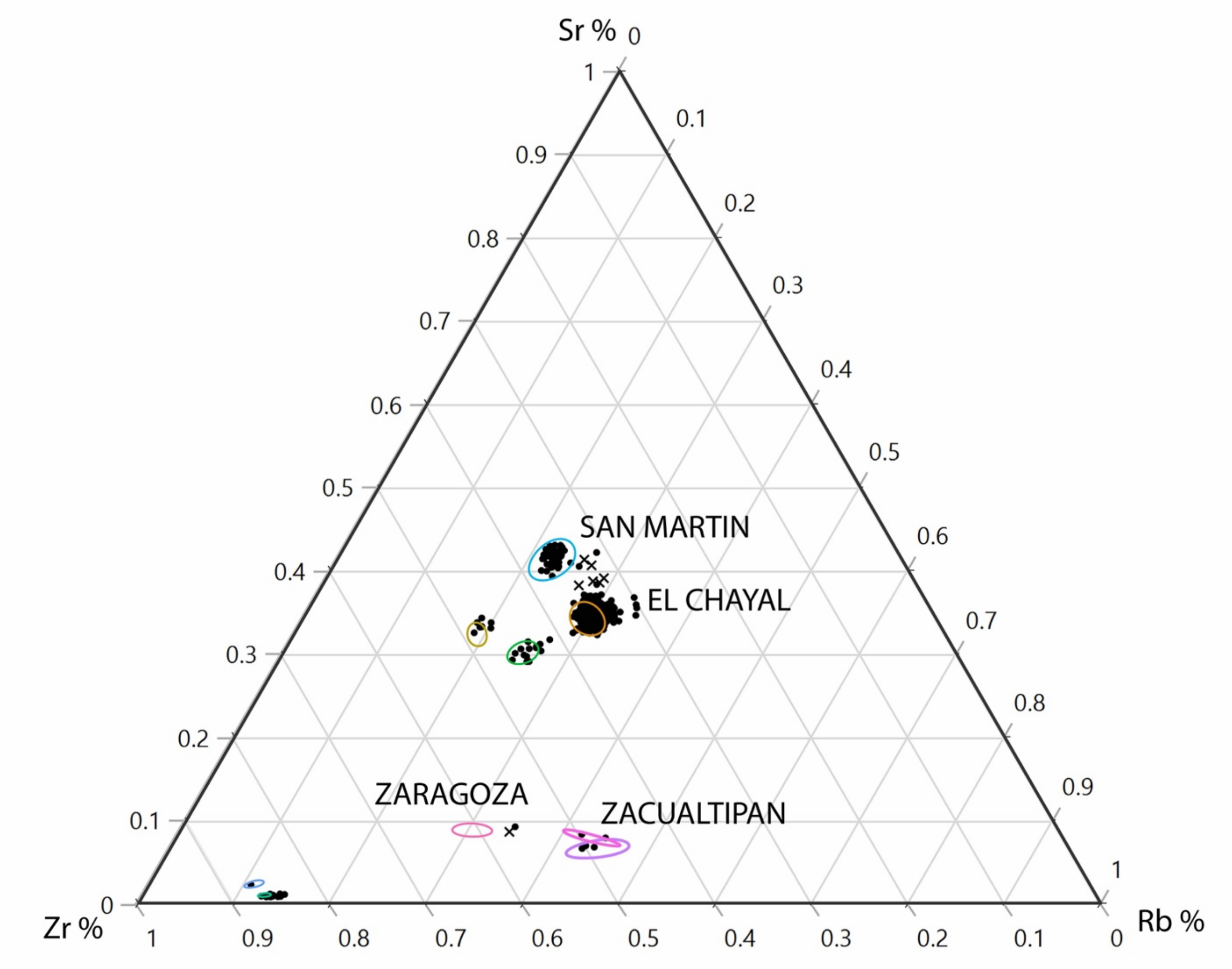

Figure 21:Zirconium, strontium, and rubidium plot with the unassigned artifacts.

Yaxuna

Table 2 shows the total number of each obsidian source represented at Yaxuna and the relative percentages. The vast majority of the sample (n=588, 85.22%) can be assigned to El Chayal. While the other two Guatemalan sources are represented, Ixtepeque (n=1, <1%) and San Martin (n=58, 8.41%), it is notable that Yaxuna contains a wide variety of Mexican obsidian. Five

Mexican obsidian sources are represented, comprising nearly 5% of the total sample. Pachuca (n=15, 2.17%) and Otumba (n=14, 2.03%) are the most common Mexican sources, followed by Tulancingo (n=1, 0.14%), Ucareo (n=3, 0.43%), and Zacualtipan (n=1, 0.14%). The remaining 1.3% of the sample (n=9) was characterized as not obsidian. These samples are likely dark cherts or basalts that were misidentified as obsidian when collecting artifacts through the screen. The substantially low Rb, Sr, Y, Zr, and Nb PPM concentrations in these samples strongly implies they are not obsidian.

Table 2: Sources present in the Yaxuna assemblage.

	El Chayal	**Ixtepeque**	**San Martin**	**Otumba**	**Pachuca**	**Tulancingo**	**Ucareo**	**Zacualtipan**
N	588	1	58	14	15	1	3	1
% of Total	85.22%	0.14%	8.41%	2.03%	2.17%	0.14%	0.43%	0.14%

Coba

Table 3 shows the total number of each obsidian source represented at Coba and the relative percentages. Similar to Yaxuna, El Chayal (n=479, 96.57%) represents the dominant source in the sample, however, a theme of divergence characterizes the overall patterns found. Contrary to the sample from Yaxuna, fewer known sources were consumed at Coba. In addition, unlike the household groups at Yaxuna, Group 1 contained significantly less Mexican obsidian. Mexican sources consisted only of Zacualtipan (n=1, 0.20%) and Zaragoza (n=1, 0.20%), comprising only 0.40% of the total Coba sample. Residents of Group 1 at Coba also consumed

different proportions of Guatemalan obsidian. San Martin Jilotepeque was consumed far less at Coba and constituted only 0.20% (n=1) of the sample. More Ixtepeque (n=7, 1.41%) was consumed at Coba, but not by a substantial amount.

As previously mentioned, a total of seven artifacts were determined unassigned based on their distribution in the bivariate plots. Six artifacts (dw0705, dw0914, dw1044, dw1048, dw1112, dw1185) in **Figure 20** were plotted in between two sources, El Chayal and San Martin Jilotepeque. One artifact (dw1030) in **Figure 16** was in between the Zacualtipan and Zaragoza source groups. These samples were considered unassigned.

Table 3: Sources present in the Coba assemblage.

	El Chayal	**Ixtepeque**	**San Martin**	**Zacualtipan**	**Zaragoza**
N	479	7	1	1	1
% of Total	96.57%	1.41%	0.20%	0.20%	0.20%

Obsidian Consumption in the Late Classic Maya Lowlands

Considering Coba's unparalleled size and influence in the Late Classic period, a brief comparison of how Coba and Yaxuna's obsidian assemblages measure against those from previous investigations at both sites (**Table 4**) and at other Late Classic centers of the northern and central lowlands is useful.

A summary of Braswell and Glascock's comprehensive sourcing analysis of obsidian distribution among sites in the northern lowlands included provenance data from both Coba (N=307) and Yaxuna (N=180) (Braswell 1997; Braswell and Glascock 2007). Their methods included a combination of visual examination and instrumental neutron activation analysis (INAA). Their results, although from a smaller sample, closely align with those from this study. From a sample of 180 artifacts, the authors found that 84% (n=151) of Yaxuna's obsidian came from the El Chayal source. In addition, 11% of the sample was attributed to Central Mexican sources, largely Ucareo (n=14), but also Pachuca (n=2), Zacualtipan (n=2), and Otumba (n=2) (2007:Figure 6). Their sample from Coba was almost double the size (N=307). Of this, 96% (n=294) represented the El Chayal source, while less than 3% (n=4) was attributed to Central Mexican sources (2007:Figure 7).

Other than Braswell and Glascock's sourcing analysis, provenance studies of Coba and Yaxuna's obsidian material are quite limited. In 1983, Nelson and colleagues reported the results of sourced obsidian artifacts from numerous sites in the northern Maya lowlands, one of which was Coba. With a small sample size of only eleven artifacts, Nelson et al. (1983) and Nelson (1985) made preliminary efforts to understand obsidian trade routes and how they changed over time. Coba's entire sample was attributed to the El Chayal source, leading the authors to suggest Coba appears to have been closely related to other Classic period lowland Maya sites based on its source of obsidian. While the studies from Nelson et al. (1983) and Braswell and Glascock (2007) represent a small sample of Coba and Yaxuna's obsidian material, the results generally fit with those from other major Classic period capitals of the central lowlands and with the results of the current study.

Table 4: Percentage of sources found at Coba and Yaxuna from previous studies mentioned in the text.

	N	El Chayal	San Martin	Ixtepeque	Ucareo	Otumba	Pachuca	Zacualtipan	Other sources	Reference
Coba	307	96%	1%	1%	<1%	-	<1%	-	<1%	Braswell and Glascock (2007)
	11	100%	-	-	-	-	-	-	-	Nelson et al. (1983)
Yaxuna	180	84%	4%	1%	8%	1%	1%	1%	-	Braswell and Glascock (2007)

Similar patterns of obsidian procurement are shared by a host of central lowland states that emerged and grew rapidly during the Classic period. The site of Tikal, located in the Peten region of the central lowlands, was a major capital throughout the Classic period. The polity waxed and waned during the Late Classic, but ultimately experienced a resurgence and defeat of its long-time rival Calakmul in A.D. 695 (Sharer and Traxler 2006:393). Excavations at the site have yielded substantial quantities of worked obsidian, most of which were deposited between the Early and Late Classic period (Moholy-Nagy and Nelson 1990; Moholy-Nagy 2013). During the Late Classic in particular, El Chayal is the dominant source and remains so into the Terminal Classic. Investigations of the nearby Peten Lakes region also support a dominance of El Chayal (Ford et al. 1997; Rice 1984). While the presence of Mexican obsidian is scant, the use of green obsidian peaked at several sites in the region during the Early Classic (Ford et al. 1997; Moholy-Nagy 2013). The site of Calakmul exhibits a similar pattern of sourced obsidian (Braswell 2013). While only six sources were identified through INAA and visual analyses, approximately 86% of the assemblage is from the El Chayal source. Similar to Tikal, Central Mexican sources were present in meager amounts except for Pachuca, which comprised almost 5% of the assemblage

(Braswell 2013:Table 1). These patterns from both Tikal, Calakmul, and the Peten Lakes closely resemble the source attributions made from Yaxuna's obsidian material as a small but noteworthy portion of the sample was assigned to the Pachuca source. On the contrary, no green and little Central Mexican obsidian was recovered from the household group at Coba.

Likewise, a similar pattern exists for two large Late Classic polities of the Usumacinta region in the western Maya lowlands. Piedras Negras, which grew rapidly in the Late Classic period, has a relative paucity of obsidian. Compared to chert, obsidian and is considered to have been of secondary importance in the local economy (Hruby 1998, 2007). Hruby (2007) argues this may be a result of the site's distance from sources in Highland Guatemala, increasing the difficulty in obtaining obsidian through long-distance trade routes. Despite this distance, 96% of the obsidian material recovered from Piedras Negras was attributed to the El Chayal source. Nearly all the obsidian material from the site of Palenque (94%), located further north along the Usumacinta River, has also been attributed to El Chayal (Herckis 2015; Johnson 1976). These patterns from the western Maya lowlands reinforce the arguments made about the overland transport of El Chayal obsidian throughout the lowlands (e.g., Braswell 1997, 2003; Golitko et al. 2012; Golitko and Feinman 2015; Hammond 1972).

As large capitals were forming in the central lowlands (i.e., Caracol, Piedras Negras, Yaxchilan, Palenque, Tikal, and Calakmul), sites in the northern lowlands such as Edzna, Izamal, and Dzibilchaltun were expanding alongside their central lowland counterparts. Edzna, located in the Puuc Hills of the northern lowlands, likely reached its height during the Late Classic period, evidenced by a series of stelae dating from A.D. 633 to 810 (Sharer and Traxler 2006:532). Though not representative of its size in the Classic period, only a small sample of obsidian has been sourced from Edzna (N=96) (Nelson et al. 1983; Nelson 1985). As expected from this

period and region, 77.8% of the Early Classic sample and 62.5% of the Late Classic sample was sourced to El Chayal. To the north, Dzibilchaltun, which was a large capital during the Late to Terminal Classic periods, follows the same trend with 89% (n=791) of the total sample attributed to the El Chayal source (Braswell and Glascock 2007).

In contrast, the site of Izamal, and its likely port of Xcambo, were both occupied during the Early to Late Classic periods but exhibit contradicting patterns. While only a small sample of obsidian was collected through salvage excavations at Izamal (N=137), only a third represented the El Chayal source. Over 60% of the sample represented Central Mexican sources such as Ucareo and Pachuca. Nearly equivalent proportions of sourced obsidian were found at the site of Xuenkal, located 45 km northeast of Chichen Itza. Results from Izamal and Xuenkal are consistent with trade patterns proposed for sites located in the northernmost area of the Yucatan Peninsula (e.g., Braswell 1997, 2003; Golitko et al. 2012; Golitko and Feinman 2015). Yet, Xcambo, located on the northwestern tip of the Yucatan peninsula, reflects a significant Classic period occupation with 93% (n=1003) of the sample attributed to the El Chayal source. Izamal's obsidian sources are likely a reflection of a small portion of the site's collection that dates to the Classic period, as Ucareo and Pachuca are dominant sources during the Terminal Classic period (Braswell and Glascock 2007).

As outlined above, the obsidian sources that comprise the Coba and Yaxuna assemblages, as well as their relative proportions, fit with the overall pattern that characterizes obsidian distribution and consumption in the Classic period. Nearly every site reviewed from the western, central, and northern Maya lowlands exhibits a dominant pattern of El Chayal obsidian. These results are consistent with numerous other studies of Classic period obsidian trade (e.g., Braswell 2003; Braswell and Glascock 2007; Braswell et al. 2011; Golitko and Fienman 2015; Nelson et

al. 1977, 1983). Yaxuna, however, appears to fit better with the overall pattern of the northern lowlands. Specifically, the variety of Mexican obsidian is similar to that found at sites within relatively close proximity such as Dzibilchaltun, Xcambo, Edzna, and Izamal. On the contrary, Coba has noticeably less variety of Mexican obsidian sources present in its sample. Potential reasons for these divergent patterns are discussed in detail below.

Implications for Coba and Yaxuna

The source differences between the Coba and Yaxuna site assemblages are pertinent to previous hypotheses concerning Yaxuna's position in local and regional trade networks (e.g., Braswell 1997, 2003; Golitko and Feinman 2015; Stanton 2000; Stanton and Ardren 2005; Stanton et al. 2010; Stanton 2012; Stanton 2017). From early on, investigations at Yaxuna have called attention to the site's significance in early ancient Maya society. Brainerd's (1958) dating of the large acropolis at Yaxuna suggests that the site was already a significant landmark in the northern lowlands by the Late Preclassic period (Freidel 1986). Artifactual (ceramic) evidence from the Middle Formative and Early Classic periods, as well as the rare presence of an E-Group, indicate that Yaxuna may have served as a hub for regional trade throughout these periods and possibly into the Late Classic (Stanton and Ardren 2005; Stanton 2012; Stanton 2017). Beginning in the Middle Formative, Yaxuna supported one of two confirmed Preclassic E-Group complexes in the northern lowlands. These two E-Groups (the other at San Antonio Chel) and the distribution of other possible E-Groups in the region align with what Stanton (2017) has interpreted as two early inland trade routes that connected the northern and southern lowlands shown in **Figure 22**. Coastal data from this period support inland trade at this time, as coastal sites were likely small fishing camps, and not trading centers, yet Olmec-style greenstone

artifacts and obsidian have been reported from several sites in the northern lowlands. These sites, including Yaxuna, Chacsinkin located just south of Yaxuna, and numerous sites in the western area of the peninsula, generally conform with those that form the E-Group pattern mentioned above (Stanton 2017:Figure 14.1). Interestingly, ceramic groups from the southern lowlands such as Muxunal and Pital appear in significant amounts in the same general area where E-groups have been confirmed or are suspected, including Yaxuna. In addition, a foreign white-slipped ware belonging to the Central Mexican El Llanto group, was identified at Yaxuna with motifs that resemble Middle Preclassic Olmec-style ceramics (Stanton and Ardren 2005). Whether this group was an imported tradeware from the Gulf Coast, or representative of local borrowing techniques, the ceramic evidence indicates connections with people from the southern Maya lowlands, Gulf Coast, and beyond into Central Mexico (Stanton 2005:225; Stanton 2012).

Throughout the Late Formative and into the Early Classic period, Yaxuna continued to have substantial amounts of southern lowland ceramics and likely participated in the exchange of ceramics or ceramic ideas with neighbors to the south (Stanton 2012). The Early Classic is characterized by a local polychrome tradition or an influx of Peten-style wares that relate to the Manik II phase at Tikal, as well as an increase in the production of the Usil Group ceramics (Smith 1940; Stanton et al. 2010:38). These wares may have been traded along the same proposed inland trade route that connected the Peten and Gulf Coast to the northern Yucatan peninsula during the Middle Formative (Stanton 2017).

Considering the possibility that Yaxuna may have continued as a hub for regional trade into the Late and Terminal Classic periods, it is reasonable to also propose that the site and households within it had greater access to resources, including obsidian from Central Mexico. Braswell (1997:2003) has advanced similar arguments related to Yaxuna's participation in

regional trade networks. Geographically, the center of Yucatan, specifically the area around Chichen Itza and Yaxuna, has been considered a link between regional styles of the northern lowlands (Braswell 1997:595). Based on his "obsidian exchange spheres," the area north of Yaxuna (specifically Chichen Itza and Uxmal) participated in an international obsidian trade network during the Terminal Classic, while sites like Coba and Ek Balam did not (Braswell 2003:Figure 20.2). This division is evidenced by a significant portion (50-70%) of Central Mexican obsidian at sites in the Sotuta sphere (Chichen Itza, Isla Cerritos, Uxmal), and little to none (< 11%) at sites in the Western Cehpech sphere (Yaxuna, Xkipche, Ek Balam). These statistics closely resemble those from this analysis; Yaxuna clearly exhibits a greater amount and variety of Mexican obsidian sources than Coba. It is also important to point out that Yaxuna has Mexican obsidian earlier than the Terminal Classic period when many models presume it should be more present (e.g., Braswell 2003; Braswell and Glasock 2013). Future research will focus on the exact contexts from which the Mexican obsidian was recovered and expand on this interpretation.

Golitko and Feinman's (2015) recent social network analysis provides more insight into Yaxuna's role in obsidian trade during the Late Classic period. Their analyses suggest Chichen Itza and affiliated sites such as Isla Cerritos, Oxkintok, and Yaxuna were of central importance to the northern Yucatan network structure. In other words, these sites provided some of the "main linkages between western and eastern Mesoamerica" (2015:223). While Yaxuna did not likely participate in international obsidian trade to the extent that sites further north did, it is evident that Yaxuna was connected to regions throughout Mesoamerica including the southern lowlands and Central Mexico during the Late and Terminal Classic periods (Braswell 1997, 2003; Golitko and Feinman 2015; Stanton 2012; Stanton 2017).

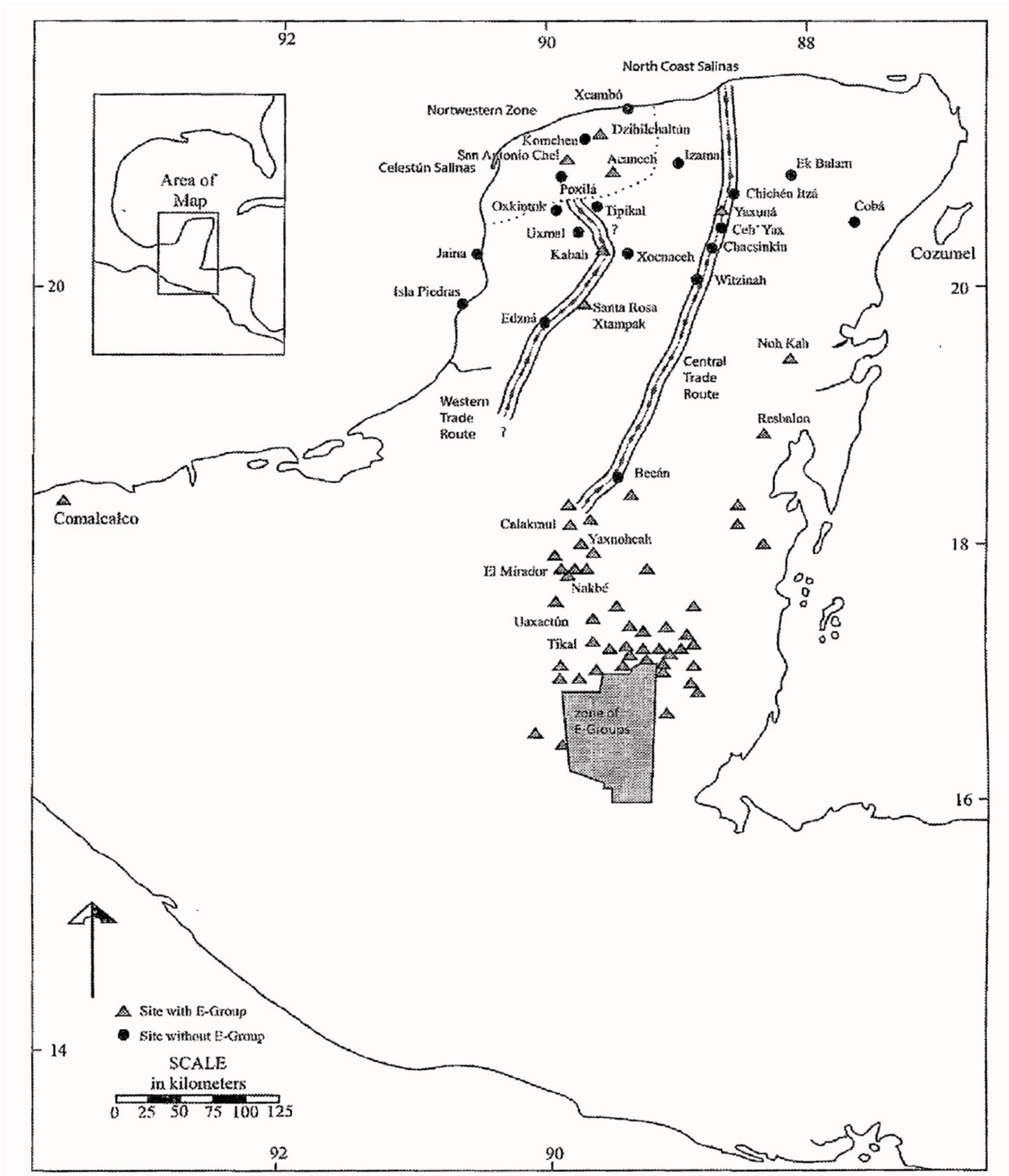

Figure 22: Sites with E-groups and proposed Preclassic period trade routes (Stanton 2017).

Limitations

One of the primary limitations of this thesis research was the inaccessibility to detailed context information such as chronological data and stratigraphic context. Although excavations within Operation 161 and Operation 1 firmly date to the Early to Late Classic transition based on the presence of the Yulum ceramic type, a type-variety analysis of the Coba ceramic material was still underway during the duration of this research. As a result, a chronology of occupation in domestic groups and architectural construction sequences was not complete. Without this information, I was limited to making broad site comparisons between domestic-focused operations at Coba and Yaxuna. In addition, a more micro-level of analysis of how obsidian sources vary between individual structures, patios, and circulation spaces was not appropriate without the necessary context information.

In addition, an inevitable limitation of this research is the restricted time frame. Without attending additional semesters of graduate school, I was unable to both scan all the samples with the Handheld XRF, subdivide and then compare by contexts at a more micro-level, for instance by household or sub-operation. As an alternative, this thesis aimed for a general site comparison, as opposed to multiple comparisons of how obsidian was consumed differently at separate household groups at Yaxuna and Coba. This data is hoped to be completed and published in the future following the completion of the above-mentioned analyses.

While Handheld XRF is a valid method for determining provenance (Nazaroff et al. 2010), there are limitations to using this methodology. In Nazaroff et al.'s (2010:893) assessment of the applicability of pXRF for obsidian provenance research, the authors concluded that when compared to a laboratory XRF instrument, the pXRF instrument is "not statistically accurate for each element within each obsidian geochemical group." More specifically, they observed

significant statistical differences in elemental concentrations in both the El Chayal and Ixtepeque groups between the laboratory and pXRF instruments. Consistent with Nazaroff et al.'s results, Drake et al. (2009) also concluded statistical analysis demonstrated that geochemical data are not equivalent between the two instruments. Nevertheless, although the authors found the elemental readings not as statistically accurate when compared to the laboratory XRF, they concluded that pXRF is a valid technique through its ability to differentiate between different geochemical source groups. In addition, it is important to point out that many others have employed this methodology successfully (e.g., Cecil et al. 2007; Drake 2009; Frahm 2013; Moholy-Nagy et al. 2013; Millhauser et al. 2011).

Finally, in an ideal scenario, the source samples used to construct the confidence regions would consist of an equal number of small samples such as pressure flakes and larger, infinitely thick samples from each of the 12 sources (Martindale Johnson et al. 2018). This is done in order to have a wider region, which requires smaller-sized source samples to represent the range of variation for individual sources. This, however, would be impossible with the time constraints of this thesis research. Thus, the large source samples provided by MURR were used to construct the confidence ellipses and regions, which means the confidence regions will inevitably not represent the entire range of variation for each source with both small and large samples. Due to this constraint, ternary plots and biplots of both PPM concentrations and peak count ratios were used to corroborate source assignments between the different methods of analysis.

CHAPTER 5: CONCLUSIONS

XRF technology has proven useful in provenance studies throughout Mesoamerica since it was introduced in the early twentieth century (e.g., Braswell et al. 2000; Glascock 2002; Davis et al. 1998; Frahm 2013; M0holy-Nagy et al. 2013; Millhauser et al. 2011). Not only is it effective in differentiating geochemical sources, it is also a relatively quick and cost-effective methodology for determining provenance. In addition, XRF is a non-destructive technique, allowing the PSYC and future projects to perform useful technological, use-wear, and artifact type analyses of the Coba and Yaxuna obsidian material.

Using Handheld XRF, this thesis research found that during the Early to Late Classic transition (A.D. 500-750/800), Coba and Yaxuna exploited various obsidian sources consistent with the overarching trend of obsidian distribution in the Classic period Maya lowlands (e.g., Braswell 2003; Braswell and Glascock 2007; Braswell et al. 2011; Golitko and Feinman 2015; Nelson et al. 1977). Specifically, the majority of obsidian consumed by households at Coba and Yaxuna was attributed to the El Chayal source. These patterns are similar to those from contemporaneous, large Late Classic capitals in the western, central, and northern lowlands from this time period. Sites like Tikal (Moholy-Nagy and Nelson 1990; Moholy-Nagy 2013), Calakmul (Braswell 2013), Palenque (Herckis 2015; Johnson 1976), Edzna (Nelson et al. 1983; Nelson 1985), and Dzibilchaltun (Braswell and Glascock 2007) are also dominated by El Chayal obsidian.

As for patterns specific to the northern lowlands, Yaxuna bears a closer resemblance to sites like Uxmal and Dzibilchaltun rather than Coba. Coba has a minimal amount and variety of Mexican obsidian. In contrast, the Yaxuna sample includes a wide variety of Mexican obsidian

sources and a greater amount of Mexican obsidian overall. While sites like Uxmal and Dzibilchaltun are still dominated by El Chayal, the proportions of various Mexican obsidian sources are similar to those found at Yaxuna. Despite the fact that Group 1 at Coba and Strs. 5E-110 and 5E-112 at Yaxuna were both within similar proximities to *Sacbe* 1, Coba generally seems to have had less access to a variety of obsidian than Yaxuna and most sites in the Classic period northern lowlands.

The divergence between the Coba and Yaxuna obsidian material substantiates previous arguments concerning Yaxuna's role in local and regional trade during the Classic period (e.g., Stanton 2000; Stanton 2012; Stanton 2017). Ceramic and architectural evidence suggest Yaxuna may have continued as a hub for regional trade from the Middle Formative into the Late and Terminal Classic periods (Stanton 2000; Stanton and Ardren 2005; Stanton et al. 2010; Stanton 2012; Stanton 2017). This level of integration within widespread trade networks lends credence to the wide variety of obsidian in Yaxuna households and their resemblance to obsidian patterns from prominent sites in the northern lowlands. Perhaps this access to widespread trade networks that had been established over centuries was the primary motivator behind Coba's interest and incorporation of the site through the construction of *Sacbe* 1. Provenance studies of obsidian trade during the Classic period suggest that sites on the eastern side of the Yucatan Peninsula did not have the same access to Caribbean and Gulf trade networks as those located on the western and northern interior portions of the peninsula (Braswell 1997, 2003; Golitko and Feinman 2015). The sourcing results from Coba fit this description and may explain why Coba needed to incorporate a site to its west in order to gain access to and/or control of its trade connections. Additional attribute analyses of other types of artifactual evidence will attest to whether Yaxuna did have greater access to widespread trade networks overall.

Future Directions of Research

The results from this sourcing analysis broaden the research that has investigated the relationship between Coba and Yaxuna, as lithic evidence had never been examined in regard to Coba and Yaxuna during this period expansion and socioeconomic integration. However, these source attributions serve as only a starting point for provenance research on a local and regional level, as only a broad comparison was made between the obsidian assemblages at Coba and Yaxuna household groups that were firmly dated to the Early to Late Classic transition. In the future, the sourced obsidian from this research should be subdivided into specific operations, household groups, time period, and other areas of interest at each site in order to make more micro-scale comparisons. For instance, separate analysis of obsidian from Early Classic and Late/Terminal Classic contexts should be performed to further assess if Coba did gain greater access to obsidian sources following its integration of Yaxuna. Moreover, a typological analysis of the obsidian artifacts should be correlated to geochemical source. More nuanced analyses such as these will also aid in answering remaining questions about Late Classic Coba and Yaxuna such as whether household practices increased or changed as a result of changing demands from the state or from access to new resources and sharing of ideas.

In addition, source attributions that could not be included from the surrounding subsidiary sites and those along *Sacbe* 1 should be compared with those from Coba and Yaxuna. These patterns should further aid in interpretations of Coba's relationship to sites integrated within its political sphere. For instance, do the obsidian patterns from these smaller sites resemble those from Yaxuna or Coba? Did obsidian procurement at these sites change following the construction of *Sacbe* 1, if at all?

As previously mentioned, additional attribute analyses of other types of artifactual evidence, such as ceramics, should be compared to the sourcing results of this research. Variability in kinds and frequencies of vessel forms may reveal differential household access and directions of exchange. Ceramic patterns from the last several field seasons can be compared with similar research that has already been done at Coba and Yaxuna (Loya González and Stanton 2013; Shaw and Johnstone 2001; Suhler et al. 1998) to understand the greater trade connections at Coba and Yaxuna.

Moreover, the results from this provenance study should be compared to more provenance studies in the region than what was discussed here, specifically those focused on the Late Classic period. Not only does this research reveal information about the household-level economies of Coba and Yaxuna, it can also be added to an understanding of the Late Classic regional economy of the northern lowlands. Because Coba represents the capital of the largest Late Classic polity and potentially most important political power in the northern lowlands (Guenter 2013; Sharer and Traxler 2006), data from here, as well as Yaxuna, is especially important to understanding of obsidian trade and exchange trends of the Late Classic northern lowlands.

Though not within the scope of this research, questions of market exchange at Coba and Yaxuna should be pursued in the future. With evidence for market exchange already present at Coba (i.e., Coronel et al. 2015), patterns of exchange that include a change in access to non-local goods, including imported obsidian, may shed light on whether and/or to what degree households at Coba and Yaxuna participated in market exchange. Based on the divergent obsidian sourcing results from Coba and Yaxuna households, did Yaxuna participate in market exchange without oversight from Coba, resulting in a wider variety of obsidian at Strs. 5E-110 and 5E-112, but not

Group 1? Did households at Coba and Yaxuna have equal access to goods through market exchange or did Yaxuneros maintain their own strategies for acquiring imported goods? These questions can now begin to be answered in concert with other stylistic and attribute analyses.

APPENDIX A: CHEMICAL PARTS PER MILLION DATA FOR COBA AND YAXUNA ARTIFACTS

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0001	2016_YAX161-1-1_AT	El Chayal	644	7041	52	25	11	160	157	23	115	11
dw0002	2016_YAX161-1-1_AU	El Chayal	680	6624	52	21	12	163	160	22	117	10
dw0003	2016_YAX161-1-1_AV	El Chayal	643	7016	84	22	14	164	156	17	113	13
dw0004	2016_YAX161-1-1_AW	El Chayal	740	7740	109	24	14	153	152	22	117	12
dw0005	2016_YAX161-1-1_AX	El Chayal	785	6985	81	24	12	166	157	23	114	11
dw0006	2016_YAX161-1-1_AY	El Chayal	794	8320	168	21	8	161	147	17	104	9
dw0007	2016_YAX161-1-1_AZ	El Chayal	431	6265	50	20	8	151	150	21	108	10
dw0009	2016_YAX161-1-1_BA	El Chayal	633	6781	57	17	13	157	149	17	112	10
dw0010	2016_YAX161-1-1_BB	El Chayal	540	5720	87	22	8	134	137	19	107	9
dw0011	2016_YAX161-1-1_BC	El Chayal	703	6959	68	23	12	172	155	21	123	11
dw0012	2016_YAX161-1-1_BD	El Chayal	582	6882	63	20	9	160	152	19	114	11
dw0013	2016_YAX161-1-1_BE	El Chayal	677	7160	69	21	12	163	158	23	118	9
dw0014	2016_YAX161-1-1_BF	El Chayal	581	6667	52	13	14	135	133	20	101	10
dw0015	2016_YAX161-1-1_BG	El Chayal	837	6999	65	20	12	137	133	21	101	11
dw0016	2016_YAX161-1-1_BH	El Chayal	600	6201	51	14	11	142	130	16	100	10
dw0017	2016_YAX161-1-1_BI	El Chayal	610	6057	54	16	11	128	121	16	95	10
dw0018	2016_YAX161-1-1_BJ	El Chayal	594	6443	47	14	12	140	132	17	101	9
dw0019	2016_YAX161-1-1_BK	El Chayal	742	6920	82	19	14	141	138	19	107	11
dw0020	2016_YAX161-1-1_BL	El Chayal	707	6887	69	16	12	149	130	17	105	9
dw0021	2016_YAX161-1-1_BM	El Chayal	633	6432	44	17	13	136	127	21	114	11
dw0022	2016_YAX161-1-1_BN	El Chayal	643	7473	95	25	11	153	144	18	109	15
dw0023	2016_YAX161-1-1_BO	El Chayal	742	6590	63	15	11	139	128	16	103	11
dw0024	2016_YAX161-1-1_BP	El Chayal	694	6225	54	21	13	135	134	20	104	9
dw0025	2016_YAX161-1-1_BQ	El Chayal	536	6407	48	18	17	147	144	20	106	10
dw0026	2016_YAX161-1-1_BR	El Chayal	667	7378	68	20	11	160	156	21	113	14
dw0027	2016_YAX161-1-1_BS	El Chayal	735	7071	68	21	10	153	147	18	112	10
dw0028	2016_YAX161-1-1_BT	El Chayal	648	6625	56	22	10	144	148	22	113	12
dw0029	2016_YAX161-1-1_BU	El Chayal	593	7298	95	21	12	157	151	22	113	10
dw0030	2016_YAX161-1-1_BV	El Chayal	635	6280	59	21	7	154	150	19	111	12
dw0032	2016_YAX161-1-1_BX	El Chayal	666	6749	64	21	10	156	151	20	113	12
dw0033	2016_YAX161-1-1_BY	El Chayal	871	8154	75	26	12	188	168	23	121	12
dw0034	2016_YAX161-1-1_BZ	El Chayal	736	7341	55	24	13	168	164	23	115	13
dw0035	2016_YAX161-1-1_C	El Chayal	808	7269	71	23	11	170	165	23	117	13
dw0036	2016_YAX161-1-1_CA	El Chayal	650	6333	41	20	11	156	142	21	116	10
dw0037	2016_YAX161-1-1_CB	El Chayal	781	6932	71	23	10	166	156	22	114	12
dw0039	2016_YAX161-1-1_CD	El Chayal	552	6884	73	23	17	163	154	20	114	13
dw0040	2016_YAX161-1-1_CE	El Chayal	579	6175	52	19	9	140	130	18	109	11
dw0043	2016_YAX161-1-1_CH	El Chayal	637	6745	73	15	12	147	141	19	108	9
dw0044	2016_YAX161-1-1_CI	El Chayal	630	7051	72	25	8	166	151	21	115	9
dw0045	2016_YAX161-1-1_CJ	El Chayal	557	7216	40	21	11	161	155	20	116	11
dw0048	2016_YAX161-1-1_CM	El Chayal	724	7425	56	25	13	174	164	23	119	12
dw0049	2016_YAX161-1-1_CN	El Chayal	602	6583	53	24	8	162	155	21	111	12
dw0050	2016_YAX161-1-1_CO	El Chayal	526	6383	67	22	11	156	147	22	114	12
dw0051	2016_YAX161-1-1_CP	El Chayal	670	6800	80	25	13	164	152	23	115	11

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0052	2016_YAX161-1-1_CQ	El Chayal	634	6924	64	23	10	159	158	21	113	10
dw0053	2016_YAX161-1-1_CR	El Chayal	504	6571	42	19	7	152	145	18	111	11
dw0055	2016_YAX161-1-1_CT	El Chayal	628	7348	60	24	12	165	157	22	117	11
dw0056	2016_YAX161-1-1_CU	El Chayal	712	7101	61	21	12	159	153	18	114	12
dw0057	2016_YAX161-1-1_CV	El Chayal	651	6273	57	23	15	155	149	19	110	11
dw0058	2016_YAX161-1-1_CW	El Chayal	752	6859	61	24	10	155	147	19	110	13
dw0059	2016_YAX161-1-1_CX	El Chayal	597	6899	31	21	11	146	136	20	105	9
dw0060	2016_YAX161-1-1_CY	El Chayal	764	7020	53	20	11	166	152	23	117	10
dw0061	2016_YAX161-1-1_CZ	El Chayal	770	8156	94	25	12	176	166	24	116	8
dw0062	2016_YAX161-1-1_D	El Chayal	534	6105	62	22	9	145	137	18	104	10
dw0064	2016_YAX161-1-1_DB	El Chayal	595	5910	49	16	10	144	136	19	108	10
dw0065	2016_YAX161-1-1_DC	El Chayal	579	6672	60	21	7	162	154	17	114	11
dw0066	2016_YAX161-1-1_DD	El Chayal	578	6417	46	17	10	150	142	17	109	11
dw0067	2016_YAX161-1-1_DE	El Chayal	580	6954	67	22	10	159	156	18	120	11
dw0068	2016_YAX161-1-1_DF	El Chayal	692	7308	79	24	11	164	158	21	116	12
dw0069	2016_YAX161-1-1_DG	El Chayal	866	7784	103	21	12	165	156	18	114	12
dw0070	2016_YAX161-1-1_DH	El Chayal	587	7381	87	23	8	167	156	20	118	11
dw0071	2016_YAX161-1-1_DI	El Chayal	601	6995	59	22	10	153	150	18	116	11
dw0072	2016_YAX161-1-1_DJ	El Chayal	529	6284	50	23	12	159	150	20	115	9
dw0073	2016_YAX161-1-1_DK	El Chayal	631	8267	133	23	10	146	150	22	107	11
dw0074	2016_YAX161-1-1_DL	El Chayal	819	7453	92	22	11	170	158	17	116	10
dw0075	2016_YAX161-1-1_DM	El Chayal	705	7315	76	26	10	165	159	21	119	12
dw0077	2016_YAX161-1-1_DO	El Chayal	623	6777	67	16	7	155	142	21	109	11
dw0078	2016_YAX161-1-1_DP	El Chayal	566	6474	62	26	6	165	152	23	114	10
dw0079	2016_YAX161-1-1_DQ	El Chayal	730	7109	94	23	13	168	160	22	114	11
dw0080	2016_YAX161-1-1_DR	El Chayal	936	8692	170	20	10	162	149	20	107	10
dw0081	2016_YAX161-1-1_DS	El Chayal	571	6956	76	21	10	159	149	23	117	11
dw0082	2016_YAX161-1-1_DT	El Chayal	701	7341	67	18	10	147	140	19	107	10
dw0083	2016_YAX161-1-1_DU	El Chayal	593	6566	61	17	15	140	132	19	99	12
dw0084	2016_YAX161-1-1_DV	El Chayal	637	6981	62	16	11	138	128	18	99	11
dw0086	2016_YAX161-1-1_DX	El Chayal	614	6775	58	24	9	151	141	20	117	11
dw0087	2016_YAX161-1-1_DY	El Chayal	656	6809	64	25	8	154	149	19	110	12
dw0089	2016_YAX161-1-1_E	El Chayal	711	6365	50	17	10	146	142	19	110	9
dw0090	2016_YAX161-1-1_EA	El Chayal	570	6231	63	23	12	151	139	22	114	11
dw0091	2016_YAX161-1-1_EB	El Chayal	810	7805	96	26	12	178	163	20	121	12
dw0092	2016_YAX161-1-1_EC	El Chayal	576	6222	56	19	10	143	146	20	110	12
dw0093	2016_YAX161-1-1_ED	El Chayal	670	7038	71	20	14	158	142	20	113	10
dw0094	2016_YAX161-1-1_EE	El Chayal	602	6072	40	16	9	140	138	18	106	10
dw0095	2016_YAX161-1-1_EF	El Chayal	623	6232	58	20	9	148	145	20	116	13
dw0096	2016_YAX161-1-1_EG	El Chayal	746	6869	67	22	10	162	151	26	116	10
dw0097	2016_YAX161-1-1_EH	El Chayal	711	8461	105	24	17	172	161	25	121	12
dw0098	2016_YAX161-1-1_EI	El Chayal	834	7619	78	23	9	176	164	21	124	11
dw0099	2016_YAX161-1-1_EJ	El Chayal	592	6810	66	22	8	155	143	19	119	11
dw0100	2016_YAX161-1-1_EK	El Chayal	679	7181	68	22	13	162	166	20	118	11
dw0101	2016_YAX161-1-1_EL	El Chayal	609	6415	37	19	11	160	140	17	110	11

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0102	2016_YAX161-1-1_EM	El Chayal	642	7284	66	23	10	164	152	21	123	12
dw0103	2016_YAX161-1-1_EN	El Chayal	622	7051	57	22	9	157	157	19	118	10
dw0104	2016_YAX161-1-1_EO	El Chayal	831	7993	117	24	17	163	153	20	113	13
dw0105	2016_YAX161-1-1_EP	El Chayal	654	6555	66	24	11	154	148	21	108	9
dw0106	2016_YAX161-1-1_EQ	El Chayal	958	8983	231	21	12	144	135	19	94	10
dw0107	2016_YAX161-1-1_ER	El Chayal	520	6814	88	20	6	139	132	17	98	9
dw0109	2016_YAX161-1-1_ET	El Chayal	710	7559	79	22	10	166	164	20	114	12
dw0110	2016_YAX161-1-1_EU	El Chayal	625	5989	47	19	10	142	130	18	102	9
dw0111	2016_YAX161-1-1_EV	El Chayal	692	7011	96	22	18	162	158	22	113	11
dw0112	2016_YAX161-1-1_F	El Chayal	658	6754	58	22	9	150	140	20	112	11
dw0113	2016_YAX161-1-1_G	El Chayal	587	6586	47	21	11	153	149	23	117	12
dw0114	2016_YAX161-1-1_H	El Chayal	575	5929	44	19	9	141	130	19	108	10
dw0115	2016_YAX161-1-1_I	El Chayal	795	7637	69	29	13	174	167	22	119	11
dw0116	2016_YAX161-1-1_J	El Chayal	671	6934	62	22	12	163	163	21	115	12
dw0117	2016_YAX161-1-1_K	El Chayal	792	7397	82	29	13	172	161	21	122	12
dw0118	2016_YAX161-1-1_L	El Chayal	606	6607	54	23	13	151	153	21	110	11
dw0119	2016_YAX161-1-1_M	El Chayal	650	7022	69	26	12	159	157	20	111	11
dw0120	2016_YAX161-1-1_N	El Chayal	580	6216	51	20	9	150	149	18	113	12
dw0121	2016_YAX161-1-1_O	El Chayal	597	7160	55	19	12	143	139	20	103	9
dw0122	2016_YAX161-1-1_P	El Chayal	504	5519	34	15	10	126	120	17	100	9
dw0123	2016_YAX161-1-1_Q	El Chayal	615	6174	60	14	14	136	125	19	102	11
dw0125	2016_YAX161-1-1_S	El Chayal	565	5993	54	18	10	141	135	19	106	10
dw0127	2016_YAX161-1-1_U	El Chayal	563	6403	53	20	7	157	143	16	115	11
dw0128	2016_YAX161-1-1_V	El Chayal	657	6646	43	23	11	156	151	22	114	12
dw0129	2016_YAX161-1-1_W	El Chayal	569	6917	53	23	13	152	141	21	113	9
dw0130	2016_YAX161-1-1_X	El Chayal	540	6405	73	25	11	151	146	20	110	10
dw0133	2016_YAX161-1-1a_A	El Chayal	495	7097	77	22	9	156	156	19	115	11
dw0134	2016_YAX161-1-2_A	El Chayal	749	6292	47	20	12	155	146	22	116	10
dw0135	2016_YAX161-1-2_B	El Chayal	561	5786	44	21	7	142	131	19	109	9
dw0136	2016_YAX161-1-2_C	El Chayal	627	6747	50	17	12	163	158	22	114	12
dw0137	2016_YAX161-1-2_D	El Chayal	660	6842	73	27	14	165	155	19	114	10
dw0138	2016_YAX161-1-2_E	El Chayal	583	6728	61	23	11	166	154	21	115	12
dw0139	2016_YAX161-1-2_F	El Chayal	751	7838	118	29	15	151	162	23	107	10
dw0140	2016_YAX161-1-2_G	El Chayal	816	7662	102	21	9	167	162	19	118	12
dw0141	2016_YAX161-1-2_H	El Chayal	670	7115	67	25	12	162	162	24	115	11
dw0142	2016_YAX161-1-2_I	El Chayal	627	6791	59	22	11	164	156	22	117	12
dw0143	2016_YAX161-1-2_J	El Chayal	681	6668	50	20	9	154	155	22	112	11
dw0144	2016_YAX161-1-2_K	El Chayal	709	7364	83	24	13	170	161	22	118	12
dw0145	2016_YAX161-1-2_L	El Chayal	579	6877	59	22	13	165	155	19	112	12
dw0146	2016_YAX161-1-2_M	El Chayal	662	6604	66	23	10	159	150	21	112	11
dw0147	2016_YAX161-1-2_N	El Chayal	617	6650	52	19	11	151	149	22	110	11
dw0148	2016_YAX161-1-2_O	El Chayal	538	6738	66	22	15	141	130	18	106	12
dw0149	2016_YAX161-1-2_P	El Chayal	573	5846	47	17	8	133	129	22	103	10
dw0150	2016_YAX161-1-2_Q	El Chayal	561	6819	55	21	8	159	154	24	112	11
dw0151	2016_YAX161-1-2_R	El Chayal	732	7339	65	22	14	159	155	20	113	12

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0152	2016_YAX161-1-2_S	El Chayal	761	6385	48	22	10	151	145	18	111	11
dw0154	2016_YAX161-1-2_U	El Chayal	635	8112	69	20	10	144	148	19	115	13
dw0156	2016_YAX161-1-2_W	El Chayal	849	8522	88	25	13	187	179	22	130	13
dw0157	2016_YAX161-1-2_X	El Chayal	665	7243	63	20	10	168	152	17	116	13
dw0158	2016_YAX161-1-2_Y	El Chayal	773	7943	101	27	10	168	161	23	117	11
dw0159	2016_YAX161-1-3_A	El Chayal	714	7876	96	24	13	150	158	24	115	13
dw0160	2016_YAX161-1-3_B	El Chayal	658	6261	54	20	13	148	141	17	110	11
dw0161	2016_YAX161-1-4_A	El Chayal	546	6299	59	16	12	151	153	21	109	11
dw0162	2016_YAX161-1-4_B	El Chayal	584	5851	39	19	11	141	137	18	106	10
dw0163	2016_YAX161-1-4_C	El Chayal	580	7105	68	19	12	157	149	23	113	11
dw0164	2016_YAX161-1-4_D	El Chayal	609	6261	48	22	8	152	143	19	114	10
dw0165	2016_YAX161-1-4_E	El Chayal	576	6577	64	25	12	152	151	20	116	12
dw0166	2016_YAX161-2-1_A	El Chayal	608	6297	60	16	11	139	130	19	101	10
dw0167	2016_YAX161-2-1_B	El Chayal	774	8771	97	25	18	176	165	24	116	15
dw0168	2016_YAX161-SF_A	El Chayal	610	6401	55	20	8	154	143	19	110	10
dw0169	2016_YAX161-SF_B	El Chayal	642	7112	112	19	8	147	142	15	100	10
dw0170	2016_YAX161-1-1_A	El Chayal	591	5888	59	16	10	145	137	18	105	10
dw0171	2016_YAX161-1-1_AA	El Chayal	652	6972	60	22	15	159	151	21	115	12
dw0172	2016_YAX161-1-1_AB	El Chayal	515	6206	54	27	11	151	140	20	109	11
dw0173	2016_YAX161-1-1_AC	El Chayal	547	5969	56	18	9	141	134	17	101	9
dw0174	2016_YAX161-1-1_AD	El Chayal	634	7069	47	26	15	170	159	22	121	12
dw0175	2016_YAX161-1-1_AE	El Chayal	740	7116	90	23	12	165	153	18	113	11
dw0176	2016_YAX161-1-1_AF	El Chayal	581	6688	62	20	13	156	154	22	112	10
dw0177	2016_YAX161-1-1_AG	El Chayal	638	7668	86	26	14	166	159	13	110	11
dw0178	2016_YAX161-1-1_AH	El Chayal	805	7505	94	24	12	152	153	21	107	9
dw0179	2016_YAX161-1-1_AI	El Chayal	634	6347	49	20	11	152	148	20	112	12
dw0180	2016_YAX161-1-1_AJ	El Chayal	651	6782	57	19	17	161	149	20	117	11
dw0181	2016_YAX161-1-1_AK	El Chayal	507	7083	95	24	12	152	147	20	107	15
dw0182	2016_YAX161-1-1_AL	El Chayal	711	7096	88	24	14	160	149	20	117	13
dw0185	2016_YAX161-1-1_AO	El Chayal	641	6864	57	21	10	164	151	20	121	13
dw0186	2016_YAX161-1-1_AP	El Chayal	571	6185	66	22	8	150	140	17	107	11
dw0187	2016_YAX161-1-1_AQ	El Chayal	628	6254	49	18	9	147	154	21	112	11
dw0188	2016_YAX161-1-1_AR	El Chayal	657	6714	54	23	13	160	155	21	115	11
dw0189	2016_YAX161-1-1_AS	El Chayal	630	6669	55	22	14	162	155	23	116	12
dw0190	2017_YAX161-2-1-1_A	El Chayal	635	7106	121	23	13	161	145	21	113	11
dw0191	2017_YAX161-N04W44-1-1_A	El Chayal	539	6471	77	18	14	126	118	18	102	8
dw0192	2017_YAX161-N04W44-1-1_B	El Chayal	577	6646	84	23	13	162	153	22	113	11
dw0194	2017_YAX161-N04W44-1-1_D	El Chayal	854	8742	131	23	10	175	165	23	113	12
dw0195	2017_YAX161-N04W44-2-1-A	El Chayal	649	7654	113	23	11	152	141	16	110	12
dw0198	2017_YAX161-N08W42-1-1_C	El Chayal	701	7558	75	19	9	158	153	20	118	11
dw0199	2017_YAX161-N08W42-1-1_D	El Chayal	517	6906	68	16	14	115	106	17	86	8
dw0200	2017_YAX161-N08W42-1-1_E	El Chayal	638	6715	66	23	10	152	154	22	113	12
dw0201	2017_YAX161-N12W44-1-1_A	El Chayal	697	10290	71	19	7	144	136	21	105	12
dw0202	2017_YAX161-N12W44-2-1_A	El Chayal	834	7900	91	24	13	173	163	20	115	13
dw0203	2017_YAX161-N16W42-1-1_A	El Chayal	795	14117	135	25	13	159	150	19	118	12

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0204	2017_YAX161-N26W34-1-2_A	El Chayal	661	6833	82	20	9	163	155	20	114	9
dw0206	2017_YAX161-N26W34-1-2_C	El Chayal	602	5923	52	12	13	119	112	17	92	10
dw0207	2017_YAX161-N26W66-1-1_A	El Chayal	875	7949	118	27	14	171	165	17	117	11
dw0208	2017_YAX161-N28W28-1-1_A	El Chayal	741	8200	112	23	14	163	160	20	119	14
dw0210	2017_YAX161-N28W28-1-1_C	El Chayal	733	7455	79	23	10	161	162	17	114	12
dw0211	2017_YAX161-N28W28-1-1_D	El Chayal	707	6683	77	14	11	147	153	19	108	11
dw0212	2017_YAX161-N28W32_1-1_A	El Chayal	970	8895	116	24	11	185	168	23	124	11
dw0213	2017_YAX161-N28W32_1-1_B	El Chayal	730	7589	101	24	11	180	162	20	115	12
dw0214	2017_YAX161-N28W32_A	El Chayal	707	7046	87	22	8	151	146	22	108	12
dw0215	2017_YAX161-N28W32-1-1_B	El Chayal	612	6120	82	23	10	149	137	20	110	11
dw0216	2017_YAX161-N28W32-1-1_C	El Chayal	548	6086	62	22	8	155	143	18	112	10
dw0218	2017_YAX161-N28W32-1-1_E	El Chayal	628	6920	75	22	8	155	154	21	113	11
dw0219	2017_YAX161-N28W32-1-1_F	El Chayal	670	6926	80	20	7	157	146	19	111	12
dw0220	2017_YAX161-N28W32-1-1_G	El Chayal	566	6528	59	20	14	152	151	22	109	11
dw0221	2017_YAX161-N28W32-1-1_H	El Chayal	722	7574	79	23	9	161	155	21	110	11
dw0222	2017_YAX161-N28W32-1-1_I	El Chayal	580	7705	110	25	15	173	162	18	112	12
dw0223	2017_YAX161-N28W32-1-1_J	El Chayal	746	7401	85	24	12	162	148	20	121	11
dw0224	2017_YAX161-N28W32-1-1_K	El Chayal	759	8078	135	23	15	155	146	21	110	12
dw0226	2017_YAX161-N30W36-1-1_B	El Chayal	555	5991	55	17	10	142	139	20	112	11
dw0227	2017_YAX161-N30W36-1-1_C	El Chayal	789	8055	116	28	13	164	167	19	117	13
dw0230	2017_YAX161-N30W36-1-1_F	El Chayal	608	7931	73	24	13	174	165	17	120	10
dw0231	2017_YAX161-N30W36-1-1_G	El Chayal	748	7519	86	26	8	166	163	23	114	12
dw0232	2017_YAX161-N30W36-1-1_H	El Chayal	584	6797	75	27	11	159	144	19	112	13
dw0233	2017_YAX161-N30W36-1-1_I	El Chayal	667	6809	70	21	11	161	153	22	108	13
dw0234	2017_YAX161-N30W36-1-1_J	El Chayal	668	8063	101	24	8	165	164	20	118	10
dw0235	2017_YAX161-N30W38-1-1_A	El Chayal	847	7981	106	26	15	167	164	18	120	10
dw0236	2017_YAX161-N30W38-1-1_B	El Chayal	686	7797	97	26	10	160	154	16	112	12
dw0237	2017_YAX161-N30W38-1-1_C	El Chayal	721	7074	64	21	15	162	155	21	115	10
dw0238	2017_YAX161-N30W38-1-1_D	El Chayal	590	7321	81	22	14	157	147	23	111	10
dw0239	2017_YAX161-N30W38-1-1_E	El Chayal	669	7666	95	25	11	164	159	20	116	13
dw0241	2017_YAX161-N30W38-1-1_G	El Chayal	615	6831	78	18	12	155	145	18	102	11
dw0242	2017_YAX161-N30W38-1-1_H	El Chayal	668	6805	63	18	15	148	138	19	109	10
dw0243	2017_YAX161-N30W38-1-1_I	El Chayal	759	7422	112	23	14	156	149	18	115	12
dw0244	2017_YAX161-N30W38-1-1_J	El Chayal	644	7447	83	19	11	161	153	19	111	11
dw0245	2017_YAX161-N30W38-1-1_K	El Chayal	625	7601	118	27	11	170	157	19	113	13
dw0246	2017_YAX161-N30W38-1-1_L	El Chayal	561	6929	64	20	8	153	147	15	109	11
dw0248	2017_YAX161-N30W38-1-1_O	El Chayal	552	7302	95	21	10	158	152	22	117	11
dw0249	2017_YAX161-N30W38-1-1_P	El Chayal	714	6320	63	21	8	157	150	22	113	13
dw0250	2017_YAX161-N30W38-1-1_Q	El Chayal	680	7458	78	24	15	172	158	21	119	11
dw0251	2017_YAX161-N30W38-1-1_R	El Chayal	786	7309	78	24	12	156	150	24	113	13
dw0252	2017_YAX161-N32W36-1-1_A	El Chayal	642	6956	85	20	10	147	147	18	114	12
dw0254	2017_YAX161-N32W36-1-1_C	El Chayal	739	7818	87	25	12	169	157	20	116	11
dw0255	2017_YAX161-N32W36-1-1_D	El Chayal	657	7219	84	18	10	156	154	20	111	11
dw0256	2017_YAX161-N32W36-1-1_E	El Chayal	591	7172	108	18	11	155	144	19	108	10
dw0257	2017_YAX161-N32W36-1-1_F	El Chayal	734	7625	129	22	10	170	149	20	121	12

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0258	2017_YAX161-N34W36-1-1_A	El Chayal	627	6666	53	19	12	150	140	18	110	10
dw0259	2017_YAX161-N34W36-1-1_B	El Chayal	683	7083	77	22	6	156	161	18	111	13
dw0261	2017_YAX161-N34W36-1-1_D	El Chayal	653	6824	75	20	8	161	148	22	117	10
dw0263	2017_YAX161-N34W36-1-1_F	El Chayal	634	6929	60	18	10	156	153	18	113	11
dw0264	2017_YAX161-N34W36-1-1_G	El Chayal	600	7266	80	22	12	149	141	20	112	10
dw0265	2017_YAX161-N34W36-1-1_H	El Chayal	727	6870	53	22	12	155	156	20	114	13
dw0267	2017_YAX161-N34W36-1-1_J	El Chayal	696	7196	67	23	12	157	151	18	116	12
dw0270	2017_YAX161-N34W38-1-1_B	El Chayal	775	7166	87	24	13	163	160	22	120	10
dw0271	2017_YAX161-N34W38-1-1_C	El Chayal	547	6177	66	21	11	143	141	20	106	12
dw0272	2017_YAX161-N36W36-1-1_A	El Chayal	742	7708	96	23	9	181	164	17	123	11
dw0273	2017_YAX161-N36W36-1-1_B	El Chayal	648	7273	89	25	13	166	158	25	120	11
dw0274	2017_YAX161-N36W36-1-1_C	El Chayal	456	6287	57	16	12	138	138	23	106	10
dw0275	2017_YAX161-N36W36-1-1_D	El Chayal	647	7826	104	25	12	152	148	21	120	14
dw0276	2017_YAX161-N36W36-1-1_E	El Chayal	521	6567	64	14	16	121	117	18	91	7
dw0277	2017_YAX161-S04W64-2-1_A	El Chayal	647	7525	124	22	16	171	164	15	116	13
dw0278	2017_YAX161-S04W72-1-1_A	El Chayal	646	6275	59	20	10	147	145	20	113	9
dw0279	2017_YAX161-S04W72-1-1_B	El Chayal	827	9054	145	22	12	162	143	20	104	10
dw0280	2017_YAX161-S04W72-1-1_C	El Chayal	657	6087	52	19	13	131	132	22	107	9
dw0281	2017_YAX161-S04W72-1-1_D	El Chayal	578	6396	74	16	8	147	133	20	107	9
dw0282	2017_YAX161-S04W72-1-1_E	El Chayal	705	8448	105	25	17	183	175	22	120	11
dw0283	2017_YAX161-S04W72-1-1_F	El Chayal	936	8389	159	27	10	183	170	22	116	11
dw0284	2017_YAX161-S04W72-1-1_G	El Chayal	643	6957	83	15	11	154	148	22	112	10
dw0285	2017_YAX161-S04W72-1-1_H	El Chayal	595	6603	56	21	13	156	151	23	117	10
dw0286	2017_YAX161-S04W72-1-1_I	El Chayal	611	6449	60	18	10	141	143	21	107	11
dw0287	2017_YAX161-S04W72-1-1_J	El Chayal	816	7954	112	29	14	168	153	20	116	11
dw0288	2017_YAX161-S04W72-2-1_A	El Chayal	778	7586	93	24	12	155	149	20	120	13
dw0289	2017_YAX161-S04W74-1-1_A	El Chayal	692	8301	89	25	17	187	170	20	117	11
dw0293	2017_YAX161-S06W62-1-1_A	El Chayal	611	6578	77	23	10	157	161	22	117	12
dw0294	2017_YAX161-S06W62-1-1_B	El Chayal	672	6915	78	20	12	166	157	18	117	11
dw0295	2017_YAX161-S06W62-1-1_C	El Chayal	592	5878	62	17	9	137	127	22	103	10
dw0296	2017_YAX161-S06W62-1-1_D	El Chayal	847	7373	127	22	8	166	154	21	109	12
dw0298	2017_YAX161-S06W62-1-1_F	El Chayal	683	7432	78	22	12	156	156	22	114	9
dw0299	2017_YAX161-S06W62-1-1_G	El Chayal	583	6505	58	19	13	148	148	19	113	11
dw0300	2017_YAX161-S06W62-1-1_H	El Chayal	590	6631	52	21	10	152	149	20	109	11
dw0301	2017_YAX161-S06W64-1-1_A	El Chayal	528	5979	51	20	13	139	133	18	107	11
dw0302	2017_YAX161-S06W64-1-1_B	El Chayal	612	6630	87	24	12	156	150	19	114	12
dw0303	2017_YAX161-S06W64-1-1_C	El Chayal	634	6729	87	21	10	155	145	19	114	12
dw0304	2017_YAX161-S06W64-1-1_D	El Chayal	571	7222	68	21	12	137	138	17	111	11
dw0305	2017_YAX161-S06W64-1-1_E	El Chayal	739	7485	95	20	12	161	150	18	115	12
dw0306	2017_YAX161-S06W64-1-1_F	El Chayal	617	6469	58	21	14	149	152	21	110	10
dw0307	2017_YAX161-S06W64-1-1_G	El Chayal	677	6714	78	22	10	155	150	19	113	10
dw0309	2017_YAX161-S06W64-1-1_I	El Chayal	744	7233	82	25	15	163	151	26	116	11
dw0310	2017_YAX161-S06W66-1-1_A	El Chayal	534	6577	68	19	10	150	138	19	108	12
dw0311	2017_YAX161-S06W66-1-1_B	El Chayal	618	6542	79	18	12	150	148	18	109	11
dw0312	2017_YAX161-S06W66-1-1_C	El Chayal	618	6318	63	17	13	152	148	21	110	10

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0314	2017_YAX161-S06W66-1-1_E	El Chayal	671	6970	77	19	12	161	151	20	119	13
dw0315	2017_YAX161-S06W66-1-1_F	El Chayal	702	7270	91	25	13	169	154	17	119	14
dw0316	2017_YAX161-S06W66-1-1_G	El Chayal	602	6435	83	19	11	151	152	20	118	10
dw0317	2017_YAX161-S06W66-1-1_H	El Chayal	626	6865	76	21	12	157	155	20	116	12
dw0318	2017_YAX161-S06W66-1-1_I	El Chayal	452	5923	43	20	7	146	139	20	111	10
dw0319	2017_YAX161-S06W68-1-1_A	El Chayal	830	8030	187	22	10	153	146	15	106	11
dw0320	2017_YAX161-S06W68-1-1_B	El Chayal	698	7632	120	24	7	162	156	23	115	11
dw0322	2017_YAX161-S06W68-1-1_D	El Chayal	616	6497	77	18	12	144	135	20	106	9
dw0323	2017_YAX161-S06W68-1-1_E	El Chayal	555	6838	86	23	12	162	157	20	114	10
dw0324	2017_YAX161-S06W68-1-1_F	El Chayal	658	6920	85	23	10	165	148	20	113	11
dw0325	2017_YAX161-S06W68-1-1_G	El Chayal	567	6061	60	18	14	137	138	18	110	9
dw0327	2017_YAX161-S06W68-1-1_I	El Chayal	851	7882	124	27	14	159	160	20	120	10
dw0328	2017_YAX161-S06W68-1-1_J	El Chayal	787	8194	106	20	9	175	159	21	119	11
dw0329	2017_YAX161-S06W68-1-1_K	El Chayal	564	6601	70	22	10	151	148	21	109	10
dw0330	2017_YAX161-S06W72-1-1_A	El Chayal	747	6588	69	23	12	152	140	20	111	11
dw0331	2017_YAX161-S06W72-1-1_B	El Chayal	649	7667	71	19	13	169	162	22	118	11
dw0333	2017_YAX161-S06W74-1-1_B	El Chayal	683	8012	105	24	10	170	154	20	118	11
dw0334	2017_YAX161-S06W74-1-1_C	El Chayal	631	6586	57	20	10	153	145	22	113	11
dw0335	2017_YAX161-S06W76-1-1_A	El Chayal	798	6956	62	25	14	161	154	18	113	9
dw0337	2017_YAX161-S06W76-1-1_C	El Chayal	607	6226	70	19	6	151	148	19	109	11
dw0340	2017_YAX161-S06W76-1-1_F	El Chayal	570	7100	84	26	13	161	157	23	116	10
dw0341	2017_YAX161-S06W76-1-1_G	El Chayal	709	7920	80	24	13	164	164	19	123	14
dw0342	2017_YAX161-S06W76-1-1_H	El Chayal	631	7054	77	21	14	160	152	22	116	11
dw0344	2017_YAX161-S06W78-1-1_B	El Chayal	810	8817	171	28	15	169	162	23	122	10
dw0345	2017_YAX161-S06W78-1-1_C	El Chayal	584	5885	74	16	9	152	140	18	106	10
dw0346	2017_YAX161-S06W78-1-1_D	El Chayal	749	7546	105	23	15	167	162	20	116	11
dw0347	2017_YAX161-S06W78-1-1_E	El Chayal	689	7451	99	23	10	156	151	22	118	11
dw0348	2017_YAX161-S06W78-1-1_F	El Chayal	648	6036	59	20	11	148	145	20	110	10
dw0349	2017_YAX161-S06W78-1-1_G	El Chayal	622	6369	66	22	14	148	143	20	109	10
dw0350	2017_YAX161-S06W78-1-1_H	El Chayal	561	6499	66	20	15	153	147	18	112	11
dw0352	2017_YAX161-S08W66-1-1_A	El Chayal	583	6168	60	20	9	150	140	19	106	10
dw0353	2017_YAX161-S08W72-1-1_A	El Chayal	648	6214	55	20	10	149	143	17	114	9
dw0354	2017_YAX161-S08W72-1-1_B	El Chayal	573	6229	52	18	9	153	143	17	113	11
dw0355	2017_YAX161-S08W72-1-1_C	El Chayal	644	8380	135	25	8	153	155	20	106	10
dw0357	2017_YAX161-S08W78-1-1_A	El Chayal	628	6648	83	22	14	155	153	21	119	12
dw0358	2017_YAX161-S08W78-1-1_B	El Chayal	748	7948	106	26	13	169	173	21	118	10
dw0359	2017_YAX161-S08W78-1-1_C	El Chayal	703	6937	86	21	12	162	148	19	117	11
dw0360	2017_YAX161-S08W78-1-1_D	El Chayal	560	6332	60	19	9	146	144	20	106	9
dw0363	2017_YAX161-S10W56-2-1_A	El Chayal	738	8999	128	29	13	172	155	21	120	13
dw0364	2017_YAX161-S10W58-1-1_A	El Chayal	713	8641	153	25	13	162	154	17	108	11
dw0365	2017_YAX161-S10W58-1-1_B	El Chayal	589	6465	73	21	9	148	150	22	112	12
dw0366	2017_YAX161-S10W58-2-1_A	El Chayal	619	7090	75	22	8	164	164	24	114	7
dw0367	2017_YAX161-S10W60-1-1_A	El Chayal	711	7195	104	21	13	162	166	21	120	13
dw0368	2017_YAX161-S10W74-1-1_A	El Chayal	589	6661	72	21	10	156	151	19	112	11
dw0369	2017_YAX161-S10W74-1-1_B	El Chayal	745	7631	110	23	10	164	161	16	117	12
dw0370	2017_YAX161-S10W74-1-1_C	El Chayal	662	6167	88	15	13	145	134	23	107	10

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0372	2017_YAX161-S10W74-1-1_E	El Chayal	615	6871	68	24	10	162	153	18	118	9
dw0373	2017_YAX161-S10W74-1-1_F	El Chayal	625	7503	103	25	15	155	154	20	115	11
dw0374	2017_YAX161-S10W82-1-1_A	El Chayal	646	7821	128	23	13	147	141	17	111	11
dw0375	2017_YAX161-S10W82-1-1_B	El Chayal	667	7199	94	24	12	165	149	20	118	11
dw0376	2017_YAX161-S10W82-1-1_C	El Chayal	625	6353	78	20	12	138	143	25	108	11
dw0377	2017_YAX161-S10W82-1-1_D	El Chayal	803	7643	84	19	11	151	159	23	118	10
dw0378	2017_YAX161-S10W82-1-1_E	El Chayal	604	7321	109	21	11	163	159	20	118	11
dw0379	2017_YAX161-S10W82-1-1_F	El Chayal	683	7060	80	23	8	153	153	23	113	10
dw0380	2017_YAX161-S10W84-1-1_A	El Chayal	518	6599	67	18	13	153	151	22	111	9
dw0381	2017_YAX161-S10W84-1-1_B	El Chayal	709	8130	106	24	12	155	146	18	105	12
dw0382	2017_YAX161-S10W84-1-1_C	El Chayal	795	8326	111	21	14	156	154	21	111	10
dw0383	2017_YAX161-S10W84-1-1_D	El Chayal	629	7128	92	20	13	163	147	17	113	11
dw0384	2017_YAX161-S10W84-1-1_E	El Chayal	557	6556	73	23	11	144	147	23	114	10
dw0385	2017_YAX161-S12W56-1-1_A	El Chayal	542	7754	114	25	10	156	144	16	112	11
dw0386	2017_YAX161-S12W56-1-1_B	El Chayal	638	7303	77	23	12	160	153	19	121	12
dw0387	2017_YAX161-S12W56-1-1_C	El Chayal	685	7067	79	18	10	161	148	19	114	11
dw0388	2017_YAX161-S12W56-2-2_A	El Chayal	683	6795	86	22	10	154	148	20	111	10
dw0389	2017_YAX161-S12W64-1-2_A	El Chayal	502	6213	61	16	12	158	143	20	110	11
dw0390	2017_YAX161-S12W64-2-1_A	El Chayal	555	5622	49	16	9	140	131	19	108	9
dw0391	2017_YAX161-S12W64-2-1_B	El Chayal	794	7814	89	23	14	178	151	18	125	13
dw0392	2017_YAX161-S12W64-2-1_C	El Chayal	633	6984	67	21	12	122	118	20	94	10
dw0393	2017_YAX161-S12W64-2-1_D	El Chayal	732	7651	125	22	12	163	157	21	113	11
dw0394	2017_YAX161-S12W64-2-1_E	El Chayal	605	6723	81	22	12	154	156	23	115	13
dw0395	2017_YAX161-S12W64-2-1_F	El Chayal	592	7610	122	20	17	160	157	21	115	10
dw0396	2017_YAX161-S12W64-2-1_G	El Chayal	517	6686	66	23	9	153	142	21	112	11
dw0397	2017_YAX161-S12W64-2-1_H	El Chayal	499	5538	59	19	12	139	127	17	101	11
dw0398	2017_YAX161-S12W64-2-1_I	El Chayal	744	8369	144	19	11	165	156	20	110	9
dw0399	2017_YAX161-S12W66-1-2_A	El Chayal	663	6975	63	22	10	158	165	21	110	12
dw0400	2017_YAX161-S12W66-1-2_B	El Chayal	953	8449	117	24	13	177	164	20	120	11
dw0401	2017_YAX161-S12W66-2-2_A	El Chayal	665	7295	89	21	15	168	157	18	119	12
dw0402	2017_YAX161-S12W66-2-2_B	El Chayal	559	6745	73	20	11	157	151	23	115	10
dw0403	2017_YAX161-S12W66-2-2_C	El Chayal	596	7044	64	28	11	161	153	19	118	13
dw0404	2017_YAX161-S12W68-1-1_A	El Chayal	689	6971	74	25	9	152	151	19	110	11
dw0405	2017_YAX161-S12W68-1-1_B	El Chayal	645	6278	73	23	12	151	140	22	112	11
dw0406	2017_YAX161-S12W68-1-1_C	El Chayal	524	6711	75	22	12	154	152	18	119	10
dw0407	2017_YAX161-S12W68-1-1_D	El Chayal	625	7307	82	23	11	165	157	23	119	9
dw0408	2017_YAX161-S12W72-1-1_A	El Chayal	866	8054	108	25	13	172	163	25	122	11
dw0409	2017_YAX161-S12W72-1-1_B	El Chayal	728	7512	109	22	13	153	154	20	106	11
dw0411	2017_YAX161-S12W80-1-1_B	El Chayal	570	6109	63	21	8	146	146	18	115	10
dw0412	2017_YAX161-S12W80-1-1_C	El Chayal	650	6745	64	22	6	160	148	19	114	11
dw0413	2017_YAX161-S12W80-1-1_D	El Chayal	752	7256	107	22	12	151	152	21	112	11
dw0414	2017_YAX161-S12W84-2-1_A	El Chayal	679	6909	109	28	11	153	146	19	110	11
dw0415	2017_YAX161-S12W86-1-1_A	El Chayal	759	6950	78	24	9	157	148	23	111	10
dw0416	2017_YAX161-S12W86-1-1_B	El Chayal	608	6123	68	19	5	147	141	24	113	12
dw0417	2017_YAX161-S12W86-1-1_C	El Chayal	624	6361	69	20	11	141	141	19	108	11
dw0418	2017_YAX161-S12W86-1-1_D	El Chayal	641	6923	59	21	10	159	156	18	111	12
dw0419	2017_YAX161-S12W86-1-1_E	El Chayal	731	7433	92	24	16	168	155	22	122	12

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0421	2017_YAX161-S12W86-2-1_A	El Chayal	654	6640	69	21	10	152	145	21	116	13
dw0422	2017_YAX161-S12W86-3-1_A	El Chayal	750	7526	133	26	12	160	157	22	112	12
dw0423	2017_YAX161-S12W86-3-1_B	El Chayal	676	6672	112	22	12	140	126	20	105	8
dw0424	2017_YAX161-S12W86-3-1_C	El Chayal	745	7964	118	28	10	163	154	24	114	10
dw0426	2017_YAX161-S14W52-1-1_B	El Chayal	620	6287	63	23	6	155	146	23	117	12
dw0427	2017_YAX161-S14W56-1-1_A	El Chayal	589	7112	159	22	11	135	141	21	99	10
dw0428	2017_YAX161-S14W56-2-1_A	El Chayal	728	6769	64	23	10	163	154	19	116	13
dw0429	2017_YAX161-S14W58-1-1_A	El Chayal	423	6109	56	21	8	148	137	19	113	11
dw0430	2017_YAX161-S14W62-1-1_A	El Chayal	574	6713	77	18	10	152	152	20	115	11
dw0431	2017_YAX161-S14W62-1-1_B	El Chayal	796	7905	127	25	7	170	172	22	123	11
dw0432	2017_YAX161-S14W62-1-1_C	El Chayal	914	8683	153	26	15	180	171	19	122	13
dw0433	2017_YAX161-S14W62-2-1_A	El Chayal	567	5881	62	19	8	145	143	20	103	9
dw0434	2017_YAX161-S14W62-3-1_A	El Chayal	649	5926	72	17	15	142	145	19	109	10
dw0435	2017_YAX161-S14W62-5-1_A	El Chayal	742	7755	100	27	9	166	153	19	119	12
dw0436	2017_YAX161-S14W62-5-1_B	El Chayal	934	8314	124	30	10	175	160	20	116	15
dw0438	2017_YAX161-S14W64-1-1_B	El Chayal	611	6067	65	18	10	152	142	17	112	11
dw0439	2017_YAX161-S14W64-2-1_A	El Chayal	553	6594	68	19	10	152	144	19	114	12
dw0440	2017_YAX161-S14W66-3-1_A	El Chayal	667	7593	99	22	11	168	156	22	123	12
dw0441	2017_YAX161-S14W66-3-1_B	El Chayal	721	6937	87	23	12	161	154	19	119	12
dw0442	2017_YAX161-S14W66-4-1_A	El Chayal	677	7007	101	23	12	156	148	19	108	11
dw0443	2017_YAX161-S14W66-5-1_A	El Chayal	686	7198	78	21	13	165	153	21	116	10
dw0444	2017_YAX161-S14W68-1-1_A	El Chayal	516	6020	56	19	9	147	142	18	109	12
dw0445	2017_YAX161-S14W74-1-1_A	El Chayal	1091	9773	170	28	9	177	157	21	111	11
dw0446	2017_YAX161-S14W74-1-1_B	El Chayal	642	6631	65	22	12	151	143	20	111	10
dw0447	2017_YAX161-S14W74-1-1_C	El Chayal	684	6725	70	22	14	157	153	21	109	10
dw0448	2017_YAX161-S14W74-1-1_D	El Chayal	670	7492	91	23	10	169	161	20	115	12
dw0449	2017_YAX161-S14W74-1-1_E	El Chayal	720	6610	86	17	11	148	141	20	109	9
dw0451	2017_YAX161-S14W74-1-1_G	El Chayal	646	6270	70	18	10	148	146	19	116	11
dw0452	2017_YAX161-S14W76-2-1_A	El Chayal	699	5744	53	14	12	113	100	15	83	8
dw0453	2017_YAX161-S14W76-2-1_B	El Chayal	717	7635	95	26	10	163	162	24	117	12
dw0454	2017_YAX161-S14W82-1-1_A	El Chayal	823	8471	105	26	13	185	177	21	122	12
dw0455	2017_YAX161-S14W82-1-1_B	El Chayal	818	7439	93	28	9	164	154	19	117	11
dw0456	2017_YAX161-S14W82-1-1_C	El Chayal	468	5895	78	20	10	135	133	17	100	9
dw0457	2017_YAX161-S14W82-1-1_D	El Chayal	714	6369	62	21	9	134	129	20	105	8
dw0458	2017_YAX161-S14W82-1-1_E	El Chayal	720	7300	78	22	9	158	158	22	115	12
dw0459	2017_YAX161-S14W84-1-1_A	El Chayal	564	6810	73	22	12	159	152	22	112	13
dw0460	2017_YAX161-S14W84-1-1_B	El Chayal	630	7337	86	21	13	167	161	20	115	13
dw0461	2017_YAX161-S14W84-1-1_C	El Chayal	624	7159	67	16	12	144	146	22	106	10
dw0462	2017_YAX161-S14W84-1-1_D	El Chayal	679	7227	87	26	12	166	159	21	116	12
dw0463	2017_YAX161-S14W84-1-1_E	El Chayal	664	7460	100	19	11	163	158	17	110	11
dw0464	2017_YAX161-S14W84-1-1_F	El Chayal	643	7298	132	24	13	162	142	16	110	10
dw0465	2017_YAX161-S16W60-1-1_A	El Chayal	477	6131	61	15	10	150	144	18	108	11
dw0466	2017_YAX161-S16W60-1-1_B	El Chayal	636	6771	89	21	10	158	149	20	113	11
dw0467	2017_YAX161-S16W60-1-1_C	El Chayal	518	5990	45	22	10	143	139	18	108	9
dw0468	2017_YAX161-S16W62-2-1_A	El Chayal	544	5826	74	19	11	146	148	22	110	11
dw0469	2017_YAX161-S16W64-1-2_A	El Chayal	751	7615	100	23	15	170	167	18	120	13
dw0470	2017_YAX161-S16W64-1-2_B	El Chayal	736	7302	95	20	11	169	158	20	119	13

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0471	2017_YAX161-S16W64-2-2_A	El Chayal	718	7275	89	22	13	165	159	21	111	12
dw0472	2017_YAX161-S16W64-2-2_B	El Chayal	846	7871	106	23	15	170	163	24	121	10
dw0474	2017_YAX161-S16W66-2-2_A	El Chayal	687	6710	75	22	16	158	155	19	116	11
dw0477	2017_YAX161-S16W80-1-1_A	El Chayal	681	6664	62	21	12	153	146	18	112	11
dw0478	2017_YAX161-S16W80-1-1_B	El Chayal	615	6317	74	23	11	148	143	20	112	10
dw0479	2017_YAX161-S16W80-1-1_C	El Chayal	557	6618	62	21	11	154	149	21	113	11
dw0480	2017_YAX161-S16W80-1-1_D	El Chayal	644	7106	99	24	10	157	153	20	117	10
dw0481	2017_YAX161-S16W80-1-1-D	El Chayal	701	6907	92	19	12	161	157	21	114	11
dw0482	2017_YAX161-S16W82-1-1_A	El Chayal	657	6617	105	22	9	152	143	17	105	10
dw0483	2017_YAX161-S16W82-1-1_B	El Chayal	636	6820	81	21	9	159	155	17	109	11
dw0484	2017_YAX161-S16W82-1-1_C	El Chayal	662	7070	86	25	12	163	152	21	118	11
dw0485	2017_YAX161-S16W82-1-1_D	El Chayal	646	7372	58	18	17	130	125	21	99	10
dw0486	2017_YAX161-S16W82-1-1_E	El Chayal	712	7504	102	26	10	170	153	19	115	11
dw0487	2017_YAX161-S16W84-1-1_A	El Chayal	628	6600	65	21	11	156	152	20	113	9
dw0488	2017_YAX161-S16W84-1-1_B	El Chayal	765	7775	112	23	11	170	152	25	113	9
dw0490	2017_YAX161-S16W84-1-1_D	El Chayal	796	7754	99	27	13	167	159	21	118	11
dw0491	2017_YAX161-S16W84-1-1_E	El Chayal	820	8382	109	26	8	191	176	20	128	14
dw0492	2017_YAX161-S16W84-1-1_F	El Chayal	598	6234	60	19	9	152	143	14	108	10
dw0493	2017_YAX161-S16W84-1-1_G	El Chayal	604	7416	98	22	11	161	159	23	119	10
dw0494	2017_YAX161-S16W84-1-1_H	El Chayal	672	6978	74	22	13	155	148	21	119	13
dw0495	2017_YAX161-S16W84-1-1_I	El Chayal	715	7829	114	24	9	174	157	17	116	12
dw0496	2017_YAX161-S16W84-1-1_J	El Chayal	665	6633	67	14	13	111	106	19	87	10
dw0497	2017_YAX161-S16W84-1-1_K	El Chayal	536	6499	70	23	11	149	141	21	110	11
dw0498	2017_YAX161-S16W84-1-1_L	El Chayal	559	6339	70	22	12	154	146	22	111	10
dw0501	2017_YAX161-S18W52-1-1_B	El Chayal	694	6094	56	19	12	144	139	20	110	10
dw0502	2017_YAX161-S18W52-1-1_C	El Chayal	731	8029	128	28	13	161	163	18	116	15
dw0503	2017_YAX161-S18W52-1-1_D	El Chayal	698	7215	73	29	12	166	160	24	117	11
dw0505	2017_YAX161-S18W62-1-1_B	El Chayal	553	7085	71	23	13	160	157	23	117	11
dw0506	2017_YAX161-S18W62-1-1_C	El Chayal	693	6652	71	21	13	152	146	21	113	12
dw0507	2017_YAX161-S18W62-1-1_D	El Chayal	585	6455	60	22	13	153	152	22	113	12
dw0508	2017_YAX161-S18W62-1-1_E	El Chayal	644	7049	97	22	16	164	149	19	120	11
dw0509	2017_YAX161-S18W62-2-1_A	El Chayal	693	6578	70	19	10	148	142	19	112	11
dw0510	2017_YAX161-S18W66-1-1_A	El Chayal	484	6547	79	18	6	141	134	16	108	9
dw0511	2017_YAX161-S18W66-1-1_B	El Chayal	557	5918	50	21	8	137	138	19	108	9
dw0512	2017_YAX161-S18W66-1-1_C	El Chayal	700	7224	71	21	16	169	154	20	117	12
dw0513	2017_YAX161-S18W66-1-1_D	El Chayal	664	7059	68	20	9	159	156	24	117	12
dw0514	2017_YAX161-S18W68-1-1_A	El Chayal	699	6441	64	21	7	152	148	19	109	12
dw0515	2017_YAX161-S18W82-1-1_A	El Chayal	594	6619	73	24	8	162	148	21	108	12
dw0516	2017_YAX161-S18W82-1-1_B	El Chayal	592	6280	52	20	9	142	146	22	109	8
dw0517	2017_YAX161-S18W82-1-1_C	El Chayal	646	6328	46	22	12	152	147	22	114	11
dw0518	2017_YAX161-S18W82-1-1_D	El Chayal	549	5798	58	21	9	143	130	19	110	11
dw0519	2017_YAX161-S18W82-1-1_E	El Chayal	762	7882	121	24	16	169	159	18	125	11
dw0520	2017_YAX161-S18W82-1-1_F	El Chayal	615	6434	57	17	10	150	142	20	110	8
dw0521	2017_YAX161-S18W82-1-1_G	El Chayal	676	7880	110	25	9	151	149	19	117	12
dw0522	2017_YAX161-S18W82-1-1_H	El Chayal	500	6262	70	25	12	158	146	17	113	12
dw0523	2017_YAX161-S18W82-1-1_I	El Chayal	945	9124	174	27	21	173	158	23	118	11

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0524	2017_YAX161-S18W82-1-1_J	El Chayal	616	6154	59	25	11	143	139	19	108	9
dw0525	2017_YAX161-S18W84-1-1_A	El Chayal	604	6769	67	23	14	149	146	19	112	11
dw0526	2017_YAX161-S18W84-1-1_B	El Chayal	552	7245	68	23	12	164	153	21	116	11
dw0527	2017_YAX161-S18W84-1-1_C	El Chayal	687	5944	69	21	11	145	137	17	108	11
dw0528	2017_YAX161-S18W84-1-1_D	El Chayal	720	7380	100	21	11	166	147	24	117	11
dw0529	2017_YAX161-S18W84-1-1_E	El Chayal	573	8181	140	28	14	158	156	28	116	12
dw0530	2017_YAX161-S18W84-1-1_F	El Chayal	543	6300	61	19	11	150	146	21	108	10
dw0531	2017_YAX161-S18W84-1-1_G	El Chayal	610	6240	50	20	9	148	136	22	113	11
dw0532	2017_YAX161-S18W84-1-1_H	El Chayal	577	6914	94	22	9	152	147	19	113	10
dw0533	2017_YAX161-S18W84-1-1_I	El Chayal	646	9961	163	18	8	153	143	17	97	9
dw0534	2017_YAX161-S18W84-1-1_J	El Chayal	597	7381	62	19	13	137	119	20	98	9
dw0535	2017_YAX161-S18W84-1-1_K	El Chayal	610	6923	72	23	10	161	162	21	125	10
dw0536	2017_YAX161-S20W52-1-1_A	El Chayal	599	6720	68	23	14	152	148	20	111	12
dw0537	2017_YAX161-S20W52-1-1_B	El Chayal	856	7731	208	26	13	145	140	13	107	11
dw0540	2017_YAX161-S20W52-1-1_E	El Chayal	639	6947	85	21	11	155	146	18	113	10
dw0541	2017_YAX161-S20W52-3-1_A	El Chayal	733	7653	79	25	12	161	157	20	115	10
dw0542	2017_YAX161-S20W62-1-1_A	El Chayal	596	6441	66	20	8	150	152	20	111	12
dw0543	2017_YAX161-S20W62-1-1_B	El Chayal	614	6638	75	18	11	152	145	19	107	12
dw0544	2017_YAX161-S20W62-1-1_C	El Chayal	640	7006	75	25	10	160	149	21	115	12
dw0545	2017_YAX161-S20W62-1-1_D	El Chayal	645	7236	84	26	13	160	161	21	117	11
dw0546	2017_YAX161-S20W62-3-1_A	El Chayal	612	6745	66	26	8	156	148	20	112	11
dw0547	2017_YAX161-S20W62-4-1_A	El Chayal	687	6857	88	24	14	160	150	20	116	11
dw0548	2017_YAX161-S20W62-5-1_A	El Chayal	656	7106	102	25	9	166	149	18	112	11
dw0549	2017_YAX161-S20W62-5-1_B	El Chayal	557	7085	89	23	9	166	158	24	124	10
dw0550	2017_YAX161-S20W66-1-1_A	El Chayal	649	6908	83	22	15	158	143	18	116	10
dw0551	2017_YAX161-S20W66-1-1_B	El Chayal	695	6609	84	20	12	151	142	18	110	8
dw0552	2017_YAX161-S20W66-1-1_C	El Chayal	725	6750	70	19	11	166	150	18	118	11
dw0553	2017_YAX161-S20W66-1-1_D	El Chayal	584	6396	75	14	13	113	103	17	86	8
dw0555	2017_YAX161-S20W66-1-1_F	El Chayal	1114	9186	134	26	11	187	176	23	118	14
dw0556	2017_YAX161-S20W66-2-1_A	El Chayal	811	7316	137	20	17	147	152	22	109	11
dw0557	2017_YAX161-S20W66-2-1_B	El Chayal	780	8607	102	27	11	176	174	24	123	12
dw0558	2017_YAX161-S20W68-1-1_A	El Chayal	820	6903	70	24	10	158	144	20	116	12
dw0559	2017_YAX161-S20W68-1-1_B	El Chayal	650	6248	84	20	12	137	135	17	102	11
dw0560	2017_YAX161-S20W68-1-1_C	El Chayal	588	6489	59	18	12	150	151	21	112	9
dw0561	2017_YAX161-S20W68-1-1_D	El Chayal	670	6846	78	22	10	155	141	18	111	11
dw0562	2017_YAX161-S20W68-1-1_E	El Chayal	605	6443	48	21	8	142	146	22	110	10
dw0563	2017_YAX161-S20W68-1-1_F	El Chayal	720	6669	73	20	10	155	147	17	115	11
dw0565	2017_YAX161-S20W68-1-1_H	El Chayal	622	6974	104	23	11	157	158	22	116	10
dw0566	2017_YAX161-S20W68-1-1_I	El Chayal	637	8263	112	23	12	170	162	22	120	10
dw0567	2017_YAX161-S20W68-2-1_A	El Chayal	560	6879	69	19	12	154	149	16	112	11
dw0568	2017_YAX161-S20W68-2-1_B	El Chayal	691	7003	79	27	12	164	153	21	118	10
dw0569	2017_YAX161-S20W68-2-1_C	El Chayal	716	8039	127	22	13	166	162	24	116	13
dw0570	2017_YAX161-S20W68-2-1_D	El Chayal	653	6438	70	12	11	117	106	20	94	12
dw0572	2017_YAX161-S20W72-2-1_B	El Chayal	743	8071	103	21	11	165	154	16	115	11
dw0574	2017_YAX161-S20W74-1-1_B	El Chayal	664	7390	68	25	14	158	160	24	112	10
dw0575	2017_YAX161-S20W74-1-1_C	El Chayal	736	7195	89	23	10	157	156	19	113	12

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0576	2017_YAX161-S20W74-1-1_D	El Chayal	606	5601	46	14	10	106	104	16	87	7
dw0577	2017_YAX161-S20W74-1-1_E	El Chayal	744	7552	138	23	15	153	152	20	106	10
dw0578	2017_YAX161-S20W74-2-1_A	El Chayal	634	6689	74	18	13	154	149	16	105	12
dw0579	2017_YAX161-S20W76-1-1_A	El Chayal	720	7282	86	25	11	160	152	22	113	11
dw0580	2017_YAX161-S20W76-1-1_B	El Chayal	701	6701	61	23	11	157	153	19	110	12
dw0581	2017_YAX161-S20W76-1-1_C	El Chayal	741	7190	81	22	7	154	148	18	109	11
dw0582	2017_YAX161-S20W76-1-1_D	El Chayal	445	6639	173	24	11	130	135	19	96	6
dw0584	2017_YAX161-S20W76-1-1_F	El Chayal	635	7166	200	27	7	141	133	18	99	11
dw0585	2017_YAX161-S20W76-1-1_G	El Chayal	745	7861	189	14	19	124	105	20	79	10
dw0586	2017_YAX161-S20W76-1-1_H	El Chayal	740	6981	60	23	13	150	148	20	116	11
dw0587	2017_YAX161-S20W76-2-1_A	El Chayal	545	5395	82	14	10	126	123	18	99	9
dw0588	2017_YAX161-S20W76-3-1_A	El Chayal	685	7230	85	24	13	162	152	21	113	10
dw0591	2017_YAX161-S20W78-2-1_E	El Chayal	718	6829	57	21	13	155	148	18	114	10
dw0593	2017_YAX161-S22W54-3-1_B	El Chayal	762	7711	77	26	9	170	160	18	122	13
dw0594	2017_YAX161-S22W58-1-2_A	El Chayal	770	7514	82	21	12	166	161	19	115	13
dw0595	2017_YAX161-S22W58-1-2_B	El Chayal	552	6069	54	22	12	147	138	22	114	10
dw0596	2017_YAX161-S22W60-1-1_A	El Chayal	655	7786	121	27	8	158	155	20	121	8
dw0597	2017_YAX161-S22W64-1-1_A	El Chayal	672	7379	71	23	8	169	165	21	119	14
dw0598	2017_YAX161-S22W64-1-1_B	El Chayal	701	8455	102	20	12	173	161	21	119	12
dw0599	2017_YAX161-S22W64-1-1_C	El Chayal	909	8286	140	25	12	163	156	20	115	9
dw0600	2017_YAX161-S22W66-1-1_A	El Chayal	747	7955	122	22	10	175	159	18	113	12
dw0601	2017_YAX161-S22W66-1-1_B	El Chayal	752	8393	96	26	8	176	169	24	114	11
dw0602	2017_YAX161-S22W66-1-1_C	El Chayal	738	6830	80	24	11	158	150	23	112	9
dw0603	2017_YAX161-S22W66-2-1_B	El Chayal	641	6574	65	22	7	152	152	23	121	12
dw0604	2017_YAX161-S22W66-2-2_A	El Chayal	804	7299	101	24	14	161	160	25	113	10
dw0605	2017_YAX161-S22W72-1-1_A	El Chayal	598	7029	77	20	15	166	155	17	111	9
dw0607	2017_YAX161-S22W76-2-1_B	El Chayal	752	8186	131	27	13	178	166	21	116	9
dw0608	2017_YAX161-S22W76-2-1_C	El Chayal	534	6398	62	22	11	142	138	20	105	9
dw0609	2017_YAX161-S22W76-2-1_D	El Chayal	725	7526	112	24	10	165	160	20	117	11
dw0610	2017_YAX161-S22W78-1-1_A	El Chayal	813	8232	104	24	14	176	161	20	119	15
dw0611	2017_YAX161-S22W78-1-1_B	El Chayal	635	6681	64	19	12	149	140	21	112	11
dw0613	2017_YAX161-S22W78-1-1_D	El Chayal	631	7352	78	25	12	157	150	20	120	11
dw0614	2017_YAX161-S22W78-1-1_E	El Chayal	668	6970	92	19	12	151	145	17	109	9
dw0616	2017_YAX161-S22W78-1-1_G	El Chayal	755	7746	98	28	14	163	152	21	116	10
dw0617	2017_YAX161-S22W78-1-1_H	El Chayal	837	7369	93	21	11	173	149	22	121	10
dw0618	2017_YAX161-S22W78-1-1_I	El Chayal	717	6676	72	16	16	123	115	17	90	9
dw0619	2017_YAX161-S22W78-1-1_J	El Chayal	597	6036	63	12	11	115	107	17	88	7
dw0620	2017_YAX161-S22W78-1-1_K	El Chayal	667	6488	75	24	10	154	146	22	111	11
dw0621	2017_YAX161-S22W78-1-1_L	El Chayal	669	7292	86	24	12	161	157	20	115	12
dw0622	2017_YAX161-S22W78-1-1_M	El Chayal	639	7021	107	25	11	156	152	18	121	12
dw0623	2017_YAX161-S22W78-1-1_N	El Chayal	730	6775	85	20	5	159	148	20	116	12
dw0624	2017_YAX161-S22W78-1-1_O	El Chayal	814	9271	168	33	11	172	166	21	120	13
dw0625	2017_YAX161-S22W78-1-1_P	El Chayal	622	6582	90	23	12	150	152	19	110	11
dw0626	2017_YAX161-S24W54-1-1_A	El Chayal	719	6597	81	18	14	144	141	21	111	11
dw0629	2017_YAX161-S24W54-1-1_D	El Chayal	665	7817	111	25	13	179	167	23	127	14
dw0631	2017_YAX161-S24W56-1-1_A	El Chayal	582	5961	58	19	12	144	135	16	111	8

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0633	2017_YAX161-S24W64_A	El Chayal	643	6533	70	20	14	150	140	21	109	12
dw0634	2017_YAX161-S24W64-1-1_A	El Chayal	696	7282	98	24	13	165	157	21	113	11
dw0635	2017_YAX161-S24W64-1-1_B	El Chayal	659	6383	49	22	14	153	143	19	110	9
dw0636	2017_YAX161-S24W64-1-1_C	El Chayal	583	6727	73	22	12	161	156	23	116	10
dw0637	2017_YAX161-S24W66_1-1_A	El Chayal	789	7348	66	25	13	165	157	20	115	11
dw0639	2017_YAX161-S24W66_2-1_A	El Chayal	646	7557	93	22	15	158	157	21	118	13
dw0640	2017_YAX161-S24W66-2-1_A	El Chayal	543	5963	55	18	11	150	138	19	109	10
dw0641	2017_YAX161-S24W66-2-1_B	El Chayal	789	7922	100	27	13	174	162	18	122	13
dw0642	2017_YAX161-S24W66-4-1_A	El Chayal	769	8998	112	23	11	190	176	23	120	14
dw0644	2017_YAX161-S24W76-1-1_B	El Chayal	687	7627	114	24	10	158	153	16	112	9
dw0645	2017_YAX161-S24W78-3-1_A	El Chayal	668	7082	73	21	11	158	157	21	115	10
dw0646	2017_YAX161-S24W78-3-1_B	El Chayal	673	6970	77	22	11	153	148	21	111	11
dw0648	2017_YAX161-S26W56-2-1_A	El Chayal	618	7630	98	22	9	157	144	20	111	12
dw0650	2017_YAX161-S26W64-1-1_A	El Chayal	627	6907	58	18	13	147	145	21	109	11
dw0652	2017_YAX161-S26W64-1-1_C	El Chayal	869	7945	133	26	7	165	159	22	122	10
dw0653	2017_YAX161-S26W64-1-1_D	El Chayal	550	6488	51	21	13	149	151	20	116	10
dw0654	2017_YAX161-S26W64-1-1_E	El Chayal	598	6155	78	19	10	142	135	18	108	13
dw0655	2017_YAX161-S26W64-1-1_F	El Chayal	612	6438	70	15	14	153	143	22	110	11
dw0656	2017_YAX161-S26W64-1-1_G	El Chayal	636	6121	91	20	12	142	139	18	105	12
dw0657	2017_YAX161-S26W66-1-1_A	El Chayal	715	6530	90	20	6	162	160	21	111	10
dw0658	2017_YAX161-S26W74-2-1_A	El Chayal	593	5940	57	19	9	148	137	20	106	9
dw0659	2017_YAX161-S26W76-1-1_A	El Chayal	610	7124	87	19	11	157	153	20	116	12
dw0662	2017_YAX161-S28W56-1-1_C	El Chayal	547	7506	69	21	10	143	136	16	109	11
dw0663	2017_YAX161-S28W56-1-1_D	El Chayal	713	7844	89	23	12	159	161	22	118	12
dw0664	2017_YAX161-S28W56-1-1_E	El Chayal	566	5999	55	19	11	139	142	20	110	10
dw0666	2017_YAX161-S28W66-1-1_B	El Chayal	748	6995	79	22	12	155	147	19	110	10
dw0672	2017_YAX161-S30W56-1-1_D	El Chayal	1006	7874	149	18	13	173	166	21	118	14
dw0674	2017_YAX161-S30W66-1-1_B	El Chayal	643	6790	97	22	15	147	142	21	104	10
dw0675	2017_YAX161-S30W66-1-1_C	El Chayal	654	6027	53	18	8	146	136	18	109	10
dw0677	2017_YAX161-S30W68-2-1_B	El Chayal	541	6678	77	19	12	160	149	19	111	12
dw0678	2017_YAX161-S30W68-2-1_C	El Chayal	940	9260	148	26	19	181	175	27	121	11
dw0679	2017_YAX161-S30W70-1-1_A	El Chayal	611	6970	70	25	9	157	157	17	115	10
dw0681	2017_YAX161-S32W54-1-1_B	El Chayal	707	7179	74	22	15	161	151	20	116	12
dw0682	2017_YAX161-S32W54-1-1_C	El Chayal	514	6671	68	20	11	156	147	18	114	13
dw0683	2017_YAX161-S32W54-1-1_D	El Chayal	787	7557	109	23	12	160	156	21	116	8
dw0684	2017_YAX161-S32W54-1-1_E	El Chayal	573	6485	66	21	8	148	145	18	108	14
dw0685	2017_YAX161-S32W54-1-1_F	El Chayal	680	6697	61	22	11	150	152	22	116	10
dw0686	2017_YAX161-S32W58-1-1_A	El Chayal	634	6293	57	14	15	115	107	15	86	7
dw0687	2017_YAX161-S32W58-1-1_B	El Chayal	826	7941	88	25	13	174	172	23	122	10
dw0689	2017_YAX161-S32W58-1-1_D	El Chayal	677	6548	65	21	10	162	151	22	114	9
dw0690	2017_YAX161-S34W54-1-1_A	El Chayal	516	8045	87	22	16	157	148	21	111	10
dw0691	2018_CO1F-1-1-1_A	El Chayal	586	6192	60	23	10	141	151	21	103	10
dw0692	2018_CO1F-1-1-1_B	El Chayal	765	8263	115	24	10	168	177	20	116	11
dw0693	2018_CO1F-1-1-1_C	El Chayal	1005	10406	196	27	12	175	157	20	114	10
dw0694	2018_CO1F-1-1-1_D	El Chayal	550	6463	59	19	10	147	153	21	109	9
dw0695	2018_CO1F-1-1-1_E	El Chayal	863	8381	148	30	13	158	170	22	115	10

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0696	2018_CO1F-1-1-1_F	El Chayal	612	6159	73	22	11	154	154	19	107	12
dw0697	2018_CO1F-1-1-1_G	El Chayal	621	6051	57	20	9	141	152	22	103	11
dw0698	2018_CO1F-N14E18-1-1_A	El Chayal	539	5929	56	17	12	142	147	17	110	8
dw0699	2018_CO1F-N14E18-1-1_B	El Chayal	633	6644	81	23	8	150	152	23	112	10
dw0700	2018_CO1F-N14E18-1-1_C	El Chayal	552	6334	157	18	11	139	157	19	98	11
dw0701	2018_CO1F-N14E18-1-1_D	El Chayal	606	6525	67	20	12	138	138	23	99	10
dw0702	2018_CO1F-N14E18-1-1_E	El Chayal	573	6261	59	19	14	133	131	24	104	12
dw0703	2018_CO1F-N14E18-1-1_F	El Chayal	620	6388	99	17	15	136	139	21	100	7
dw0704	2018_CO1F-N14E18-1-1_G	El Chayal	685	7124	83	23	9	157	149	22	117	9
dw0706	2018_CO1F-N14E18-1-1_I	El Chayal	566	5755	46	19	11	136	130	19	105	9
dw0707	2018_CO1F-N14E18-1-1_J	El Chayal	661	6031	71	21	10	151	139	20	108	10
dw0708	2018_CO1F-N14E18-1-1_K	El Chayal	501	6434	85	22	10	151	153	19	113	10
dw0709	2018_CO1F-N14E18-1-1_L	El Chayal	912	8386	164	23	10	170	161	18	111	11
dw0710	2018_CO1F-N14E18-1-1_M	El Chayal	653	6418	68	21	13	153	157	18	111	10
dw0711	2018_CO1F-N14E18-1-1_N	El Chayal	514	6143	76	16	9	150	149	17	112	9
dw0712	2018_CO1F-N14E18-1-1_O	El Chayal	797	7549	105	22	13	172	171	19	115	12
dw0713	2018_CO1F-N14E18-1-1_P	El Chayal	645	7741	130	22	8	172	157	16	111	11
dw0714	2018_CO1F-N14E18-1-1_Q	El Chayal	610	7565	110	24	15	180	162	21	120	10
dw0715	2018_CO1F-N14E20-1-1_A	El Chayal	552	6018	54	18	14	147	144	21	112	13
dw0716	2018_CO1F-N14E20-1-1_B	El Chayal	499	5569	64	15	10	135	135	18	107	10
dw0717	2018_CO1F-N14E20-1-1_C	El Chayal	716	6521	69	24	15	152	155	26	120	12
dw0718	2018_CO1F-N14E20-1-1_D	El Chayal	508	6204	78	21	6	141	148	20	108	12
dw0719	2018_CO1F-N14E20-1-1_E	El Chayal	622	5892	68	22	10	144	149	20	107	10
dw0720	2018_CO1F-N14E20-1-1_F	El Chayal	490	6727	118	19	12	143	144	20	101	12
dw0721	2018_CO1F-N14E20-1-1_G	El Chayal	812	7564	125	25	13	170	171	21	120	11
dw0722	2018_CO1F-N14E20-1-1_H	El Chayal	570	5862	62	19	10	130	136	17	100	11
dw0723	2018_CO1F-N14E20-1-1_I	El Chayal	626	6362	85	24	10	149	150	20	108	10
dw0724	2018_CO1F-N14E20-1-1_J	El Chayal	655	7184	110	22	13	164	158	21	114	12
dw0725	2018_CO1F-N14E20-1-1_K	El Chayal	731	7252	110	24	10	173	167	22	113	11
dw0726	2018_CO1F-N14E20-1-1_L	El Chayal	572	6447	82	21	12	148	152	20	108	12
dw0727	2018_CO1F-N14E20-1-2_A	El Chayal	678	6605	72	19	12	153	155	19	110	10
dw0728	2018_CO1F-N14E20-1-2_B	El Chayal	584	6596	104	23	10	156	157	20	109	12
dw0729	2018_CO1F-N14E20-1-2_C	El Chayal	574	6166	60	18	14	151	159	23	110	11
dw0730	2018_CO1F-N14E22_A	El Chayal	716	7135	100	22	11	158	148	21	113	12
dw0731	2018_CO1F-N14E22-1-1_A	El Chayal	534	5803	57	15	10	136	132	20	105	12
dw0732	2018_CO1F-N14E22-1-1_B	El Chayal	582	6740	71	24	9	160	157	23	117	11
dw0733	2018_CO1F-N14E22-1-1_C	El Chayal	671	6261	64	21	13	151	144	20	109	10
dw0734	2018_CO1F-N14E22-1-1_D	El Chayal	661	7086	124	23	8	155	156	14	111	12
dw0735	2018_CO1F-N14E22-1-1_E	El Chayal	548	6068	71	17	11	148	148	20	111	12
dw0736	2018_CO1F-N14E22-1-1_F	El Chayal	657	6897	102	23	14	148	141	21	104	13
dw0737	2018_CO1F-N14E22-1-1_G	El Chayal	541	6884	109	20	7	151	152	20	108	12
dw0738	2018_CO1F-N14E22-1-1_H	El Chayal	577	5902	72	19	11	146	143	16	108	12
dw0739	2018_CO1F-N14E22-1-1_I	El Chayal	693	7336	112	24	10	167	155	19	114	11
dw0740	2018_CO1F-N14E22-1-1_J	El Chayal	593	6698	63	26	13	161	155	20	114	12
dw0741	2018_CO1F-N14E22-1-1_K	El Chayal	685	6330	100	19	9	158	158	19	117	14
dw0742	2018_CO1F-N14E22-1-1_L	El Chayal	952	8221	128	26	11	185	177	19	117	15

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0743	2018_CO1F-N14E22-1-2_A	El Chayal	605	6826	57	21	11	163	154	23	117	12
dw0744	2018_CO1F-N14E22-1-2_B	El Chayal	625	5967	49	20	8	140	140	20	110	11
dw0745	2018_CO1F-N14E22-1-2_C	El Chayal	681	7505	125	20	12	160	161	20	115	11
dw0746	2018_CO1F-N14E22-1-2_D	El Chayal	706	7273	136	29	11	185	164	19	99	13
dw0747	2018_CO1F-N14E22-1-2_E	El Chayal	615	6342	94	20	9	147	157	23	112	10
dw0748	2018_CO1F-N14E22-1-2_F	El Chayal	739	7557	102	24	13	169	168	20	121	11
dw0749	2018_CO1F-N14E24-1-1_A	El Chayal	698	7396	100	27	11	162	166	21	117	13
dw0750	2018_CO1F-N14E24-1-1_B	El Chayal	635	7158	97	21	11	160	159	18	111	10
dw0751	2018_CO1F-N14E24-1-1_C	El Chayal	536	6108	54	23	10	143	139	19	110	10
dw0752	2018_CO1F-N14E24-1-1_D	El Chayal	553	5913	63	20	12	141	143	20	109	9
dw0753	2018_CO1F-N14E24-1-1_E	El Chayal	662	6882	83	22	10	153	156	19	115	11
dw0754	2018_CO1F-N14E24-1-1_F	El Chayal	908	8111	121	29	8	161	150	22	119	13
dw0755	2018_CO1F-N14E24-1-1_G	El Chayal	617	6300	71	19	13	146	153	19	111	10
dw0756	2018_CO1F-N14E24-1-1_H	El Chayal	728	6781	98	19	15	149	153	20	108	10
dw0757	2018_CO1F-N14E24-1-2_A	El Chayal	698	7008	81	25	11	174	161	18	119	13
dw0758	2018_CO1F-N14E24-1-2_B	El Chayal	558	6328	78	23	13	150	145	21	108	10
dw0759	2018_CO1F-N14E24-1-2_C	El Chayal	632	6503	91	24	10	150	164	22	115	13
dw0760	2018_CO1F-N14E24-1-2_D	El Chayal	676	7225	77	22	10	169	159	17	117	11
dw0761	2018_CO1F-N14E24-1-2_E	El Chayal	697	6370	85	20	10	150	147	21	109	10
dw0762	2018_CO1F-N14E24-2-1_A	El Chayal	662	6247	82	16	13	134	145	21	104	11
dw0763	2018_CO1F-N14E24-2-1_B	El Chayal	585	5928	69	22	12	139	143	18	109	10
dw0764	2018_CO1F-N14E24-3-1_A	El Chayal	645	6735	65	21	10	156	157	20	118	13
dw0765	2018_CO1F-N14E24-5-1_A	El Chayal	646	6485	67	21	14	160	154	21	111	10
dw0766	2018_CO1F-N14E26-1-1_A	El Chayal	820	7916	125	27	17	178	166	21	123	12
dw0767	2018_CO1F-N14E26-1-2_A	El Chayal	540	6157	77	20	9	144	142	21	109	10
dw0768	2018_CO1F-N14E26-1-2_B	El Chayal	575	6467	91	23	13	157	152	21	108	12
dw0769	2018_CO1F-N14E26-1-2_C	El Chayal	545	6627	73	22	12	151	152	19	112	8
dw0770	2018_CO1F-N14E26-1-2_D	El Chayal	573	6462	72	22	8	151	144	20	111	10
dw0771	2018_CO1F-N14E26-1-2_E	El Chayal	485	5391	65	16	9	127	137	15	100	8
dw0772	2018_CO1F-N14E28-1-1_A	El Chayal	593	6477	57	19	16	145	139	17	107	11
dw0773	2018_CO1F-N14E28-1-1_B	El Chayal	889	7979	79	23	12	165	152	22	114	12
dw0774	2018_CO1F-N14E28-1-1_C	El Chayal	529	5852	57	17	9	130	134	18	109	10
dw0775	2018_CO1F-N14E28-1-1_D	El Chayal	545	5388	54	16	7	130	129	20	102	8
dw0776	2018_CO1F-N14E28-1-1_E	El Chayal	769	7904	94	18	14	181	163	19	122	11
dw0777	2018_CO1F-N14E28-1-1_F	El Chayal	613	6245	57	20	9	150	150	17	113	9
dw0778	2018_CO1F-N14E28-1-1_G	El Chayal	601	7111	108	26	9	168	164	22	115	11
dw0779	2018_CO1F-N14E28-1-1_H	El Chayal	594	5480	73	16	14	138	130	18	101	9
dw0780	2018_CO1F-N14E28-1-1_I	El Chayal	804	8014	147	22	15	168	163	16	115	11
dw0781	2018_CO1F-N14E28-1-1_J	El Chayal	604	7415	96	26	11	170	159	20	113	11
dw0782	2018_CO1F-N14E28-1-1_K	El Chayal	520	5966	56	17	9	147	144	20	111	9
dw0783	2018_CO1F-N14E28-1-1_L	El Chayal	929	8219	175	21	10	162	151	18	120	9
dw0784	2018_CO1F-N14E28-1-1_M	El Chayal	664	6941	168	24	8	151	144	20	103	12
dw0785	2018_CO1F-N14E28-1-1_N	El Chayal	817	7976	114	28	14	183	167	21	121	12
dw0786	2018_CO1F-N14E30-1-1_A	El Chayal	527	5760	50	16	13	130	123	21	101	11
dw0787	2018_CO1F-N14E30-1-1_B	El Chayal	742	7138	109	21	15	144	142	23	106	10
dw0788	2018_CO1F-N14E30-1-1_C	El Chayal	566	6466	79	23	9	157	150	19	113	13

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0789	2018_CO1F-N14E30-1-1_D	El Chayal	638	6212	63	20	14	164	145	18	113	11
dw0790	2018_CO1F-N14E30-1-1_E	El Chayal	613	6198	69	20	11	152	147	22	115	10
dw0791	2018_CO1F-N14E30-1-1_F	El Chayal	610	6809	84	22	8	161	152	22	113	11
dw0792	2018_CO1F-N14E30-1-1_G	El Chayal	540	6103	59	21	10	148	148	20	110	12
dw0793	2018_CO1F-N14E30-1-1_H	El Chayal	635	6600	77	21	13	158	152	21	113	11
dw0794	2018_CO1F-N14E30-1-1_I	El Chayal	539	6387	68	23	11	146	142	21	113	9
dw0795	2018_CO1F-N14E30-1-1_J	El Chayal	555	6393	77	23	13	150	148	18	113	11
dw0796	2018_CO1F-N14E30-1-1_K	El Chayal	544	6212	64	17	13	150	147	19	111	10
dw0797	2018_CO1F-N14E30-1-1_L	El Chayal	501	6111	98	21	12	138	130	21	106	9
dw0798	2018_CO1F-N14E30-1-1_M	El Chayal	480	5696	68	17	9	136	122	16	103	8
dw0799	2018_CO1F-N14E30-1-1_N	El Chayal	583	6210	82	19	12	155	148	20	109	11
dw0800	2018_CO1F-N14E30-1-1_O	El Chayal	575	6027	65	19	9	150	141	18	108	9
dw0801	2018_CO1F-N14E30-1-1_P	El Chayal	599	7093	109	17	12	160	155	18	119	14
dw0802	2018_CO1F-N14E30-2-1_A	El Chayal	568	6344	58	20	11	150	145	21	111	11
dw0803	2018_CO1F-N14E30-2-1_B	El Chayal	505	5824	55	19	9	143	133	21	105	10
dw0804	2018_CO1F-N14E30-2-1_C	El Chayal	643	6280	76	21	12	147	165	20	113	11
dw0805	2018_CO1F-N14E30-2-1_D	El Chayal	846	6941	96	25	9	154	150	19	112	11
dw0806	2018_CO1F-N14E30-2-1_E	El Chayal	600	6527	51	20	11	152	159	23	119	11
dw0807	2018_CO1F-N14E30-2-1_F	El Chayal	856	8749	122	26	12	188	184	20	121	11
dw0808	2018_CO1F-N14E30-2-1_G	El Chayal	572	6506	73	21	10	151	142	20	109	11
dw0809	2018_CO1F-N14E32-1-1_A	El Chayal	544	6749	69	18	13	149	140	20	109	8
dw0810	2018_CO1F-N14E32-1-1_B	El Chayal	770	7818	74	22	10	169	163	21	117	12
dw0811	2018_CO1F-N14E32-1-1_C	El Chayal	575	6153	54	20	10	145	141	18	109	10
dw0812	2018_CO1F-N14E32-1-1_D	El Chayal	633	6804	72	22	9	156	150	22	115	13
dw0813	2018_CO1F-N14E32-1-1_E	El Chayal	596	6191	76	19	9	145	143	23	109	11
dw0814	2018_CO1F-N14E32-1-1_F	El Chayal	631	6292	60	21	12	146	144	18	113	10
dw0815	2018_CO1F-N14E32-1-1_G	El Chayal	601	6329	89	21	12	148	141	18	110	10
dw0816	2018_CO1F-N14E32-1-1_H	El Chayal	598	6785	92	20	9	148	140	20	107	11
dw0817	2018_CO1F-N14E32-1-1_I	El Chayal	398	4395	44	10	12	100	93	19	85	8
dw0818	2018_CO1F-N14E32-1-1_J	El Chayal	662	6071	75	17	8	141	149	20	107	13
dw0819	2018_CO1F-N14E32-1-1_K	El Chayal	482	5536	62	19	11	135	132	19	103	10
dw0820	2018_CO1F-N14E32-1-1_L	El Chayal	617	6112	86	22	8	153	150	19	111	11
dw0821	2018_CO1F-N14E32-1-1_M	El Chayal	680	6647	86	19	13	151	146	20	112	10
dw0822	2018_CO1F-N14E32-1-1_N	El Chayal	562	5965	69	22	11	142	137	19	109	10
dw0823	2018_CO1F-N14E32-1-1_O	El Chayal	684	6466	72	18	11	151	147	18	108	13
dw0824	2018_CO1F-N14E32-1-1_P	El Chayal	905	8249	203	25	14	177	163	20	117	14
dw0825	2018_CO1F-N14E34-1-1_A	El Chayal	660	6925	86	20	12	161	156	19	118	11
dw0826	2018_CO1F-N14E34-1-1_B	El Chayal	597	6326	67	21	13	140	134	19	103	11
dw0827	2018_CO1F-N14E34-1-1_C	El Chayal	512	5889	50	17	11	133	134	24	103	11
dw0828	2018_CO1F-N14E34-1-1_E	El Chayal	788	8220	119	26	13	175	157	23	106	11
dw0829	2018_CO1F-N14E34-1-1_F	El Chayal	596	6775	76	25	10	160	139	18	109	11
dw0830	2018_CO1F-N14E34-1-1_G	El Chayal	461	5976	61	15	13	145	145	20	106	10
dw0831	2018_CO1F-N14E34-1-1_H	El Chayal	619	7470	99	23	12	166	158	18	117	11
dw0832	2018_CO1F-N14E34-1-1_I	El Chayal	968	8777	131	26	18	189	179	23	118	14
dw0833	2018_CO1F-N14E36-1-1_A	El Chayal	673	6457	71	22	11	152	146	20	113	12
dw0834	2018_CO1F-N14E36-1-1_B	El Chayal	492	5406	42	19	9	133	125	16	99	10

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0835	2018_CO1F-N14E36-1-1_C	El Chayal	592	6009	59	21	9	138	139	18	107	11
dw0836	2018_CO1F-N14E36-1-1_D	El Chayal	797	7444	67	23	13	170	164	18	122	12
dw0837	2018_CO1F-N14E36-1-1_E	El Chayal	606	6427	74	25	12	151	151	21	108	12
dw0838	2018_CO1F-N16E20-1-1_A	El Chayal	785	8926	172	24	11	173	155	20	112	13
dw0839	2018_CO1F-N16E20-1-1_B	El Chayal	830	7622	68	22	14	173	167	24	121	12
dw0840	2018_CO1F-N16E20-1-1_C	El Chayal	678	6661	76	24	14	149	150	23	118	11
dw0841	2018_CO1F-N16E20-1-1_D	El Chayal	512	6112	85	21	9	148	141	18	104	13
dw0842	2018_CO1F-N16E20-1-1_E	El Chayal	681	6794	77	21	7	157	150	22	113	12
dw0843	2018_CO1F-N16E20-1-1_F	El Chayal	608	6134	76	22	10	133	149	19	111	9
dw0844	2018_CO1F-N16E20-1-1_G	El Chayal	560	6567	58	23	9	149	151	20	113	8
dw0845	2018_CO1F-N16E20-1-1_H	El Chayal	597	7231	78	25	12	165	162	20	120	10
dw0846	2018_CO1F-N16E20-1-1_I	El Chayal	627	6493	69	19	13	148	152	20	110	10
dw0847	2018_CO1F-N16E20-1-1_J	El Chayal	517	5943	39	20	9	137	133	23	104	9
dw0848	2018_CO1F-N16E20-1-1_K	El Chayal	674	6875	79	21	12	158	154	21	116	11
dw0849	2018_CO1F-N16E20-1-1_L	El Chayal	664	7516	75	21	11	167	162	20	118	10
dw0850	2018_CO1F-N16E20-1-1_M	El Chayal	569	5705	47	17	8	137	140	19	109	9
dw0852	2018_CO1F-N16E20-1-1_O	El Chayal	545	6213	85	21	8	146	147	19	110	10
dw0853	2018_CO1F-N16E20-1-1_P	El Chayal	711	8956	110	22	12	190	165	20	119	15
dw0854	2018_CO1F-N16E20-1-1_Q	El Chayal	601	6486	57	19	15	152	144	21	111	11
dw0855	2018_CO1F-N16E20-1-1_R	El Chayal	633	6881	81	22	11	148	145	20	111	12
dw0856	2018_CO1F-N16E20-1-1_S	El Chayal	537	5738	91	19	5	139	132	17	99	9
dw0857	2018_CO1F-N16E20-1-1_T	El Chayal	554	6179	78	24	13	152	139	21	107	9
dw0858	2018_CO1F-N16E20-1-1_U	El Chayal	893	8506	109	27	17	185	178	21	121	14
dw0859	2018_CO1F-N16E20-1-2_A	El Chayal	710	7198	97	18	11	162	163	21	120	10
dw0860	2018_CO1F-N16E20-1-2_B	El Chayal	718	7497	101	21	11	162	153	23	114	11
dw0861	2018_CO1F-N16E20-1-2_C	El Chayal	524	5623	56	18	9	129	128	20	101	9
dw0862	2018_CO1F-N16E20-1-2_D	El Chayal	548	5806	48	16	11	132	122	19	100	8
dw0863	2018_CO1F-N16E22-1-1_A	El Chayal	567	5609	52	17	13	143	140	20	105	9
dw0864	2018_CO1F-N16E22-1-1_B	El Chayal	579	6428	74	23	10	153	147	23	114	11
dw0865	2018_CO1F-N16E22-1-1_C	El Chayal	708	7725	87	24	9	162	158	21	113	8
dw0866	2018_CO1F-N16E22-1-1_D	El Chayal	559	6533	66	21	11	149	149	19	114	9
dw0867	2018_CO1F-N16E22-1-1_E	El Chayal	586	6607	73	21	8	148	145	22	108	8
dw0868	2018_CO1F-N16E22-1-1_F	El Chayal	786	7513	93	24	14	167	154	21	118	11
dw0869	2018_CO1F-N16E22-1-1_G	El Chayal	641	7186	93	23	11	175	163	19	114	11
dw0870	2018_CO1F-N16E22-1-1_H	El Chayal	638	6275	58	17	13	154	153	21	114	9
dw0871	2018_CO1F-N16E22-1-1_I	El Chayal	572	7457	243	22	9	174	163	19	116	12
dw0872	2018_CO1F-N16E22-1-1_J	El Chayal	660	6302	74	25	13	161	155	20	109	10
dw0873	2018_CO1F-N16E22-1-1_K	El Chayal	630	6009	59	19	11	149	143	18	106	11
dw0874	2018_CO1F-N16E22-1-1_L	El Chayal	872	8332	213	29	17	187	173	22	101	13
dw0875	2018_CO1F-N16E22-1-1_M	El Chayal	676	7017	94	20	13	165	157	19	114	11
dw0876	2018_CO1F-N16E22-1-1_N	El Chayal	667	6173	95	19	12	153	144	17	111	11
dw0877	2018_CO1F-N16E22-1-1_O	El Chayal	602	6152	71	19	11	150	140	21	112	10
dw0878	2018_CO1F-N16E22-1-1_P	El Chayal	681	7336	108	23	10	167	159	20	127	13
dw0879	2018_CO1F-N16E22-1-1_Q	El Chayal	675	5960	67	18	5	147	144	20	110	9
dw0880	2018_CO1F-N16E22-1-1_R	El Chayal	602	6649	75	23	9	158	152	20	110	13
dw0881	2018_CO1F-N16E22-1-2_A	El Chayal	524	6445	83	19	11	157	147	19	112	10

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0882	2018_CO1F-N16E22-1-2_B	El Chayal	583	5936	76	19	10	146	161	19	110	8
dw0883	2018_CO1F-N16E22-1-2_C	El Chayal	719	6643	77	19	11	162	156	18	119	11
dw0884	2018_CO1F-N16E22-1-2_D	El Chayal	578	6300	67	22	10	150	146	21	113	11
dw0885	2018_CO1F-N16E22-2-1_A	El Chayal	605	5677	52	18	10	143	138	17	108	9
dw0886	2018_CO1F-N16E22-2-1_B	El Chayal	593	6527	81	23	13	147	158	20	110	10
dw0890	2018_CO1F-N16E32-1-1_D	El Chayal	479	5532	52	15	13	126	117	18	100	10
dw0891	2018_CO1F-N16E32-1-1_E	El Chayal	552	6320	110	20	12	142	144	21	107	11
dw0892	2018_CO1F-N16E34-1-1_A	El Chayal	558	6259	56	18	10	147	147	19	108	14
dw0893	2018_CO1F-N16E34-1-1_B	El Chayal	536	6027	54	21	12	148	144	18	108	11
dw0894	2018_CO1F-N16E34-1-1_C	El Chayal	498	5117	63	15	8	126	134	18	101	11
dw0895	2018_CO1F-N16E36-1-1_A	El Chayal	617	6152	56	18	12	153	147	20	112	12
dw0896	2018_CO1F-N16E36-1-1_B	El Chayal	687	7756	98	24	13	167	168	21	124	14
dw0898	2018_CO1F-N18E20-1-1_A	El Chayal	644	5957	74	21	11	139	139	21	109	10
dw0899	2018_CO1F-N18E20-1-2_A	El Chayal	805	7384	94	23	12	158	153	21	120	16
dw0900	2018_CO1F-N18E20-1-2_B	El Chayal	683	8311	114	25	13	182	173	16	122	13
dw0901	2018_CO1F-N18E20-1-2_C	El Chayal	692	6907	80	23	11	158	156	17	117	12
dw0902	2018_CO1F-N18E20-1-2_D	El Chayal	579	6871	87	24	11	158	156	20	115	13
dw0903	2018_CO1F-N18E22-1-1_A	El Chayal	650	6925	75	22	11	162	158	21	113	12
dw0904	2018_CO1F-N18E22-1-1_B	El Chayal	574	6690	82	21	11	166	154	21	117	11
dw0905	2018_CO1F-N18E22-1-2_A	El Chayal	743	7201	76	26	13	155	152	22	113	12
dw0906	2018_CO1F-N18E22-1-2_B	El Chayal	738	7340	86	22	12	169	153	17	118	11
dw0907	2018_CO1F-N18E22-1-2_C	El Chayal	668	7013	82	19	14	148	147	21	115	11
dw0908	2018_CO1F-N18E22-1-2_D	El Chayal	687	6889	75	23	12	165	158	22	113	14
dw0909	2018_CO1F-N18E22-1-2_E	El Chayal	635	6665	73	20	14	153	149	20	113	9
dw0910	2018_CO1F-N18E22-1-2_F	El Chayal	686	6514	51	19	11	157	152	19	111	10
dw0911	2018_CO1F-N18E22-1-2_G	El Chayal	606	6093	51	20	10	150	141	17	105	10
dw0912	2018_CO1F-N18E22-1-2_H	El Chayal	685	7267	93	19	8	158	159	19	109	10
dw0913	2018_CO1F-N18E22-1-2_I	El Chayal	864	8111	92	23	12	179	166	20	120	13
dw0915	2018_CO1F-N18E22-1-2_K	El Chayal	552	5984	72	17	11	145	143	17	102	11
dw0916	2018_CO1F-N18E22-1-2_L	El Chayal	734	6863	104	24	12	158	151	20	116	12
dw0917	2018_CO1F-N18E22-1-2_M	El Chayal	654	6468	72	23	14	160	151	20	113	12
dw0918	2018_CO1F-N18E22-1-2_N	El Chayal	643	7793	130	27	12	155	160	25	115	9
dw0919	2018_CO1F-N18E22-1-2_O	El Chayal	668	7318	132	23	13	155	155	22	116	10
dw0920	2018_CO1F-N18E22-1-2_P	El Chayal	680	6370	74	20	10	153	145	23	113	11
dw0921	2018_CO1F-N18E22-2-1_A	El Chayal	661	7667	75	25	15	164	167	22	118	11
dw0922	2018_CO1F-N18E22-2-1_B	El Chayal	714	7121	88	22	14	152	150	20	114	10
dw0923	2018_CO1F-N18E22-2-1_C	El Chayal	589	5848	55	18	14	145	129	20	104	10
dw0924	2018_CO1F-N18E22-2-1_D	El Chayal	574	6233	56	22	15	152	148	21	111	12
dw0925	2018_CO1F-N18E22-2-1_E	El Chayal	731	7340	70	23	11	171	165	22	121	12
dw0926	2018_CO1F-N18E22-2-1_F	El Chayal	667	6392	82	24	9	152	150	22	111	11
dw0927	2018_CO1F-N18E22-2-1_G	El Chayal	869	7884	148	29	15	177	170	20	124	10
dw0928	2018_CO1F-N18E22-2-1_H	El Chayal	532	6092	71	21	10	140	142	20	114	10
dw0929	2018_CO1F-N18E24-1-1_A	El Chayal	623	6399	62	24	11	148	148	20	111	10
dw0930	2018_CO1F-N18E24-1-1_B	El Chayal	635	6216	51	22	10	155	144	17	114	10
dw0931	2018_CO1F-N18E24-1-1_C	El Chayal	668	6319	61	23	8	148	145	18	113	11
dw0932	2018_CO1F-N18E24-1-1_D	El Chayal	598	6716	80	21	14	150	142	20	119	12

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0933	2018_CO1F-N18E24-1-1_E	El Chayal	566	5806	42	17	12	154	147	22	111	9
dw0934	2018_CO1F-N18E24-1-1_F	El Chayal	654	6418	63	22	12	157	149	20	118	8
dw0935	2018_CO1F-N18E24-1-1_G	El Chayal	495	5525	67	17	6	133	130	21	105	12
dw0936	2018_CO1F-N18E24-1-1_H	El Chayal	580	6067	79	20	12	148	143	24	116	10
dw0937	2018_CO1F-N18E24-1-1_I	El Chayal	494	6226	92	19	9	148	143	19	105	10
dw0938	2018_CO1F-N18E24-1-1_J	El Chayal	530	5426	70	16	10	126	131	18	101	10
dw0939	2018_CO1F-N18E24-1-1_K	El Chayal	632	6667	93	23	13	171	157	25	115	11
dw0940	2018_CO1F-N18E24-1-1_L	El Chayal	636	6529	73	18	16	148	146	20	109	12
dw0941	2018_CO1F-N18E24-1-1_M	El Chayal	530	6333	83	21	12	151	150	20	115	13
dw0942	2018_CO1F-N18E24-1-1_N	El Chayal	600	6361	68	26	12	149	151	19	108	11
dw0943	2018_CO1F-N18E24-1-1_O	El Chayal	607	7200	86	24	9	166	164	21	123	10
dw0944	2018_CO1F-N18E24-1-1_P	El Chayal	656	6561	100	20	8	152	141	19	105	12
dw0945	2018_CO1F-N18E24-1-2_A	El Chayal	830	7574	99	23	11	164	164	20	116	13
dw0946	2018_CO1F-N18E24-1-2_B	El Chayal	705	7685	148	28	15	178	155	19	96	13
dw0947	2018_CO1F-N18E24-1-2_C	El Chayal	579	6513	80	19	8	141	141	19	111	11
dw0948	2018_CO1F-N18E24-1-2_D	El Chayal	692	7467	96	19	12	178	170	19	119	13
dw0949	2018_CO1F-N18E24-1-2_E	El Chayal	701	7172	121	24	11	165	160	23	120	9
dw0950	2018_CO1F-N18E24-1-2_F	El Chayal	476	6156	48	23	9	144	136	21	117	11
dw0951	2018_CO1F-N18E32-2-1_A	El Chayal	539	6040	75	19	9	142	137	20	103	10
dw0952	2018_CO1F-N18E32-2-1_B	El Chayal	594	6005	62	19	9	144	153	22	106	10
dw0954	2018_CO1F-N18E32-2-1_D	El Chayal	591	6160	73	20	15	143	150	18	115	10
dw0955	2018_CO1F-N18E32-2-1_E	El Chayal	572	6328	74	23	10	152	152	20	113	10
dw0956	2018_CO1F-N18E32-2-1_F	El Chayal	722	7446	93	21	13	165	161	22	114	12
dw0957	2018_CO1F-N18E32-2-1_G	El Chayal	584	6758	95	24	11	157	151	20	117	13
dw0958	2018_CO1F-N18E32-2-1_H	El Chayal	479	6389	62	23	10	152	146	17	111	12
dw0959	2018_CO1F-N18E34-1-1_A	El Chayal	561	5729	58	19	11	132	129	19	100	12
dw0960	2018_CO1F-N18E34-1-1_B	El Chayal	630	6790	82	20	14	160	149	19	115	13
dw0961	2018_CO1F-N18E34-1-1_C	El Chayal	578	6903	83	21	13	167	160	19	114	13
dw0962	2018_CO1F-N18E36-1-1_A	El Chayal	568	6004	118	18	8	134	140	21	110	9
dw0963	2018_CO1F-N18E36-1-1_B	El Chayal	733	7321	86	22	13	157	155	22	114	13
dw0964	2018_CO1F-N18E36-1-1_C	El Chayal	522	5225	61	13	11	129	119	17	95	8
dw0965	2018_CO1F-N18E36-1-1_D	El Chayal	709	6897	87	21	15	160	157	19	118	11
dw0966	2018_CO1F-N18E36-1-1_E	El Chayal	905	8251	189	24	9	149	148	21	110	11
dw0967	2018_CO1F-N18E36-1-1_F	El Chayal	631	5688	44	17	10	135	140	18	105	10
dw0968	2018_CO1F-N20E20-1-1_A	El Chayal	580	5623	66	18	12	136	134	20	105	12
dw0969	2018_CO1F-N20E20-1-2_A	El Chayal	658	6490	101	20	10	149	154	19	111	11
dw0970	2018_CO1F-N20E22-1-1_A	El Chayal	638	8158	153	25	11	170	155	16	108	12
dw0971	2018_CO1F-N20E22-1-1_B	El Chayal	644	6073	57	20	9	139	142	20	105	8
dw0972	2018_CO1F-N20E22-1-1_C	El Chayal	625	6638	84	24	10	152	152	20	116	12
dw0973	2018_CO1F-N20E22-1-1_D	El Chayal	644	6895	106	22	11	157	150	19	116	11
dw0974	2018_CO1F-N20E22-1-1_E	El Chayal	635	6410	99	22	15	149	148	19	114	13
dw0976	2018_CO1F-N20E24-1-2_A	El Chayal	649	6275	49	19	11	152	142	19	111	11
dw0977	2018_CO1F-N20E24-1-2_B	El Chayal	632	6926	77	24	13	160	153	21	116	12
dw0978	2018_CO1F-N20E24-1-2_C	El Chayal	633	7060	112	24	13	156	154	20	113	10
dw0979	2018_CO1F-N20E24-1-2_D	El Chayal	538	5322	67	16	7	136	131	19	102	9
dw0980	2018_CO1F-N20E24-1-2_E	El Chayal	692	6901	134	18	15	157	151	17	114	12

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0981	2018_CO1F-N20E32-1-1_A	El Chayal	461	6060	54	19	13	148	148	18	110	10
dw0982	2018_CO1F-N20E32-1-1_B	El Chayal	711	7319	105	23	7	152	143	25	112	12
dw0983	2018_CO1F-N20E32-1-1_C	El Chayal	615	6876	63	21	9	150	151	23	111	12
dw0984	2018_CO1F-N20E32-1-1_D	El Chayal	599	6899	84	23	12	165	150	16	116	12
dw0985	2018_CO1F-N20E36-1-1_A	El Chayal	694	6726	103	23	15	150	149	19	107	11
dw0986	2018_CO1F-N22E22-1-1_A	El Chayal	552	5738	58	19	11	142	138	19	106	9
dw0987	2018_CO1F-N22E22-1-1_B	El Chayal	813	7497	96	26	13	166	162	21	120	9
dw0988	2018_CO1F-N22E22-1-1_C	El Chayal	872	8942	138	25	12	176	176	18	127	11
dw0989	2018_CO1F-N22E22-1-1_D	El Chayal	623	6123	87	18	9	141	141	19	109	9
dw0990	2018_CO1F-N22E22-1-1_E	El Chayal	692	7387	84	26	8	173	159	22	119	10
dw0991	2018_CO1F-N22E22-1-1_F	El Chayal	702	6674	101	22	13	151	159	18	111	10
dw0992	2018_CO1F-N22E22-1-1_G	El Chayal	749	7430	124	20	15	163	165	22	117	11
dw0993	2018_CO1F-N22E22-1-1_H	El Chayal	593	6368	87	20	11	153	143	18	111	11
dw0994	2018_CO1F-N22E22-1-1_I	El Chayal	532	6582	111	21	10	158	156	18	108	11
dw0995	2018_CO1F-N22E22-1-1_J	El Chayal	636	6370	70	23	11	152	151	21	114	10
dw0996	2018_CO1F-N22E22-1-2_A	El Chayal	640	6852	96	23	12	148	148	24	111	10
dw0997	2018_CO1F-N22E22-1-2_B	El Chayal	541	5971	58	20	11	143	135	17	106	11
dw0998	2018_CO1F-N22E22-1-2_C	El Chayal	626	5928	86	20	11	141	137	17	110	10
dw0999	2018_CO1F-N22E22-1-2_D	El Chayal	591	6043	68	18	10	148	145	20	111	11
dw1001	2018_CO1F-N22E32-0-0_A	El Chayal	573	5620	61	19	13	134	138	21	106	9
dw1002	2018_CO1F-N22E36-1-1_A	El Chayal	668	7117	101	25	10	149	156	21	111	12
dw1003	2018_CO1F-N24E22-1-1&2_A	El Chayal	752	7118	76	19	11	152	140	20	109	10
dw1004	2018_CO1F-N24E22-1-1&2_B	El Chayal	580	6499	76	24	10	142	133	18	105	10
dw1005	2018_CO1F-N24E22-1-1&2_C	El Chayal	633	6415	57	21	14	143	138	18	113	9
dw1006	2018_CO1F-N24E22-1-1&2_D	El Chayal	563	5431	56	14	11	123	119	19	95	10
dw1007	2018_CO1F-N24E22-1-2_A	El Chayal	673	7395	76	24	10	158	159	24	113	10
dw1008	2018_CO1F-N24E22-1-2_B	El Chayal	662	7174	83	20	12	160	156	18	111	10
dw1009	2018_CO1F-N24E30-1-1_A	El Chayal	621	6846	62	19	10	163	150	17	117	10
dw1010	2018_CO1F-N24E32-1-1_A	El Chayal	611	6998	84	19	14	148	147	19	110	10
dw1011	2018_CO1F-N24E34-1-1_A	El Chayal	602	6230	90	19	10	142	141	17	106	9
dw1012	2018_CO1F-N24E34-1-1_B	El Chayal	621	6290	42	19	13	144	141	21	108	11
dw1013	2018_CO1F-N24E34-1-1_C	El Chayal	599	6779	64	19	11	136	134	17	103	13
dw1014	2018_CO1F-N24E36-1-1_A	El Chayal	712	6267	77	24	12	149	152	21	113	11
dw1015	2018_CO1F-N24E36-1-1_B	El Chayal	932	8699	148	24	12	175	159	15	109	11
dw1016	2018_CO1F-N26E22-1-1_A	El Chayal	647	7248	79	23	13	157	160	24	118	13
dw1017	2018_CO1F-N26E22-1-1_B	El Chayal	759	8214	117	29	17	184	169	19	118	14
dw1018	2018_CO1F-N26E22-1-1_C	El Chayal	606	6863	95	18	14	141	133	19	94	9
dw1019	2018_CO1F-N26E22-1-2_A	El Chayal	660	6735	93	24	9	165	159	21	116	11
dw1020	2018_CO1F-N26E22-1-2_B	El Chayal	624	6562	68	20	10	150	158	20	115	12
dw1021	2018_CO1F-N26E22-2-1_A	El Chayal	727	7692	82	26	17	168	177	22	114	12
dw1022	2018_CO1F-N26E22-2-1_B	El Chayal	507	6617	59	20	9	149	148	19	114	12
dw1023	2018_CO1F-N26E22-2-1_C	El Chayal	564	6707	69	26	14	154	155	20	112	10
dw1024	2015_CO1A-1-2-1_A	El Chayal	644	7065	87	24	12	164	156	23	116	11
dw1025	2015_CO1A-1-2-1_B	El Chayal	938	8251	123	25	12	173	158	19	118	10
dw1026	2015_CO1A-2-2-1_A	El Chayal	663	5658	41	22	7	142	137	18	106	11
dw1027	2015_CO1A-2-2-1_B	El Chayal	628	5666	55	18	11	146	137	19	104	9

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw1028	2015_CO1A-2-2-1_C	El Chayal	641	6476	67	15	15	131	120	19	102	12
dw1029	2015_CO1A-2-2-1_D	El Chayal	647	6787	85	21	12	160	154	21	112	12
dw1031	2015_CO1A-2-2-1_F	El Chayal	583	5928	54	17	11	135	133	19	104	10
dw1032	2015_CO1A-2-2-1_G	El Chayal	537	6409	82	18	11	156	141	20	114	10
dw1033	2015_CO1A-2-2-1_H	El Chayal	636	6641	78	22	10	156	149	17	115	12
dw1034	2015_CO1A-2-2-1_I	El Chayal	700	6422	83	21	10	154	147	20	115	12
dw1035	2015_CO1A-2-2-1_J	El Chayal	652	6930	67	21	12	165	153	18	116	12
dw1036	2015_CO1A-2-2-2_A	El Chayal	574	6112	70	21	10	136	141	21	106	10
dw1037	2015_CO1A-2-2-2_B	El Chayal	546	6974	87	19	8	154	153	20	117	10
dw1038	2015_CO1A-2-2-2_C	El Chayal	610	7598	97	23	14	161	167	22	119	11
dw1039	2015_CO1A-2-2-2_D	El Chayal	676	6568	60	23	7	153	150	20	118	10
dw1040	2015_CO1A-2-2-2_E	El Chayal	662	6778	71	20	11	163	150	20	116	14
dw1041	2015_CO1B-1-2-1_A	El Chayal	724	7334	102	27	14	169	160	22	115	11
dw1042	2015_CO1B-1-3-1_A	El Chayal	762	7751	123	26	12	173	163	22	118	12
dw1043	2018_CO1D-S26E12-2-1_A	El Chayal	728	8178	103	21	12	168	168	24	118	13
dw1046	2018_CO1D-S28E20-1-1_A	El Chayal	518	5867	60	19	8	143	135	19	106	10
dw1047	2018_CO1D-S30E10-1-2_A	El Chayal	691	6371	72	17	9	152	157	18	113	11
dw1049	2018_CO1D-S30E12-2-1_A	El Chayal	604	6580	65	20	12	156	156	21	113	10
dw1050	2018_CO1D-S30E14-2-1_A	El Chayal	654	6483	98	22	10	154	148	21	113	12
dw1051	2018_CO1D-S30E16-1-1_A	El Chayal	894	7947	100	20	11	142	124	19	100	11
dw1052	2018_CO1D-S30E18-1-1_A	El Chayal	541	5864	51	20	13	142	136	16	109	13
dw1053	2018_CO1D-S30E20-1-1_A	El Chayal	645	6496	63	16	11	152	149	22	110	12
dw1054	2018_CO1D-S30E20-1-3_A	El Chayal	658	7390	107	21	10	153	152	21	117	11
dw1055	2018_CO1D-S30E22-1-1_A	El Chayal	615	5628	59	19	9	132	128	20	103	9
dw1056	2018_CO1D-S30E26-1-1_A	El Chayal	699	7043	66	22	8	157	148	18	116	10
dw1057	2018_CO1D-S32E10-1-1_A	El Chayal	725	7554	91	20	19	131	119	19	96	11
dw1058	2018_CO1D-S32E10-1-1_B	El Chayal	572	5862	45	15	11	113	106	17	87	8
dw1059	2018_CO1D-S32E10-1-1_C	El Chayal	620	6622	66	23	12	158	149	20	114	13
dw1060	2018_CO1D-S32E18-1-1_A	El Chayal	581	6209	56	21	8	146	146	23	113	9
dw1061	2018_CO1D-S32E20-1-1_A	El Chayal	501	6002	55	17	10	141	140	18	109	10
dw1062	2018_CO1D-S32E22-1-1_A	El Chayal	676	7995	104	26	14	164	161	20	121	12
dw1063	2018_CO1D-S34E12-1-2_A	El Chayal	562	5612	56	19	9	146	129	17	110	10
dw1064	2018_CO1D-S34E14-1-2_A	El Chayal	594	6461	90	19	12	147	150	20	108	13
dw1065	2018_CO1D-S34E16-1-2_A	El Chayal	928	8098	120	23	13	139	135	17	100	10
dw1066	2018_CO1D-S34E18-1-2_A	El Chayal	681	6442	77	21	11	156	140	20	108	10
dw1067	2018_CO1D-S34E18-1-2_B	El Chayal	629	7191	83	20	11	150	150	18	117	12
dw1068	2018_CO1D-S34E20-1-1_A	El Chayal	761	7969	107	30	10	180	171	20	113	11
dw1069	2018_CO1D-S34E26-1-1_A	El Chayal	578	5807	58	14	11	120	105	18	89	10
dw1070	2018_CO1D-S36E18-1-1_A	El Chayal	655	7276	85	20	12	164	146	21	118	11
dw1071	2018_CO1D-S36E24-1-1_A	El Chayal	753	7808	107	20	14	134	114	15	93	10
dw1072	2018_CO1D-S36E28-1-1_A	El Chayal	806	8596	113	26	11	177	164	18	122	12
dw1073	2018_CO1D-S36E28-1-1_B	El Chayal	793	8576	129	21	10	164	160	21	116	11
dw1074	2018_CO1D-S40E18-1-2_A	El Chayal	638	7141	70	20	10	159	152	17	108	12
dw1075	2018_CO1D-S42E18-1-1_A	El Chayal	789	7225	103	24	13	167	154	21	117	12
dw1076	2018_CO1C-1-1-1_A	El Chayal	709	7137	82	19	12	167	158	21	117	10
dw1077	2018_CO1C-1-1-1_B	El Chayal	880	8262	94	28	12	182	175	22	125	13

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw1078	2018_CO1C-1-1-1_C	El Chayal	508	5743	50	16	7	136	134	21	107	11
dw1079	2018_CO1C-1-1-1_D	El Chayal	503	5551	56	19	11	132	128	17	102	7
dw1080	2018_CO1C-1-1-1_E	El Chayal	657	7733	139	18	12	148	151	20	108	9
dw1081	2018_CO1C-1-1-1_F	El Chayal	638	6710	58	23	14	149	149	19	111	11
dw1082	2018_CO1C-1-1-1_G	El Chayal	917	8909	112	30	10	177	162	21	119	11
dw1083	2018_CO1C-1-1-1_H	El Chayal	638	6702	82	23	13	159	156	20	117	12
dw1084	2018_CO1G-1-1-1_A	El Chayal	583	7462	69	22	9	164	159	23	119	11
dw1085	2018_CO1G-1-1-1_AA	El Chayal	969	9033	154	25	10	177	166	24	112	12
dw1086	2018_CO1G-1-1-1_AB	El Chayal	521	6129	43	21	7	150	148	18	105	10
dw1087	2018_CO1G-1-1-1_AC	El Chayal	767	7144	70	23	12	173	159	24	119	12
dw1088	2018_CO1G-1-1-1_AD	El Chayal	624	5640	37	15	10	136	130	19	106	11
dw1089	2018_CO1G-1-1-1_AE	El Chayal	518	5893	70	20	8	141	140	18	103	10
dw1090	2018_CO1G-1-1-1_AF	El Chayal	964	10339	160	33	15	190	176	23	119	12
dw1091	2018_CO1G-1-1-1_AG	El Chayal	677	7205	68	24	12	164	161	23	111	12
dw1092	2018_CO1G-1-1-1_AH	El Chayal	723	7017	50	22	13	161	156	25	116	11
dw1093	2018_CO1G-1-1-1_AI	El Chayal	679	6260	67	19	9	147	139	24	112	11
dw1094	2018_CO1G-1-1-1_AJ	El Chayal	659	6796	45	21	12	160	157	20	116	11
dw1095	2018_CO1G-1-1-1_AK	El Chayal	723	8266	60	26	17	184	173	23	124	11
dw1096	2018_CO1G-1-1-1_AL	El Chayal	840	7679	69	25	12	165	165	22	120	12
dw1097	2018_CO1G-1-1-1_AM	El Chayal	970	8125	156	22	14	185	172	17	117	13
dw1098	2018_CO1G-1-1-1_AN	El Chayal	477	6260	61	20	11	154	144	16	108	8
dw1099	2018_CO1G-1-1-1_AO	El Chayal	672	6505	44	21	10	152	157	18	115	11
dw1100	2018_CO1G-1-1-1_AP	El Chayal	731	6402	76	22	10	148	149	23	112	10
dw1101	2018_CO1G-1-1-1_AQ	El Chayal	753	7115	89	23	15	185	155	24	101	13
dw1102	2018_CO1G-1-1-1_AR	El Chayal	641	6418	45	18	10	147	146	23	115	11
dw1103	2018_CO1G-1-1-1_AS	El Chayal	740	6993	66	24	11	160	151	19	112	13
dw1104	2018_CO1G-1-1-1_AT	El Chayal	693	6635	64	23	12	160	149	19	107	10
dw1105	2018_CO1G-1-1-1_AU	El Chayal	663	6401	53	15	12	155	151	22	117	10
dw1106	2018_CO1G-1-1-1_AV	El Chayal	622	6303	54	20	8	155	148	24	113	11
dw1107	2018_CO1G-1-1-1_AW	El Chayal	535	6628	93	19	11	148	159	21	110	12
dw1108	2018_CO1G-1-1-1_AX	El Chayal	668	6199	49	17	16	147	145	21	115	8
dw1109	2018_CO1G-1-1-1_AY	El Chayal	789	9786	165	32	15	166	164	17	106	10
dw1110	2018_CO1G-1-1-1_AZ	El Chayal	715	7292	65	25	13	163	159	20	119	11
dw1111	2018_CO1G-1-1-1_B	El Chayal	621	7553	88	21	12	162	164	20	111	11
dw1113	2018_CO1G-1-1-1_BB	El Chayal	689	6094	59	18	10	145	130	20	108	11
dw1114	2018_CO1G-1-1-1_BC	El Chayal	838	7395	68	23	17	165	149	22	121	14
dw1115	2018_CO1G-1-1-1_BD	El Chayal	623	6751	58	18	13	157	146	19	110	11
dw1116	2018_CO1G-1-1-1_BE	El Chayal	715	6455	63	17	14	145	143	22	112	11
dw1117	2018_CO1G-1-1-1_BF	El Chayal	803	7566	96	25	13	158	170	20	117	11
dw1118	2018_CO1G-1-1-1_BG	El Chayal	759	6864	69	21	11	150	145	21	112	11
dw1119	2018_CO1G-1-1-1_BH	El Chayal	686	6485	59	18	11	148	139	21	110	12
dw1120	2018_CO1G-1-1-1_BI	El Chayal	608	6103	48	17	11	138	142	19	105	10
dw1121	2018_CO1G-1-1-1_BJ	El Chayal	670	7636	65	23	11	167	164	22	115	13
dw1122	2018_CO1G-1-1-1_BK	El Chayal	578	6058	42	16	8	138	142	22	107	12
dw1123	2018_CO1G-1-1-1_BL	El Chayal	729	7380	90	21	15	159	149	26	114	13
dw1124	2018_CO1G-1-1-1_BM	El Chayal	644	6238	51	19	12	148	144	19	114	10

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw1125	2018_CO1G-1-1-1_BN	El Chayal	591	5841	47	19	10	139	130	19	105	10
dw1126	2018_CO1G-1-1-1_BO	El Chayal	741	7255	58	21	12	164	161	22	124	12
dw1127	2018_CO1G-1-1-1_BP	El Chayal	664	6458	64	20	12	158	148	19	119	10
dw1128	2018_CO1G-1-1-1_BQ	El Chayal	571	5442	43	14	11	133	143	21	101	10
dw1129	2018_CO1G-1-1-1_BR	El Chayal	786	7958	97	25	14	172	165	23	124	13
dw1130	2018_CO1G-1-1-1_BS	El Chayal	649	6394	56	19	9	155	144	18	109	13
dw1131	2018_CO1G-1-1-1_BT	El Chayal	791	7291	70	24	12	162	158	21	115	12
dw1132	2018_CO1G-1-1-1_BU	El Chayal	826	7855	94	26	17	169	168	21	115	12
dw1133	2018_CO1G-1-1-1_BV	El Chayal	743	6681	50	18	13	151	154	19	119	11
dw1134	2018_CO1G-1-1-1_BW	El Chayal	503	5651	42	17	9	139	138	20	107	12
dw1135	2018_CO1G-1-1-1_BX	El Chayal	548	6070	69	20	9	156	144	21	110	10
dw1136	2018_CO1G-1-1-1_BY	El Chayal	614	6255	57	21	11	150	142	19	109	14
dw1137	2018_CO1G-1-1-1_BZ	El Chayal	785	7354	61	18	12	165	158	23	117	11
dw1138	2018_CO1G-1-1-1_C	El Chayal	752	7107	73	25	12	163	157	18	111	9
dw1139	2018_CO1G-1-1-1_CA	El Chayal	703	6905	66	23	12	158	163	20	112	12
dw1140	2018_CO1G-1-1-1_CB	El Chayal	542	6330	61	17	10	136	145	19	101	11
dw1141	2018_CO1G-1-1-1_CC	El Chayal	536	6378	48	21	11	151	164	18	111	10
dw1142	2018_CO1G-1-1-1_CD	El Chayal	517	6207	64	20	16	149	142	21	113	11
dw1143	2018_CO1G-1-1-1_CE	El Chayal	534	6178	47	19	9	142	142	22	108	12
dw1145	2018_CO1G-1-1-1_CG	El Chayal	540	6124	39	20	12	154	144	19	106	12
dw1146	2018_CO1G-1-1-1_CH	El Chayal	538	6214	48	18	10	139	143	22	108	9
dw1147	2018_CO1G-1-1-1_CI	El Chayal	691	5959	55	19	12	143	137	18	110	11
dw1148	2018_CO1G-1-1-1_CJ	El Chayal	759	6244	55	21	10	151	147	21	112	12
dw1149	2018_CO1G-1-1-1_D	El Chayal	593	6971	96	24	13	158	160	21	114	11
dw1150	2018_CO1G-1-1-1_E	El Chayal	632	6377	45	20	10	150	146	20	108	12
dw1151	2018_CO1G-1-1-1_F	El Chayal	662	6276	58	23	12	160	151	18	111	11
dw1152	2018_CO1G-1-1-1_G	El Chayal	652	6260	58	18	11	154	144	20	108	11
dw1153	2018_CO1G-1-1-1_H	El Chayal	625	6125	54	22	10	147	140	16	109	11
dw1154	2018_CO1G-1-1-1_I	El Chayal	506	6417	46	18	15	155	152	20	113	13
dw1155	2018_CO1G-1-1-1_J	El Chayal	629	6720	67	26	10	162	155	23	114	10
dw1156	2018_CO1G-1-1-1_K	El Chayal	710	6511	47	18	12	148	149	22	114	11
dw1157	2018_CO1G-1-1-1_L	El Chayal	516	6198	61	19	9	148	148	19	109	11
dw1158	2018_CO1G-1-1-1_M	El Chayal	599	6760	52	22	10	160	156	24	113	12
dw1159	2018_CO1G-1-1-1_N	El Chayal	740	8223	118	31	8	176	174	24	118	12
dw1160	2018_CO1G-1-1-1_O	El Chayal	621	6738	70	21	10	153	155	21	110	12
dw1161	2018_CO1G-1-1-1_P	El Chayal	616	7138	77	24	7	174	164	18	118	10
dw1162	2018_CO1G-1-1-1_Q	El Chayal	497	6171	51	18	13	154	151	23	110	7
dw1163	2018_CO1G-1-1-1_R	El Chayal	722	6575	53	19	9	133	128	19	100	11
dw1164	2018_CO1G-1-1-1_S	El Chayal	650	6322	49	15	13	135	127	19	101	9
dw1165	2018_CO1G-1-1-1_T	El Chayal	688	7154	58	17	13	147	132	17	101	12
dw1166	2018_CO1G-1-1-1_U	El Chayal	582	6834	52	19	16	133	125	19	97	11
dw1167	2018_CO1G-1-1-1_V	El Chayal	593	6135	51	20	11	134	134	20	104	10
dw1168	2018_CO1G-1-1-1_W	El Chayal	579	6507	62	18	12	138	132	20	102	13
dw1169	2018_CO1G-1-1-1_X	El Chayal	1111	9579	132	24	16	189	170	18	120	14
dw1170	2018_CO1G-1-1-1_Y	El Chayal	599	5412	117	18	10	119	114	16	91	7
dw1171	2018_CO1G-1-1-1_Z	El Chayal	511	6090	53	19	11	139	139	23	107	10

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw1172	2018_CO1G-1-1-2_A	El Chayal	881	8334	109	23	12	155	141	22	110	10
dw1173	2018_CO1G-1-1-2_B	El Chayal	674	6678	50	20	12	155	164	20	116	11
dw1174	2018_CO1G-1-1-2_C	El Chayal	550	5880	43	18	8	146	142	21	111	10
dw1175	2018_CO1G-1-1-2_D	El Chayal	655	6891	101	19	12	155	149	18	109	9
dw1176	2018_CO1G-1-1-2_E	El Chayal	490	6036	72	20	8	152	146	17	105	9
dw1177	2018_CO1G-1-1-2_F	El Chayal	556	6186	43	21	10	155	144	16	114	12
dw1178	2018_CO1G-1-1-2_G	El Chayal	663	6625	57	24	13	158	160	19	111	11
dw1179	2018_CO1G-1-1-2_H	El Chayal	625	6986	67	22	12	162	155	21	115	11
dw1180	2018_CO1G-1-1-2_I	El Chayal	699	6109	48	19	11	144	142	21	108	10
dw1181	2018_CO1G-1-1-2_J	El Chayal	755	7353	66	27	13	179	176	22	127	12
dw1182	2018_CO1G-1-1-2_K	El Chayal	650	6392	58	21	11	147	153	16	106	12
dw1183	2018_CO1G-1-1-2_L	El Chayal	678	6871	59	23	12	159	155	22	115	11
dw1184	2018_CO1G-1-2-1_A	El Chayal	662	6350	59	20	15	137	129	16	102	9
dw1186	2018_CO1G-1-3-1_A	El Chayal	547	6421	43	20	12	147	147	20	110	12
dw0209	2017_YAX161-N28W28-1-1_B	Ixtepeque	610	12342	82	26	12	126	175	20	182	12
dw0851	2018_CO1F-N16E20-1-1_N	Ixtepeque	387	9969	119	24	3	98	153	16	156	8
dw0887	2018_CO1F-N16E32-1-1_A	Ixtepeque	391	9442	62	24	9	105	157	19	167	10
dw0889	2018_CO1F-N16E32-1-1_C	Ixtepeque	546	8939	83	20	6	88	129	16	140	11
dw0897	2018_CO1F-N16E36-1-1_C	Ixtepeque	402	8462	63	17	4	99	146	16	156	11
dw0953	2018_CO1F-N18E32-2-1_C	Ixtepeque	341	9415	71	21	7	99	156	20	163	9
dw1045	2018_CO1D-S28E16-1-2_A	Ixtepeque	448	8434	61	20	8	95	140	18	157	10
dw1144	2018_CO1G-1-1-1_CF	Ixtepeque	493	10111	70	23	8	115	167	18	169	11
dw0196	2017_YAX161-N08W42-1-1_A	Not obsidian	-10910	-2055797	208	34	36	15	12	18	84	6
dw0197	2017_YAX161-N08W42-1-1_B	Not obsidian	-10531	-1903154	280	32	33	15	19	13	89	9
dw0205	2017_YAX161-N26W34-1-2_B	Not obsidian	129	2367	79	14	-2	5	121	3	20	0
dw0253	2017_YAX161-N32W36-1-1_B	Not obsidian	-13476	-2778551	214	31	25	13	8	14	81	11
dw0343	2017_YAX161-S06W78-1-1_A	Not obsidian	-20	2497	107	12	-6	4	8	3	18	0
dw0473	2017_YAX161-S16W66-1-1_A	Not obsidian	-34	2151	127	12	-2	5	13	2	18	1
dw0475	2017_YAX161-S16W66-2-2_B	Not obsidian	46	2098	121	16	-4	5	15	2	20	3
dw0573	2017_YAX161-S20W74-1-1_A	Not obsidian	722	4324	237	15	1	10	140	19	27	3
dw0643	2017_YAX161-S24W76-1-1_A	Not obsidian	36	3545	96	14	-3	7	16	3	19	2
dw0041	2016_YAX161-1-1_CF	Otumba	333	8826	61	23	13	119	126	20	133	15
dw0132	2016_YAX161-1-1_Z	Otumba	558	12720	113	27	12	158	156	30	151	16
dw0155	2016_YAX161-1-2_V	Otumba	514	10167	64	22	13	142	141	22	148	16
dw0193	2017_YAX161-N04W44-1-1_C	Otumba	520	15470	154	29	20	163	155	20	163	18
dw0228	2017_YAX161-N30W36-1-1_D	Otumba	468	9708	86	23	11	138	128	25	150	14
dw0229	2017_YAX161-N30W36-1-1_E	Otumba	467	10457	124	25	12	136	132	25	151	15
dw0247	2017_YAX161-N30W38-1-1_M	Otumba	308	8355	62	20	12	113	114	18	126	11
dw0262	2017_YAX161-N34W36-1-1_E	Otumba	364	9455	85	22	8	122	127	23	141	12
dw0268	2017_YAX161-N34W36-1-1_K	Otumba	379	8842	104	19	5	125	117	21	139	14
dw0269	2017_YAX161-N34W38-1-1_A	Otumba	326	9524	108	11	10	116	117	16	142	14
dw0410	2017_YAX161-S12W80-1-1_A	Otumba	399	8706	101	21	11	113	118	22	137	12
dw0504	2017_YAX161-S18W62-1-1_A	Otumba	516	12066	115	24	16	155	154	24	156	16
dw0564	2017_YAX161-S20W68-1-1_G	Otumba	364	8384	82	20	9	111	110	19	127	11
dw0615	2017_YAX161-S22W78-1-1_F	Otumba	385	9809	100	21	16	128	126	19	135	13
dw0008	2016_YAX161-1-1_B	Pachuca	1465	24790	451	35	20	238	6	107	894	84

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0042	2016_YAX161-1-1_CG	Pachuca	990	14403	198	23	20	184	2	102	845	86
dw0054	2016_YAX161-1-1_CS	Pachuca	1142	17946	371	28	22	198	4	104	821	78
dw0063	2016_YAX161-1-1_DA	Pachuca	1024	17539	231	30	17	216	4	117	944	101
dw0085	2016_YAX161-1-1_DW	Pachuca	1524	19901	380	28	23	212	6	106	830	83
dw0126	2016_YAX161-1-1_T	Pachuca	1475	24804	394	32	30	283	4	134	1092	103
dw0297	2017_YAX161-S06W62-1-1_E	Pachuca	1083	18973	285	31	22	225	3	115	946	94
dw0332	2017_YAX161-S06W74-1-1_A	Pachuca	1349	20032	289	33	22	242	3	132	1024	101
dw0437	2017_YAX161-S14W64-1-1_A	Pachuca	987	16370	242	25	25	214	4	122	919	98
dw0489	2017_YAX161-S16W84-1-1_C	Pachuca	1166	16314	336	32	20	205	1	98	807	79
dw0499	2017_YAX161-S16W84-1-1_M	Pachuca	1340	18180	323	26	21	220	3	122	911	87
dw0651	2017_YAX161-S26W64-1-1_B	Pachuca	1079	17745	313	30	20	208	2	117	906	94
dw0661	2017_YAX161-S28W56-1-1_B	Pachuca	771	15164	333	25	15	193	5	100	823	78
dw0676	2017_YAX161-S30W68-2-1_A	Pachuca	1141	18669	270	30	21	240	2	129	1008	105
dw0680	2017_YAX161-S32W54-1-1_A	Pachuca	1489	19834	341	32	18	246	4	126	1023	99
dw0031	2016_YAX161-1-1_BW	San Martin	526	7240	110	22	9	105	166	14	102	10
dw0038	2016_YAX161-1-1_CC	San Martin	633	6912	91	18	6	113	176	14	120	8
dw0046	2016_YAX161-1-1_CK	San Martin	602	7088	62	22	9	122	189	17	111	10
dw0047	2016_YAX161-1-1_CL	San Martin	579	8350	94	21	11	128	201	17	114	12
dw0076	2016_YAX161-1-1_DN	San Martin	687	7712	70	21	8	118	191	17	112	9
dw0088	2016_YAX161-1-1_DZ	San Martin	648	9593	149	26	12	133	199	12	122	9
dw0108	2016_YAX161-1-1_ES	San Martin	604	7620	125	26	8	117	182	15	111	10
dw0124	2016_YAX161-1-1_R	San Martin	520	6717	47	21	10	113	181	17	112	11
dw0131	2016_YAX161-1-1_Y	San Martin	369	6962	74	18	7	110	183	16	112	9
dw0153	2016_YAX161-1-2_T	San Martin	615	7338	61	24	8	115	190	16	117	8
dw0183	2016_YAX161-1-1_AM	San Martin	590	7574	45	23	10	122	206	17	121	11
dw0184	2016_YAX161-1-1_AN	San Martin	552	6925	55	21	10	117	182	14	116	8
dw0217	2017_YAX161-N28W32-1-1_D	San Martin	480	7040	57	23	7	115	193	18	113	9
dw0240	2017_YAX161-N30W38-1-1_F	San Martin	532	7274	59	20	13	118	200	17	113	8
dw0266	2017_YAX161-N34W36-1-1_I	San Martin	528	7526	105	19	9	116	182	19	118	11
dw0290	2017_YAX161-S04W74-1-1_B	San Martin	550	6712	45	19	9	115	184	16	107	9
dw0292	2017_YAX161-S04W74-1-1_D	San Martin	472	6809	74	22	9	131	186	14	111	10
dw0308	2017_YAX161-S06W64-1-1_H	San Martin	547	6598	143	26	11	101	155	16	99	8
dw0313	2017_YAX161-S06W66-1-1_D	San Martin	580	7592	87	24	10	125	195	16	119	10
dw0321	2017_YAX161-S06W68-1-1_C	San Martin	568	7831	169	20	12	108	168	13	104	7
dw0326	2017_YAX161-S06W68-1-1_H	San Martin	634	8042	129	18	9	86	145	13	93	10
dw0336	2017_YAX161-S06W76-1-1_B	San Martin	521	6902	104	20	10	113	177	14	111	11
dw0338	2017_YAX161-S06W76-1-1_D	San Martin	486	7007	57	20	12	119	197	18	115	9
dw0339	2017_YAX161-S06W76-1-1_E	San Martin	635	7372	84	23	6	123	192	17	117	10
dw0356	2017_YAX161-S08W76-1-1_A	San Martin	491	7220	60	21	14	124	196	15	117	11
dw0361	2017_YAX161-S10W56-1-1_A	San Martin	664	8440	115	26	9	124	203	18	113	8
dw0362	2017_YAX161-S10W56-1-1_B	San Martin	626	7167	78	22	11	119	189	18	111	9
dw0371	2017_YAX161-S10W74-1-1_D	San Martin	397	6365	52	21	4	109	176	16	107	8
dw0420	2017_YAX161-S12W86-1-1_F	San Martin	458	7026	65	15	8	89	135	13	91	8
dw0425	2017_YAX161-S14W52-1-1_A	San Martin	528	7266	82	18	11	131	203	18	120	10
dw0450	2017_YAX161-S14W74-1-1_F	San Martin	594	7389	67	23	13	131	206	17	121	11
dw0476	2017_YAX161-S16W66-2-2_C	San Martin	550	7048	131	21	10	108	172	14	107	9

Analytical I.D.	Alternative I.D.	Source Assignment	Mn ppm	Fe ppm	Zn ppm	Ga ppm	Th ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm
dw0500	2017_YAX161-S18W52-1-1_A	San Martin	631	8211	89	22	9	141	218	16	127	10
dw0538	2017_YAX161-S20W52-1-1_C	San Martin	523	7705	83	26	8	122	203	19	118	10
dw0539	2017_YAX161-S20W52-1-1_D	San Martin	425	7260	72	17	7	122	185	17	119	10
dw0554	2017_YAX161-S20W66-1-1_E	San Martin	535	6747	70	21	10	110	181	18	111	8
dw0571	2017_YAX161-S20W72-1-1_A	San Martin	567	8733	152	26	9	130	211	18	117	8
dw0583	2017_YAX161-S20W76-1-1_E	San Martin	470	5977	62	15	6	106	178	15	109	9
dw0589	2017_YAX161-S20W76-4-1_A	San Martin	544	7714	78	26	8	127	204	18	117	9
dw0590	2017_YAX161-S20W76-4-5_A	San Martin	240	6584	58	18	8	115	183	17	111	9
dw0592	2017_YAX161-S22W54-3-1_A	San Martin	505	7423	77	24	6	123	204	14	119	10
dw0606	2017_YAX161-S22W76-2-1_A	San Martin	474	6370	66	16	9	122	180	15	114	10
dw0612	2017_YAX161-S22W78-1-1_C	San Martin	524	6196	43	20	11	119	169	16	116	9
dw0627	2017_YAX161-S24W54-1-1_B	San Martin	393	6993	87	21	9	115	189	16	113	9
dw0628	2017_YAX161-S24W54-1-1_C	San Martin	577	7355	90	23	12	118	194	18	117	8
dw0630	2017_YAX161-S24W54-1-1_E	San Martin	550	6669	67	14	12	82	125	14	88	8
dw0632	2017_YAX161-S24W56-1-1_B	San Martin	453	6615	74	20	9	112	169	15	110	7
dw0638	2017_YAX161-S24W66_1-1_B	San Martin	402	7964	107	22	9	121	209	18	120	9
dw0647	2017_YAX161-S26W56-1-1_A	San Martin	414	5731	53	17	7	94	157	15	102	6
dw0649	2017_YAX161-S26W56-2-1_B	San Martin	399	5896	67	20	7	115	155	14	82	8
dw0660	2017_YAX161-S28W56-1-1_A	San Martin	619	8402	119	25	9	132	210	15	119	10
dw0665	2017_YAX161-S28W66-1-1_A	San Martin	491	6336	55	23	12	110	181	16	115	8
dw0667	2017_YAX161-S28W66-1-1_C	San Martin	455	6690	49	22	6	120	185	16	111	8
dw0668	2017_YAX161-S28W70-2-1_A	San Martin	538	6583	64	20	6	107	185	15	112	10
dw0669	2017_YAX161-S30W56-1-1_A	San Martin	611	7711	134	23	8	115	186	15	114	8
dw0670	2017_YAX161-S30W56-1-1_B	San Martin	759	8653	135	20	9	131	206	19	119	12
dw0671	2017_YAX161-S30W56-1-1_C	San Martin	609	7631	90	22	6	126	199	19	122	10
dw0688	2017_YAX161-S32W58-1-1_C	San Martin	482	6728	67	19	7	126	184	14	117	8
dw0888	2018_CO1F-N16E32-1-1_B	San Martin	752	7183	86	16	11	132	177	14	105	12
dw0351	2017_YAX161-S08W60-1-1_A	Tulancingo	338	15867	190	25	12	110	12	88	596	44
dw0260	2017_YAX161-N34W36-1-1_C	Ucareo	253	7807	115	23	15	143	12	27	117	13
dw0291	2017_YAX161-S04W74-1-1_C	Ucareo	162	6711	46	16	11	137	12	24	110	12
dw0673	2017_YAX161-S30W66-1-1_A	Ucareo	152	7221	52	22	12	142	12	24	110	15
dw0705	2018_CO1F-N14E18-1-1_H	unassigned	733	6759	88	18	11	158	180	20	108	11
dw0914	2018_CO1F-N18E22-1-2_J	unassigned	608	6851	78	21	15	140	169	22	111	9
dw1044	2018_CO1D-S28E12-2-1_A	unassigned	655	8102	85	22	7	155	182	20	111	10
dw1048	2018_CO1D-S30E12-1-2_A	unassigned	884	8930	134	26	13	158	215	22	119	12
dw1112	2018_CO1G-1-1-1_BA	unassigned	783	9296	83	24	13	170	219	21	121	13
dw1185	2018_CO1G-1-2-1_B	unassigned	609	7549	107	24	16	176	202	21	116	12
dw1030	2015_CO1A-2-2-1_E	unassigned	459	15068	150	28	26	189	33	33	207	23
dw0225	2017_YAX161-N30W36-1-1_A	Zacualtipan	174	11628	67	21	36	278	39	45	215	21
dw1000	2018_CO1F-N22E22-1-2_E	Zacualtipan	35	9969	73	23	35	303	37	48	211	19
dw0975	2018_CO1F-N20E24-1-1_A	Zaragoza	380	16851	223	32	22	162	30	29	176	16

APPENDIX B: COPYRIGHT PERMISSION LETTERS

Danielle Waite
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February 24, 2020

Travis Stanton
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University of California, Riverside
900 University Avenue
Riverside, CA 92521
smill024@ucr.edu

Dear Dr. Stanton,

As you are aware, I am competing a master's thesis at the University of Central Florida entitled "Household Economies and Socioeconomic Integration: An Analysis of Obsidian Artifacts from Coba, Quintana Roo and Yaxuna, Yucatan, Mexico." I would like your permission to reprint seven figures and images from the following documents:

Stanton, Travis
2017 The Founding of Yaxuná: Place and Trade in Preclassic Yucatan. In *Early Maya E-Groups, Solar Calendars, and the Role of Astronomy in the Rise of Lowland Maya Urbanism*, edited by D.A. Freidel, A.F. Chase, A.S. Dowd, and J. Murdock, pp. 450-479. University of Florida Press, Gainesville.

Stanton, Travis W., Traci Ardren, Nicolas C. Barth, Juan Fernandez-Diaz, Patrick Rohrer, Dominique Meyer, Stephanie J. Miller, Aline Magnoni, and Manuel Pérez
2020 'Structure' Density, Area, and Volume as Complementary Tools to Understand Maya Settlement: An Analysis of Lidar Data along the Great Road between Cobá and Yaxuná. Journal of Archaeological Science 29:1-10.

Stanton, Travis and Traci Ardren
2016 The Role of Social and Spatial Network Structure in Patterning Social Organization. National Science Foundation.
https://www.nsf.gov/awardsearch/showAward?AWD_ID=1623603&HistoricalAwards=false, accessed August 29, 2018.

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Danielle Waite

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By: ______________________
Travis Stanton

Date: 1/24/20

Danielle Waite
Department of Anthropology
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February 24, 2020

Lucas Martindale Johnson
Far Western Anthropological Research Group, Inc.
1180 Center Point Drive, Suite 100
Henderson, NV 89074
lucas@farwestern.com

Dear Lucas,

As you are aware, I am competing a master's thesis at the University of Central Florida entitled "Household Economies and Socioeconomic Integration: An Analysis of Obsidian Artifacts from Coba, Quintana Roo and Yaxuna, Yucatan, Mexico." I would like your permission to use excerpts from the following document:

Martindale Johnson, Lucas R.
2016 Toward an Itinerary of Stone: Investigating the Movement, Crafting, and Use of Obsidian from Caracol, Belize. PhD dissertation, Department of Anthropology, University of Florida, Gainesville.

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Danielle Waite

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By: ______________________ Date: 02/24/2020
Lucas Martindale Johnson

Danielle Waite
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February 24, 2020

Stephanie Miller
Department of Anthropology
University of California, Riverside
900 University Avenue
Riverside, CA 92521
smill024@ucr.edu

Dear Stephanie,

As you are aware, I am competing a master's thesis at the University of Central Florida entitled "Household Economies and Socioeconomic Integration: An Analysis of Obsidian Artifacts from Coba, Quintana Roo and Yaxuna, Yucatan, Mexico." I would like your permission to reprint seven figures and images from the following document:

Miller, Stephanie
2019 Investigating Lived Experiences of the Longest Maya Road: The Yaxuna-Coba Sacbe. Anthropology Program, University of California Riverside.

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Danielle Waite

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By: ____________________
Stephanie Miller

Date: 2/24/20

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February 24, 2020

Aline Magnoni
alinemagnoni@gmail.com

Dear Dr. Magnoni,

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Magnoni, Aline, Travis W. Stanton, and Traci Ardren
n.d. *Proyecto Sacbé Yaxuná-Cobá: Tercera Temporada de Campo*. Informe Técnico al Consejo de Arqueología del Instituto Nacional de Antropología e Historia, Mexico, D.F.

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