

A High-Precision Radiocarbon Chronology for the Rise and Fall of a Classic Maya Noble Household

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Abstract

Classic Maya civilization (AD 250-800) declined during the 9th century with a rapid disintegration of divine lineages at multiple urban-ceremonial centers. Construction of temples and stone monuments describing kingship halted at the largest Maya centers during this time. Questions remain about what happened to the noble and commoner households surrounding these centers. Here I establish a high-precision Accelerator Mass Spectrometry (AMS) radiocarbon (¹⁴C) chronology for the decline of one noble household (House of the Bacabs) in the Copan Valley (Honduras). Direct AMS ¹⁴C dates on purified bone collagen from human skeletal remains excavated from this elite household parallel the rise and fall of Copan's dynastic lineage from historical monuments. These data suggest a rapid decline of at least one noble household that was part of this kingdom. Comparable AMS¹⁴C work will be required at other noble and commoner households to determine if decentralization and population decline occurred more broadly in the Copan Valley as the kingdom fell.

Introduction

The Classic Maya were never unified into a single state or empire. Broadscale cultural traditions were shared throughout the region, today represented by Mexico, Guatemala, El Salvador, Belize and Honduras (Figure 1), but urban Maya centers were more like city-states, with dynastic lineages controlling individual sites and forming alliances with other centers through political marriages (Ebert et al 2014). These urban areas were civic-ceremonial centers that attracted large residential populations composed of nobles and commoners. During the Classic Maya Period (AD 250-800) dynastic rulers commissioned the construction of temples and stone monuments. Hieroglyphic inscriptions on stone monuments recorded commemorative events, such as the installment of new kings, using Maya Long Count dates. Long count calendar dates were recorded with historical information on stone monuments at centers throughout the Maya region and this

allows for precise dating of political activities through the Classic Period (Coe 2011; Kennett et al. 2013).

The “collapse” of the Maya during the Terminal Classic Period (AD 800-925) refers to evidence indicating the rapid decline of political systems, dynastic lineages and the cessation of monumental constructions at most of the major population centers throughout the region (Kennett et al 2012). However, the chronology of the collapse is still debated (Webster 2004, Braswell 1992). One argument is that an abrupt disintegration of the Maya political system occurred around the time the final long count date was recorded (AD 909), which also led to an abrupt population collapse among lesser elites and commoners (Martin and Grube 2008). Others have argued for a more gradual decline and that the vast majority of the population, mostly commoners, persisted throughout the region for a century or two after the polities failed (Webster et al 2000).

Supporting evidence for these hypotheses has proven problematic based on the methods used previously to construct collapse chronologies. Ceramic dating methods can be imprecise and inaccurate (Hoggarth et al 2014). Additionally, inscribed long count calendar dates on stone monuments do not accurately reflect the day-to-day actions of the entire population, especially commoners who vastly outnumbered the elites. Direct dating techniques such as obsidian hydration methods can provide more precision but can lack in accuracy (Antoviz et al 1999; Braswell 1992).

Similar issues of chronology present themselves at Copan. In this paper I present AMS ¹⁴C dates on human skeletons from the one elite Maya household at Copan, House of the Bacabs (9N-8), and compare these results with other datasets from this Classic Period civic ceremonial center. This work contributes to our understanding the collapse with a robust chronological dataset from an elite household located away from the Main Group of the site occupied by the dynastic lineage.

Site Background

Copan was a major population center located on the southern boundary of what was once the extent of the Maya region during the Classic Period (AD 300-900). Today, it is a designated UNESCO World Heritage Site located in the Copan Valley in western Honduras near the edge of the Guatemala border (Figure 1 and 2). It is well known for the elaborate building in the civic-ceremonial core, including the Hieroglyphic Stairway, the longest inscribed text in the Maya region (UNESCO World Heritage List).

The ruins of Copan sit in a river valley cut by the Rio Copan (Figure 2). There are five alluvial plains or pockets within the valley and the civic-ceremonial center was placed in one of the larger pockets (12.5 × 4 km). Rainfall is strongly seasonal and rotational swidden cultivation was used widely in the region to allow the land to recover during an extended fallow period after use for a year or two (Webster 2000: 14-16).

Several large excavations at Copan have revealed large temples and structures on the main acropolis or Main Group (Webster 2000: 31-40). William T. Sanders and David Webster (Penn State) conducted major excavations outside of the

Main Group (PAC II: Proyecto Arqueologico Copan) between 1980 and 1984 to better understand the social, political and economic institutions of Late Classic Copan. One of the primary goals of PAC II was to excavate a series of noble households outside the civic ceremonial core known as Las Sepulturas. (Webster 2000: 34-35). These excavations unearthed several major household areas in Las Sepulturas, one of which was designated 9N-8, also known as “House of the Bacabs“ (Figure 3).

PAC II excavators established that 9N-8 was most likely occupied by a second-tier noble lineage (Webster 1989:13). Some of the structures at 9N-8 were modular and served a variety functions. These structures lacked order and uniformity seen at more elite compounds and suggest a more continuous and organic growth pattern unique to this part of the site (Webster 1989: 13). Additionally, the elaborate architecture and impressive reliefs at 9N-8 indicate that the noble lineage was prominent in the Late Classic period and was either allied or competitive with the dynastic lineage occupying the Main Group (Webster 1989: 15).

Group 9N-8 contains several plazas within the compound. Plaza A is the largest with four buildings surrounding a central plaza. It is the most complex in terms of architecture and iconography when compared to other plazas (Webster 1988). Plaza B is comparable to Plaza A in terms of size and complexity. Like Plaza A, Plaza B was also built on an artificial platform. Plazas E and F are adjoined and are surrounded by decorated buildings constructed during the Late Classic (Webster 1988). Plaza H underwent major renovations near the end of the Classic Period and evidence suggests economic activity occurred around the structure (Webster 1988). Plaza D may have served as a ritual structure with buildings adjacent to it dating to the Late and Post-Classic (along with Plaza K), although it is suspected that this plaza dates sometime during the 8th century (Webster 1988). Plaza J and C both show evidence of earlier construction, though some of the buildings surrounding Plaza C could be Late Classic or later (Webster 1988).

Methods

One hundred and eighty two burials were recovered from the House of the Bacabs during PAC II excavations and 28 were selected for AMS ¹⁴C dating based on sample quality and location within the household group (see Figure 3). Collagen was extracted and purified for AMS ¹⁴C dating in the Human Paleoecology and Isotope Geochemistry Laboratory at Penn State. Well-preserved collagen extracts were purified using the modified Longin method with ultrafiltration (Brown et al. 1988) and XAD purification was used for highly degraded samples (Lohse et al. 2014; modified from Stafford et al. 1988, 1991). Initial sample selection was largely based on the overall appearance of the available bone samples. Samples that had a white and chalky appearance were not selected nor were bones that had been burned or were coated with preservatives.

Bone samples (1000 mg) were cut and cleaned using an X-Acto[®] blade and demineralized in 0.5N HCl for 24-72 hrs at 7°C. The remaining pseudomorph was transferred into a 13x100mm culture tube and gelatinized in 0.01N HCl for 10 hrs. The gelatin solution was then extracted from the tube, frozen in liquid nitrogen and freeze-dried. If a pseudomorph remained it was gelatinized a second time following the same procedure.

Lyophilization (freeze-drying) of the samples took approximately 48-72 hours and then percent gelatin yield by weight with respect to the original sample were calculated and recorded. Modern bone contains roughly 22% collagen by weight, while archaeological bone is usually less than 3% collagen (van Klinken 1999). Samples with very low yield (i.e., <1%) or of poor quality were processed by the XAD method, and the others with higher yield were processed by ultrafiltration (UF). For UF, gelatin samples were pipetted into pre-cleaned Centriprep® 30 ultrafilters to retain gelatin larger than 30kDa or kiloDaltons (1 Da=1 amu) (McClure et al 2010). Samples were then centrifuged 3 times for 20 min at 3000 rpm, diluted with nanopure H₂O and centrifuged 3 more times for 20 minutes to remove any remaining salts from the solution. The ultrafiltered collagen was lyophilized and weighed to determine yield.

Established methods were used to remove foreign carbon contaminants such as humectants (such as glycerol, glycerin, etc.) or filter material (reconstituted cellulose from the ultrafilters before use (Ramsey et al 2004, McClure et al 2010). Glycerol coating the Centriprep filters was removed by sonicating the filters at 60°C filled with 0.01N HCl for 1 hour and then rinsed with nanopure H₂O. Filters were centrifuged with nanopure water for 3 times for 20 minutes and the inner and outer portions were refilled with nanopure H₂O and sonicated for 1 hour at 60°C. The filters were kept wet until needed after cleaning.

Samples that were not processed by ultrafiltration were processed by XAD chromatography (Stafford et al. 1988, 1991; Lohse et al. 2014). The samples were hydrolyzed in 1.5 mL of 6N HCl for 24 hours at approximately 100°C to dissolve the gelatin material. Before the samples were filtered, syringes were treated to remove a silicone-based lubricant by using 70% methanol to clean the rubber plunger of the syringe as well as drawing and expelling methanol into and out of the syringe 10-12 times. Columns of Supelco ENVI-Chrom Solid Phase Extraction (SPE) with 0.45 µm Millex Durapore filters attached were equilibrated with 50mL 6N HCl. The collagen hydrolysate as HCl was then pipetted onto the SPE column and 10mL 6N HCl was added dropwise with a syringe to force the sample into a 20 mm culture tube. Finally, the sample was dried by passing UHP N₂ gas over the sample heated at 50°C for 12 hours. Samples (XAD: 3.5-4.5 mg; UF: 2.0-2.5mg) were then collected in silver foil and placed inside a vacuum-sealed quartz tube with CuO powder and Ag wire and combusted at 800 (XAD) or 900 (UF) °C for 3 hours to produce sample CO₂.

Sample CO₂ was reduced to graphite at the University of California, Irvine (KCCAMS) at 550°C using H₂ and Fe catalyst with reaction water drawn off with Mg (ClO₄)₂ (Santos et al 2004). Graphite samples were pressed into Al boats and loaded on a target wheel to make the AMS measurement. Radiocarbon ages are δ¹³C-corrected for mass dependent fractionation with measured δ¹³C values (Stuiver and Polach 1977), and compared with samples of Pleistocene whale bone (background, >48k¹⁴C BP), late AD 1800s cow bone, and OX-1 oxalic acid standards for calibration. Sample quality was evaluated by % crude gelatin yield. AMS¹⁴C dates were calibrated with OxCal 4.2 (Ramsey 2009) using the IntCal 13 radiocarbon age calibration curve (Reimer et al 2013).

Results

The Copan skeletal remains (N=26) from 9N-8 yielded calibrated dates that largely parallel the rise and fall of the dynasty based on the dedication of stone monuments in the Main Group, but the probability distributions extent to ~AD 900. Figure 4 shows calibrated 2σ dates (2 standard deviations) 21 of which fall in the Late Classic Period (AD 600-900) while the remaining 5 dates fall in the Early Classic Period (AD 250-600). In general samples in the northeast part of 9N-8 were well preserved (see Figure 3) and 10 out of the 13 in Plazas B, D, H, I and K were ultrafiltered. Conversely, samples in Plaza A, E and F were not as well preserved and more than half failed. Out of the remaining samples, most were processed using XAD methods and only one had yields suitable to be processed using ultrafiltration (Webster 2000: 169).

Burials from Plaza A were predominantly Early Classic in age (see Figure 3). Burials from Plaza C were split between Early and Late Classic and Plaza B had one sample that dated to the Early Classic. Late Classic Period burials were present in each plaza. Plazas D, E, F, H and K were composed of all Late Classic materials.

The summed probabilities of the calibrated AMS ^{14}C dates from 9N-8 were calculated in OxCal and compared to other chronological datasets from Copan (Figure 5). OxCal combines the probability distributions to create a rough estimate of the number of burials dating to different intervals. Obsidian hydration chronologies were calculated in a similar manner and divided into commoner and elite households for all of Copan, as well as the subset from 9N-8. Monument dates are transcribed from stone monuments dedicated by the Copan Dynasty and binned into 25-year intervals.

Population estimates for the Copan Valley were modeled using ethnographic data based on the assumption that nuclear families in the Copan region averaged five people (Webster et al 2000: 159). Population estimates in this figure were reconstructed from previous demographic studies in Copan and clustered in fifty-year intervals (Webster et al 2000: 161). A similar study was conducted using agricultural based on soil type based on maize production (Webster et al 2000: 170; one of the main staple crops in the Maya region), dietary intake, soil-slope classes, annual rates of population change and recovery periods of the soil.

Discussion & Conclusion

Radiocarbon AMS ^{14}C dates from twenty-six human burials at the House of the Bacabs (9N-8) in Copan span the Early Classic and Late Classic periods. Normalized probability sums of the House of Bacabs closely parallel the rise and fall of the Copan Dynasty based on the number of stone monuments dedicated through time. The number of burials in the House of the Bacabs peaked during the 8th century and declined significantly during the 9th century. Two burials possibly date to the 9th century, but these fall on a plateau in the radiocarbon calibration curve so it is impossible to know if these individuals date to the late 8th or early 9th centuries AD. Regardless, there is a decline in the number of individuals buried in this elite household after AD 800 and this is consistent with decline or dispersal of this noble group at this time. Comparable work will be required at other elite and commoner households to reconstruct the complexities of the collapse in the Copan Valley.

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Appendix

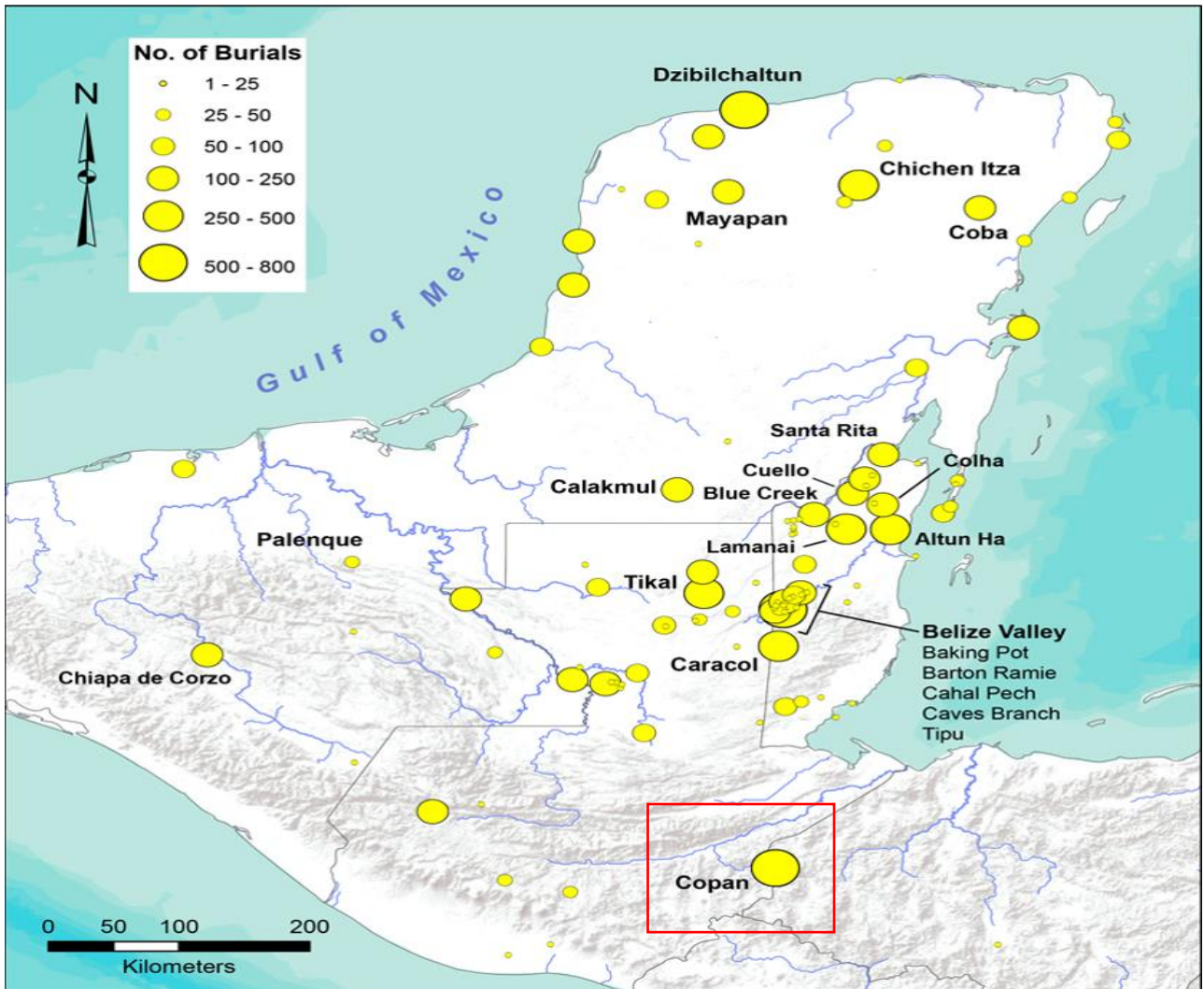


Figure 1 Map of the Classic Maya Region (AD 250-900). Copan is marked inside the red box.
Courtesy of Douglas Kennett

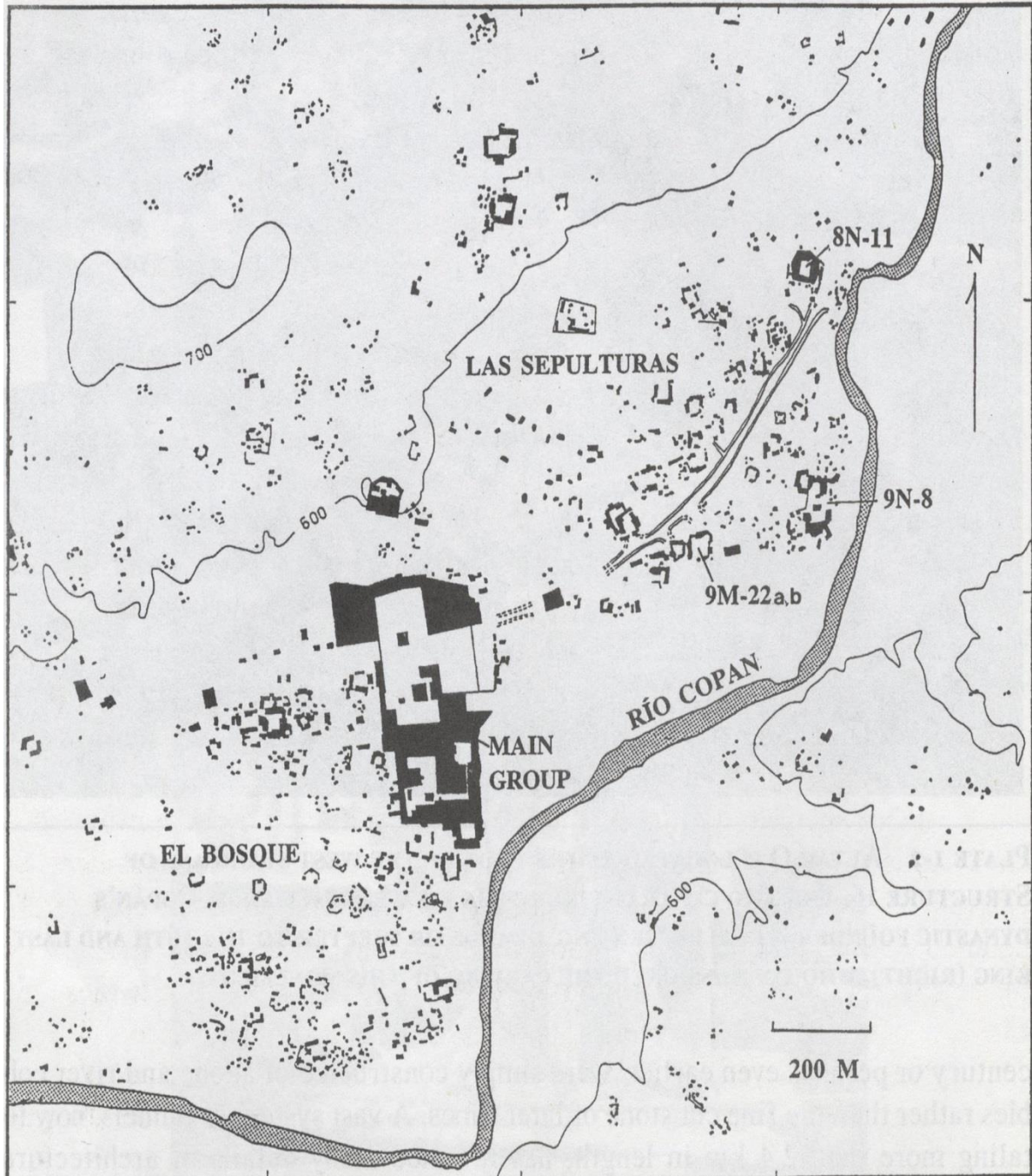


Figure 2 Map of Copan with The House of Bacabs marked in a red box (Webster 1989)

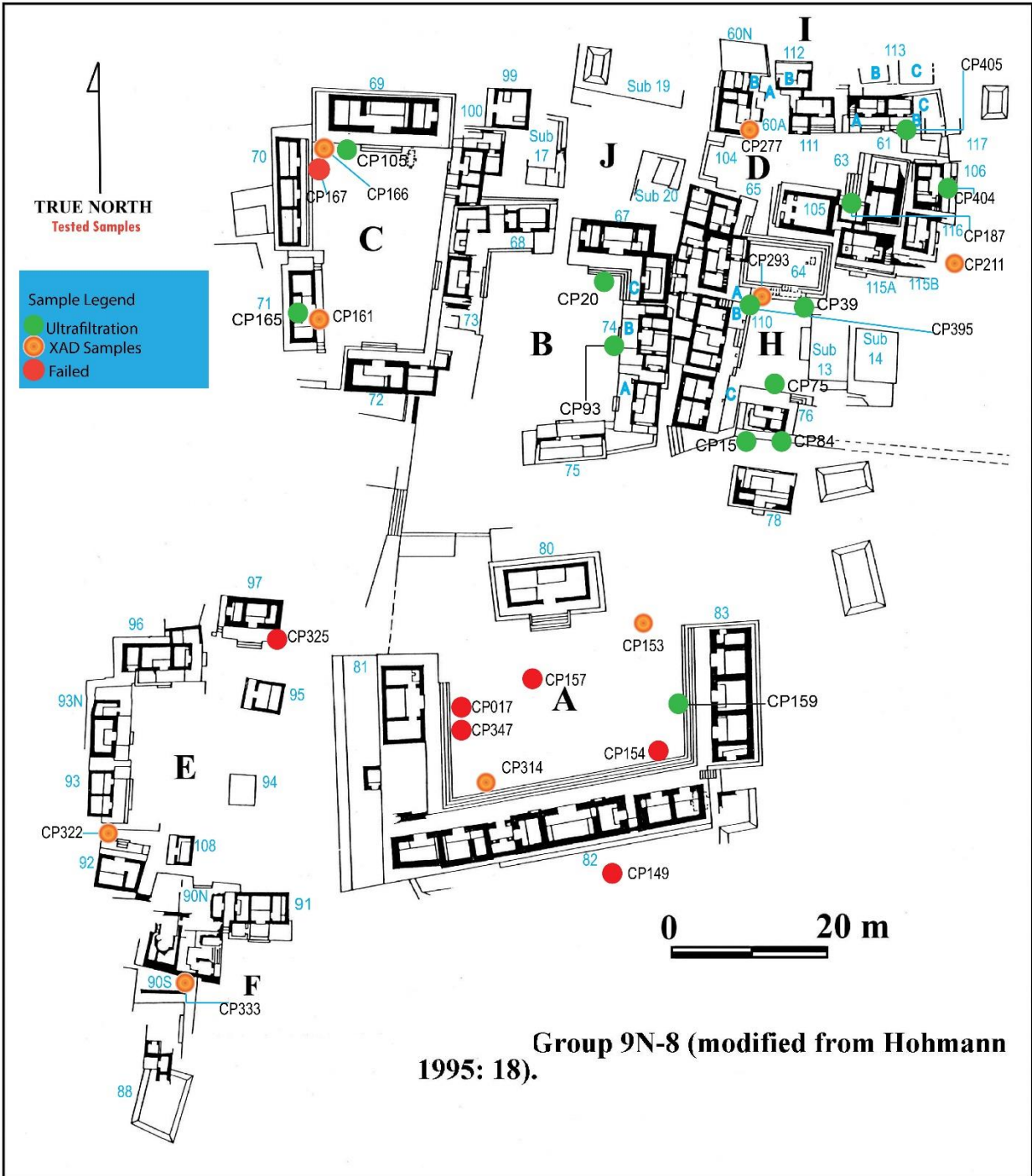


Figure 3 House of the Bacabs (Map Courtesy of Dr. David L. Webster)

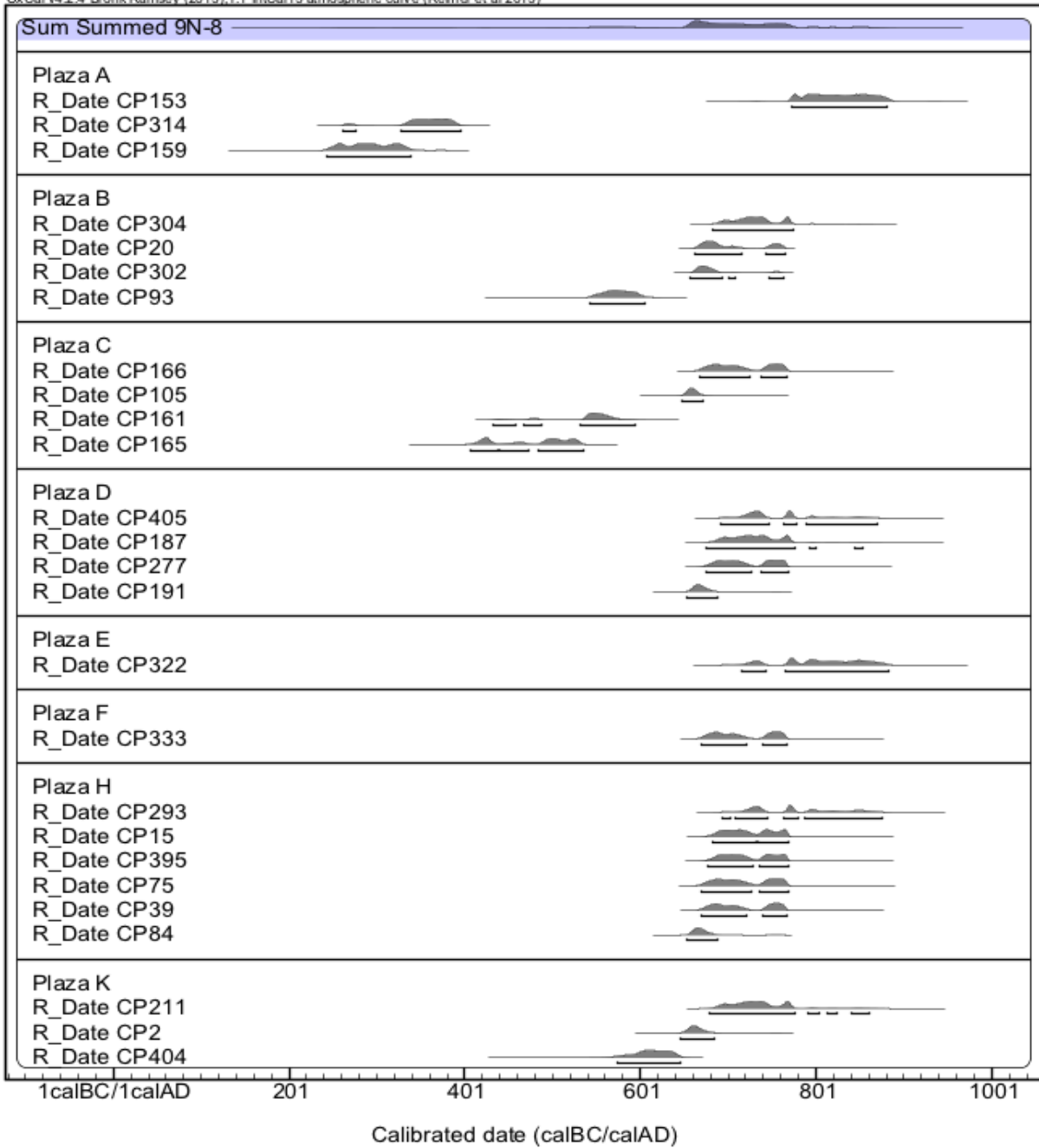


Figure 4 Calibrated AMS14C Dates. N=26

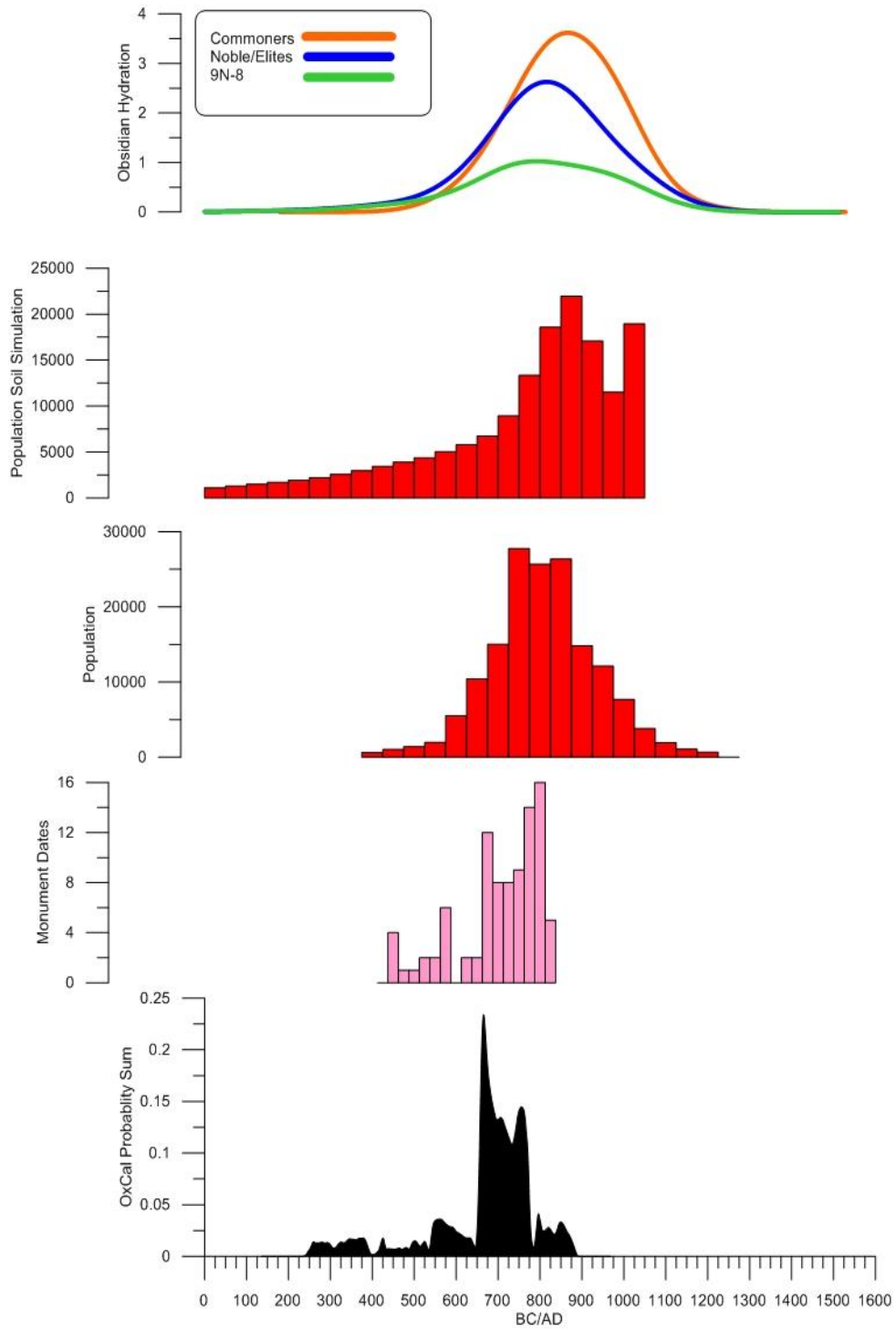


Figure 5 OxCal Sum compared to Population, Monument and Obsidian Datasets

	Gel Yield	Sex	Age	Position	Burial Type	Single/Multiple	Context
CP2	4.07%	u	child	flex	pit	single	cranial deformation, under front stairs of str 107
CP15	4.96%	u	child	flex	pit	single	in indistinguishable midden deposit behind str. 76 and str. 78
CP17	3.1%	F	adult				
CP20	5.60%	F	adult	flex	pit	single	several inlay jades, str. 67
CP39	4.16%	M	adult	flex	pit	single	plazafill, good preservation, str. 64 SE corner
CP75	4.35%	F	adult	flex	cisttop	single	along N base of str. 76 good preservation
CP84	3.32%	u	child	flex	pit	single	midden area near S wall str. 76 and 78
CP93	4.24%	F	adult	extended	pit	single	plaza W front str 74C
CP105	2.25%	F	adult	extended	pit	single	
CP149	1.6%	u	child		pit	single	60 cm below plaza I
CP153	6.3%	u	child	flex	crypt	single	crypt capped by unworked flat lajas
CP154	2.4%	u	child				54 cm below plaza III
CP157	1.4%	M	adult	extended	pit		
CP159	3.86%	M	adult	extended	simple tomb	single	El Brujo
CP161	6.1%	M	und	disart	none		bones scattered over with ceramics mixed in
CP165	4.12%	F	adult	tombsimp	complex tomb	multiple	Looted
CP166	9.3%	M	adult	extended	tombcomp	single	poorly preserved, four central niches
CP167	1.3%	M	adult	extended	pit	single	pit lined with four faced stones east of body
CP187	8.1%	M	adult	flex	cisttop	multiple	mixed w OP170-2
CP191	5.33%	M	adult	flex	none	single	mixed w OP170-2 lower extremities
CP211	4.2%	u	child	flex	none	single	artifacts above OP17-17
CP277	10.3%	M	adult	flex	cistline		cobble lined put
CP293	6.1%	F	adult	flex	pit	single	found while restoring adjacent to top of OP22-15 chamber
CP302	4.00%	M	adult	flex	cistline	single	S of str. 68 S terrace
CP304	4.09%	F	adult	flex	pit	single	E of NE corner of str 75
CP 314	5.2%	F	Adult				

Table 1 Dated Samples List