The Inhabitants of Tikal: A Bioarchaeological Pilot Project

Research Year: 1996
Culture: Maya
Chronology: Classic
Location: Petén, Guatemala
Site: Tikal

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Introduction

This report details preliminary research conducted on human skeletal remains from Tikal, Guatemala. This pilot project aimed to evaluate the feasibility of developing a larger project on Tikal bioarchaeology. Human burials were excavated at Tikal by the University of Pennsylvania Tikal Project (PTP) during the 1960s and by the Guatemalan Proyecto Nacional Tikal (PNT) during the early 1980s. Each project recovered over 200 burials, thus, the series constitutes one of the largest burial series from a single Mayan site, and has considerable potential for understanding the history of ancient Maya health and nutrition.

Some of the PTP remains are curated at Tikal in the Parque Nacional Tikal warehouse, and others have been at the University of Vermont with W. Haviland, but are soon to be repatriated to Guatemala. Approximately half of the PNT remains have been moved to the Museo Nacional in Guatemala City, while the remainder are housed at the site in the project lab. These are under the care of Licda. Vilma Fialko who expects to turn them all over to the Museum in the next year or so.

The goals of this pilot project were twofold: to conduct a preliminary inventory of the remains housed in Guatemala, and to evaluate the feasibility of paleodietary reconstruction using stable isotopes. To this end, inventory work was conducted at the PNT lab at Tikal, the Park bodega at Tikal, and at the Museo Nacional. Bone and tooth samples were collected from the PNT remains at Tikal to examine bone preservation and the effects of consolidation on bone chemistry. These preliminary analyses allow an assessment of the potential for future pathological and isotopic research.

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Osteological Inventory

Table 1 and Table 2 summarize the skeletal remains reviewed during the course of this study. Quick assessments of age and sex were made, but should not be considered as secure at this time. In addition, numerous cases of pathology were noted, and provide some insight into the nature of pathology that might be found in a more comprehensive study.

In general the PNT collections are well preserved and adequately curated. Virtually all of the numbered sequence of burials were found, but a few at Tikal were not inventoried due to lack of time. The PNT remains at Tikal are bagged in plastic, individually by burial. The museum collection is more problematic, in that both crania and teeth have been separated from postcrania for many skeletons. Although a few dentitions may have become commingled, or lost provenience tags, it should be possible to reunite

most of the remains. Contextual documentation of the burials is excellent, with both detailed burial descriptions and drawings readily accessible.

The most severe problem with the PNT remains is their liberal coating of "Resistol," a white glue. A subset of burials were consolidated by Mexican physical anthropologists, Pijoan and Salas (1984), and others have since been consolidated by V. Fialko and USAC students, following this lead. Unfortunately, some burials were consolidated unwashed, or too thickly. For some, this consolidant precludes observation of pathology, especially porotic hyperostosis, periosteal reactions, and enamel hypoplasias. Although it would be necessary to remove some of this consolidant to score pathology on selected burials, the majority of remains are in need of little further conservation.

By contrast, the PTP remains hold less potential for future work due to poor preservation and curation problems. Although moved from the original PTP bodega to the new Parque bodega, the collection is still housed in the original PTP wooden cabinets (gaveteros), Figure 1. After being closed for many years, the bodega was recently opened and inventoried by the IDAEH Registro Dept. At this time, deteriorating PTP paper bags were replaced by plastic bags labeled with marker.

Figure 1. Pennsylvania Tikal Project shelving with skeletal remains in the new bodega at the Tikal Park.

Although the transcription of labels appears to have been generally good, it is unfortunate that the original bag labels were not curated. Also, bodega guardians occasionally recopy and replace decaying labels. Some transcription errors occur because the original labels were in English. Many skeletons can be securely identified by either India ink PTP Operation numbers or by Haviland's pencil burial numbers on the bones. For a few burials, only labels on the drawers indicate provenience, and it is difficult to believe that some commingling of remains has not occurred. Although a few bone lots appear to be relatively complete skeletons, most lots have very irregular representation of skeletal elements, and lack elements usually well preserved. Since several drawers contain bones from various burials —such as crania (47-BDF), radii & ulnae (46-A), femora (47-I), etc.— this irregularity is presumably a consequence of curation history.

PTP bone is often soft and very chalky, containing little collagen. Whether this poor preservation reflects the original state of the bone or recent decay is uncertain. With its unvented tin roof, the new bodega heats up dramatically at midday, and ceramics require continual repair due to heat expansion. Bone surface erosion and collagen loss may also be due to this extreme temperature fluctuation. Some of the PTP bones show patches of white opaque deteriorating consolidant that appears to have deteriorated over the years, Figure 2. Yet other bones, some with delicate trabecular structures, remain dense and well preserved, and two infant crania with hair adhering to the bone show extremely good organic preservation (Figure 3; PTP B.160B; Chikin Tikal rescate).

Several burials show unusual weathering patches on selected bone elements, which appear to have been caused by rapid "shrinkage" of surface bone, for example on the lateral ilia of an infant in B.160, Figure 2 and Figure 4. Since consolidant overlays one of these (Figure 2), the weathering is not recent. My best hypothesis is that these are due to prolonged sun exposure at the time of burial, but some experimentation would be necessary to evaluate this hypothesis.

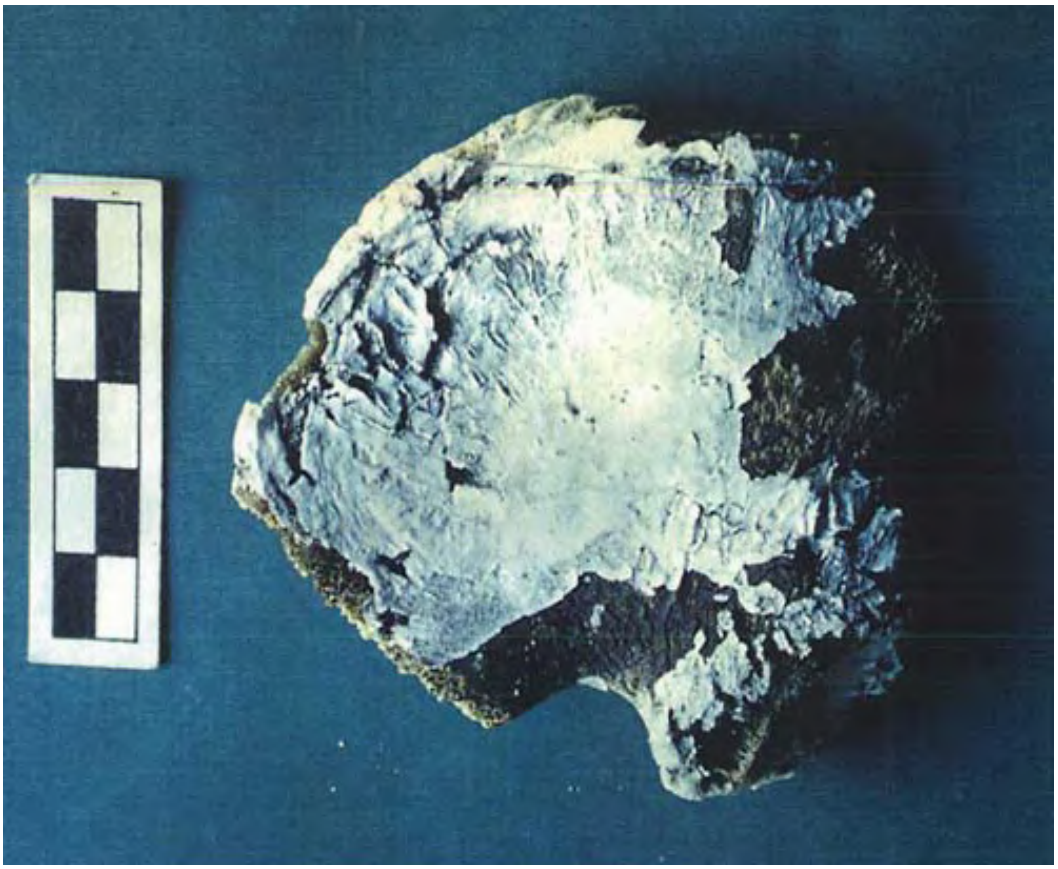

Figure 2. Infant right ilium from PTP B. 160, with original consolidant.

Figure 3. Posterior view (lambda) of infant cranium with hair, PTP B. 160.

Figure 4. Figure 4. Left and right infant ilia with weathered lateral surfaces (Chikin Tikal, looted, no number).

Paleodietary Analysis

The second phase of the project aimed to evaluate the potential of the Tikal remains for paleodietary reconstruction using stable isotopes in bone collagen. With the Tikal collections there are two potential problem areas. First, Tikal bone is poorly preserved. Much of the PTP bone which is curated at the site is very eroded and chalky in texture, indicating that little collagen remains. The PNT remains are somewhat better, but also show significant weathering. Second, many of the remains have been coated with preservatives. The white glue "Resistol" was recently applied to most remains in the PNT collection (Fialko, personal communication 1995). Many of the PTP remains had also been so treated 25 years ago with "Alvar," an acetone-soluble consolidant (Haviland, personal communication 1996). Hence, some experimentation was necessary to evaluate the feasibility of recovering biogenic collagen signals free of contamination by consolidant. In addition, diagenetic contamination of enamel was

examined to evaluate the paleodietary potential of enamel carbonates. Lab methods are briefly summarized in Appendix.

What effect does consolidation have on collagen isotopic composition? Glue from several PNT bone samples produced no measurable nitrogen gas on combustion, so must not be animal-based. Therefore, consolidation is not a problem for $\delta^{15}N$ paleodietary reconstruction. The glue from PNT burials has a very light $\delta^{1}3C$, implying a synthetic (petroleum?) origin. Glue from two samples (PNT-002 = -30.75, PNT-007 = -31.30) is more enriched in ^{13}C than two others (PNT-020 = -39.047, PNT-025 = -37.19), possibly indicating two different batches of Resistol, which had been applied at different times to the remains. By contrast, a sample of loose Alvar from the PTP remains had $\delta^{13}C$ of -22.88‰. These two, or perhaps three, glues could therefore have a significant effect on collagen $\delta^{13}C$ if they were not adequately removed. All would add light carbon to the collagen, making isotopic signals more negative, although the effect would be greater for Resistol than for the older PTP glue.

Several different solvents were evaluated in order to remove the PNT consolidant. While acetone should easily remove the PTP Alvar, it does not remove cured Resistol, although it does soften the glue slightly. Donny Hamilton (Texas A&M University) recommended a "super-solvent" mixture of 35% methanol, 24% acetone, 15% toluene, 12% methylene chloride, and 12% methyl ethyl ketone. This dissolved most cured Resistol, leaving a white residue, similar to that found on PTP bones. This residue has a $\delta^{13}C$ of -28.48‰, so may contain an organic bulking agent, from which the petroleum-based adhesive was not completely removed. Repeated rinsing with 100% ethanol, recommended by the Royal Ontario Museum Conservation Department, is as effective as super solvent, and has the advantage of being non-toxic. Paired tests using super solvent and ethanol on three samples were conducted to evaluate the efficacy of the two methods. Unfortunately only one of these three bones contained collagen. Using both methods, collagen from sample PNT-046 had the same $\delta^{13}C$ (within instrument precision) (super solvent: -8.10‰; ethanol: -8.22‰). Accordingly, ethanol was used to prepare the remaining samples. The $\delta^{13}C$ of duplicate preparations for four samples verify that the consolidant appears to have been removed consistently (PNT-042, -056, -059, -072, see Table 3). This consistency implies that the removal of consolidant has been successful and that $\delta^{13}C$ is quite close to the biological collagen value.

Although collagen was obtained from many of the 39 bone samples, nearly one third of preparations were unsuccessful, Table 3. Four samples dissolved completely, while nine produced insufficient organic material for isotopic measurement. This rate is rather lower than that obtained in other studies of Maya paleodiet, but may be due to the use of fragile (but more expendable) ribs instead of dense cortical bone. Future work on Tikal paleodiet would better focus on long bone cortical samples. In addition, surface consolidation makes it more difficult to determine the quality of bone preservation when selecting a sample.

Figure 5 illustrates the relationship between isotopic composition and measures of collagen integrity. Most samples show atomic C/N ratios within the range expected for collagen from 2.9 to 3.6 (DeNiro 1985). Neither samples with high or low C/N show any

consistent trends in $\delta^{13}C$ or $\delta^{15}N$ that might indicate glue contamination. Collagen yields show no clear relationship with $\delta^{15}N$. But low yielding samples do show very light $\delta^{13}C$, especially those below 1%, which yielded a gummy yellow residue, and cannot be interpreted in dietary terms. I exclude samples with yield below 5% that show C/N ratios beyond DeNiro's range from paleodietary reconstruction. Samples with yield greater than 2% that fall within the C/N range are retained in the analysis.

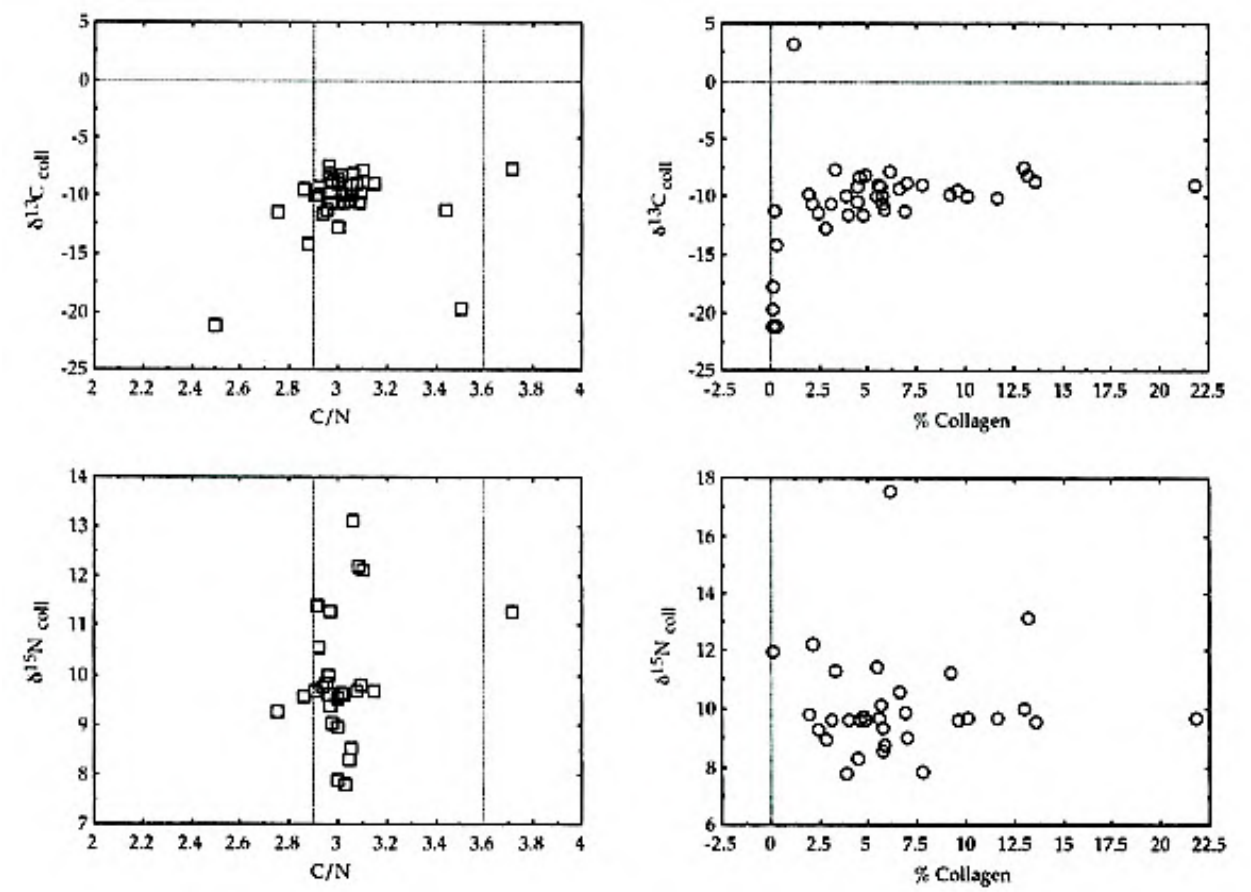

Figure 5. Stable isotopic composition of Tikal bones in relation to atomic C/N ratios and collagen yields.

Figure 6 shows isotopic data for those samples with well preserved collagen. The samples span a wide range. The sample most enriched in $\delta^{13}C$ and $\delta^{15}N$, Late Classic PNT-006 is an infant, which was still breastfeeding when it died. For the adult Preclassic samples, PNT-003 and PNT-015, $\delta^{15}N$ enrichment may hint at social distinctions in meat consumption, since these two were located in Str. 5C-54 and below the Plaza Sur, while the other two, PNT-031 and PNT-032, interred below the Plaza Alta at the base of Str. 5C-54, are less enriched. The light $\delta^{13}C$ of two Early Classic adults might indicate a chronological shift. Although the sample is too small to allow precise characterization of

dietary trends, ongoing analysis of these data will generate hypotheses to be tested in future research.

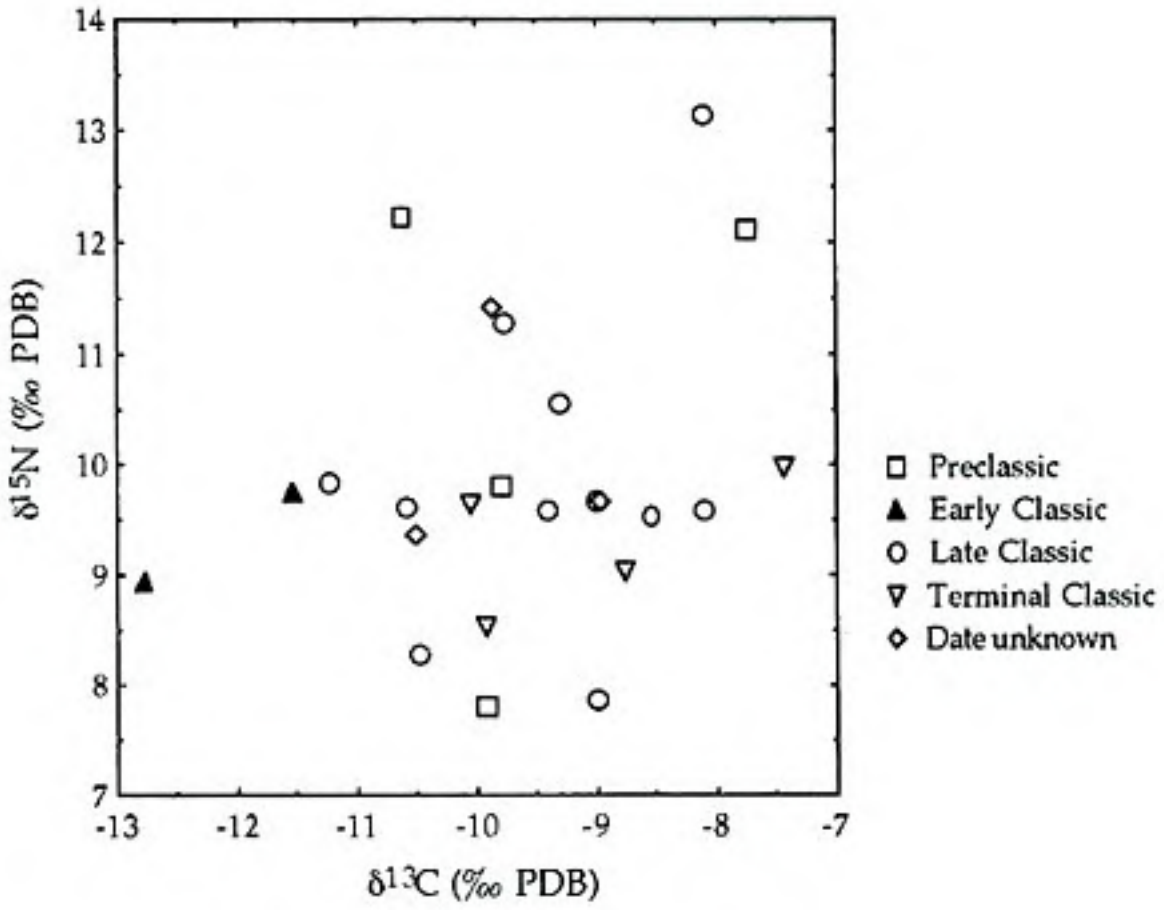

Figure 6. Isotopic composition of bone collagen from Tikal, excluding poorly preserved collagen samples.

Nine PNT third molars were sampled to evaluate enamel preservation, Table 4. On acid dissolution, carbon dioxide yields were consistently 2.0 to 2.5% by weight, and do not indicate significant carbonate contamination. FTIR spectrometry was used to examine mineral integrity following the procedures of Wright and Schwarcz (1996). None of the samples show peaks that would indicate calcite contamination. All of the samples show consistent crystallinity indices and carbonate/phosphate ratios (C/P); none demonstrate carbonate uptake or diagenetic exchange. For three samples, examined before and after acid leaching, acetic acid had little effect on carbon dioxide yields, but untreated enamel is isotopically lighter than acid-leached enamel by 0.24 to 0.45‰. Hence, acid leaching does remove a very small amount of diagenetic, isotopically-light, soil carbonate, and is necessary to recover a biogenic carbonate signal from Tikal enamel.

Prospects for Future Work

Both the PNT and PTP collections deserve continued research and curation efforts. The PNT collection holds greater potential because of greater security of burial identification of the bones and also greater representation of skeletal elements. A sizable proportion of the remains are useful for study of infection and anemia, as well as dental health. Both porotic hyperostosis and periostitis were noted on several skeletons and merit detailed study. Although few skeletons have complete long bones from which to estimate stature, alternate strategies using standard bone fragments should be applicable to many. Paleodietary analysis is also complicated by consolidation but biogenic data can be recovered, so isotopic analysis holds considerable potential to illuminate social and agronomic patterns in Tikal's dietary history.

The most serious problem affecting the collections is the separate curation of bone elements from a single burial, which could lead to further commingling and provenience loss. Likewise, once repatriated from the US, reintegration of PTP remains with national collections will be critical to ensure future research potential. A thorough research-based inventory program would provide a means to resolve these issues, and secure adequate curation of Tikal's inhabitants for the future. From this preliminary study, I hope to be able to design such a program.

Acknowledgements

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Appendix: Laboratory Methods

Consolidant Removal:

The following procedure was adopted after some experimentation. Prior to collagen extraction, visible surface consolidant was removed using a Foredom diamond burr. Samples were soaked in distilled water overnight, then in 0.25M HC1 for 10 minutes. The acid dissolved a small amount of surface bone, further loosening any remaining consolidant. The samples were then rinsed with dH_2O, and then soaked for several

days in 100% ethanol with periodic ultrasonic agitation. Dry samples were inspected microscopically to ensure no visible glue residue.

Collagen and Glue Preparations:

After weighing, bone samples were demineralized in 0.25M HC1 for several days, treated with 0.125M NaOH overnight, and rinsed to neutrality in dH_2O. Collagen and glue samples were combusted with cupric oxide under vacuum in Pyrex tubes at 550oC for 2 hours. Resulting gasses were purified cryogenically and collected for mass spectrometry. Atomic C/N ratios were calculated from gas volumes measured manometrically.

Enamel Preparations:

Enamel samples were taken from the distal aspect of the third molar, extending from cusp to crown. Enamel was finely ground, soaked in bleach overnight, rinsed with dH_2O, and then soaked in 1M buffered acetic acid overnight and rinsed to neutrality. Samples were analyzed using the Isocarb automated system on the VG Optima mass spectrometer. Each sample was analyzed twice in succession, and the second measurement is deemed most reliable as any memory effect should be from the prior sample. Carbon dioxide yields were calculated from strength of the spectrometer beam, calibrated by reaction of known mass samples of calcium carbonate. Fourier Transform Infrared Spectrometry (FTIR) was used to examine enamel mineralogy, following the method of Wright & Schwarcz (1996).

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Table 1. Skeletal Inventory: Proyecto Nacional Tikal

	Location: T=at Tikal, M=at museum, M-=quick inventory, museum;										
	Age: YA=20-35, MA=36-50 year, OA=>50 years;										
	Sex: M=Male, F=Female;										
	Sex?: C=cranial, P=pelvic;										
	Quick inventory: +=present, -=absent										
						Scorable Pathology & Inventory					
Burial	Locat.	Phase	Age	Sex	Sex?	Cranium	Teeth	Longbones	Axial	Stature?	Notes
001	T	Chuen/Ca	YA	M?	C	eroded	good	eroded	-		
002	T	Chuen	OA	M	C, P	consolidated	am loss	good	good	-	ti/fi periostitis, mt/mc fractures
003	T	Tzec	Y/MA	M	C	frags	good*	epiphyses	-	fibula	mutilated teeth removed
004	T	Chuen	YA	F	P, C	excellent	good	good	-	-	
005	T	Imix	M/OA	?	P	frags	-	-	3 verts	-	
005	T	Imix	infant	?	C	R temporal	-	-	-	-	
006	T	Imix	infant	?	-	frags	-	good	few	humeri	
006	T	Imix	child	?	-	-	-	few	ischium	-	few bones with unfused epi
006	T	Imix	2 adults	?	-	-	lots	few	good	-	
007	T		adult	M	C	good	?	few	few	-	
007	T		adult	F?	C	face only	few	-	-	-	
008	T	Imix	adult	M?	C	eroded	-	few	few	-	cranial deformation
009	T	Imix	18 ± 3 yr	F?	-	frags	good	frags	-	-	red paint
010	T	Imix	adult	?	-	eroded	good	eroded	few	-	
011	T	Imix	9 mo ± 3	?	-	frags	4	frags	-	-	occipital flattened

012	T	Imix	adult	?	-	-	-	-	pedal	-	
013	T	Imix	9 ± 3 mo	?	-	reconstr.	good	frags	-	-	
014	T	Imix	5 yr ± 18 mo	?		-	good	-	-	-	
015	T	Tzec	M/OA	F?	C	eroded	few	few	-	-	
016	T	Manik 1	adult	?	C	Frags, eroded	few	-	-	-	
017	T	Manik 1	adult	M?	C	frag	-	-	-	-	
018	T	Manik 1	child	?	P	-	-	frags	-	-	poss. adult mc & m. phalanges
019	T	Manik	MA	M?	P	-	few	frags	few	-	sacroiliac synostosis, red paint drips
020	T	Manik	adult	M	P, C	good	good	frags	few	-	fibular periostitis
021	T	Manik 1	YA	?	C	-	few	-	-	-	
022B	T	Manik 1	15 yr ± 3	?	C	-	good	-	-	-	
022C	T	Manik 1	12 yr ± 3	?	C	-	good	few	-	-	postcranial not likely same indiv.
022D	T	Manik 1	MA	M?	C	reconstr.	good	-	C2 dens	-	
022E?	T	Manik 1	7 yr ± 2	?	C	reconstr.	few	few	-	-	cut marks on R femur??
022H	T	Manik 1	1 yr ± 4 mo	?	C	-	few	few	-	-	postcranial of older child
022I	T	Manik 1	9 yr ± 2	?	C	reconstr.	good	-	-	-	
022L	T	Manik 1	MA	M??	C	mandible	good	-	-	-	
022E12	T	Manik 1	8 yr ± 2	?	C	-	good	-	-	-	
022 ?	T	Manik 1	6 yr ± 2	?	C	frags	good	few	-	-	several bags juv postcr. unid
024	T	Manik	MA	F?	P, C	good	few	frags	-	-	
025	T	Manik	YA	M?	P, C	eroded	few	frags	few	-	L5 sacralization?
026	T	Manik 2	9 mo ± 3	?	C	frags	good	-	-	-	

027	T	Imix	?	?	-	-	1	-	hand	-	
028	T	Imix?	YA	M?	C	face only	few	few	-	-	
029	T	Manik 3	18 mo ± 6	?	C	frags	few	few	good	-	+ ad. ribs & 3 L clav, charred
031	T	Eb	17-30	F?	P	-	-	excellent	few	hum, ulna	
032	T	Cauac	adult	?	-	-	-	frags	-	-	
033	T	Eznab	YA	?	-	-	-	frags	-	-	
034	T	Ik	adult	F?	C	frags	few	frags	-	-	
035	T		9 ± 3 mo	?	-	frags	good	good	good	-	
036	T	Ik	YA	F?	P, C	frags	-	frags	few	-	
037	T	Eznab	adult	?	C	consolidated	few	few	-	-	
038	T	Imix	OA	F	P, C	good	good	frags	good	-	no deformation
040	T	Eznab	1 yr ± 4 mo	?	-	good	good	good	few	-	deformation + periostitis
040	T	Eznab	adult	?	-	-	-	few			
041	T	Eznab	2 adults	M+?	C	excellent	good	good	few	-	periostitis
042	T	Imix	adult	?	-	-	few	frags	-	-	
043	T	Imix ?	M/OA	F?	C	frags	few	frags	-	-	
045	T	Imix ?	adult	M?	C	eroded	good	eroded	-	-	deformation
047	T		2 yr ± 8 mo	?	-	frags	good	frags	-	-	
048	T	Imix	Y/MA	M?	C	frags	good	frags	few	-	
049	T	Imix	adult	?	-	few frags	few	few	-	-	
050	T		1 yr ± 4 mo	?	-	good	few	frags	few	-	
051	T	Imix	9 mo ± 3 mo	?	-	good	few	good	-	-	deformation
052	T	Imix	birth ± 2 mo	?	-	few frags	few	good	few	-	
053	T	Imix	adult	?	-	-	-	eroded	-	-	
054	T		adult	?	-	frags, soil	-	frags	-	-	

055	T	Imix	Y/MA	M	P, C	excellent	good	excellent	good	-	tibial periostitis
056	T	Imix ?	YA	?	-	good	-	-	-	-	
057	T		perinatal	?	size	-	-	few	-	-	+ adult L gr. multangular
058	T	Imix	15 ± 3 yr	?	C	good	good	good	few	-	woven periostitis
058	T	Imix	YA	?	-		good				
059	T	Manik	YA	M	P	-	-	frags	-	-	green fractures
059	T	Manik	MA	M	P						
059	T	Manik	subadult	?	C	frags, smoked					
062	T	Manik 2	adult	?	-	-	few	frags	-	-	red paint
063	T	Manik 2	15-20	F?	P	good	good	eroded	few	-	
064	T	Manik 3-Ik	adult	?	-	-	-	-	-	-	tibial periostitis
064	T	Manik 3-Ik	OA	?	-	-	am loss	-	-	-	
065	T	Imix	adult	?	-	-	-	frags	-	-	
066	T	Manik-Ik	adult	?	-	-	-	frags	-	-	
067	T	Manik 3	YA?	F?	P	-	-	good	-	-	
070	M-	Manik 2	?	?	-	+	+	+	-	-	
072	T	Eznab	M/OA	M	P, C	good	good	good	good	fibula	lumbar osteophytes
072	T	Eznab	A	?		-	good	-	-	-	
072B	M-	Eznab	adult	?	-	-	+	-	-	-	
073	T	Imix	adult	F?	C	eroded	good	eroded	-	-	
076	M-	Manik-Ik	infant	?	-	+	-	+	-	-	
078	M-	Imix?	<5 yr	?	-	-	+	-	-	-	
079	M-	Imix	<5 yr	?	-	-	+	-	-	-	
081	M-	Imix	?	?	-	-	+	-	-	-	
082	M-	Imix	?	?	-	-	+	-	-	-	

083	M-	Imix	?	?	-	-	+	-	-	-	
085	M-	Imix	?	?	-	-	-	femora	-	-	bagged as path specimens
086	M-	Imix	adult?	?	-	-	-	+	+	-	
087	M-	Imix	adult	?	-	-	+	+	-	-	
088	M-	Imix	adult	M?	-	+	+	+	+	-	
089	M-	Imix	adult	?	-	-	+	+	-	-	
090	M	Imix	adult	F?	C	good	good	-	+	-	maxilla/mand glued
091	M-	Imix	adult	M?	-	+	+	+	-	-	
092	M-	Imix	adult	?	-	-	+	+	-	-	
093	M-	Manik	?	?	-	-	+	+	-	-	
094	M-	Imix	?	?	-	-	+	-	-	-	
095	M-		adult	?	-	+	+	+	+	-	
096	M	Imix	MA	M	P	mandible	good	good	+	-	fem/tib/fib periostitis
097	M-	Imix	?	?	-	+	+	+	-	-	
098	M	Imix	MA	F	P	good	few	good	few	-	tabular oblique
099	M	Imix	child	?	C	frags	good	frags	few	-	unwashed, no consolidant
100	M	Imix	OA	F?	C	frags	am loss	frags	-	-	unwashed
101	M	Imix	adult	F	P, C	reconstr.	good	good	-	-	tabular oblique
102	M	Imix	YA	F	C	good	-	-	-	-	lambdoid flattening
103	M	Imix	adult	F	P	frags	few	good	good	femur	
104	M-	Manik 3	adult	F?	C	+	+	+	+	-	
104A	M-	Manik 3	adult	M?	C	-	+	-	-	-	
105	M-	Manik 3-Imix	?	?	-	+	+	+	-	-	
106	M-	Manik 3	18 mo - 4 yr	?	-	+	+	-	-	-	

107	M-	Imix	?	?	-	-	-	+	-	-	
108A	M	Imix	adult	M?	C	frags	few	few	-	-	MNI = 3
109A	M-	Imix	MNI <2	?	-	+	+	+	-	-	femur bagged with path
110A	M	Manik 2	adult	?	C	eroded	-	eroded	few	-	
110B	M	Manik 2	adult	M?	C	frags	-	-	-	-	
110C	M	Manik 2	adult	?	-	eroded	-	-	-	-	
111	M-	Manik 2	2? adults	?	-	+	+	+	-	-	
112	M-	Imix	?	?	-	+	-	+	-	-	
113	M	Manik	OA	F	P, C	reconstr.	am loss	good	few	-	
114	M-	Manik 2	?	?	-	-	-	+	-	-	
115	M-	Manik	adult	?	-	-	-	L femur	+	-	L femur healed spiral fracture
117	M-	Imix	?	?	-	+	+	+	+	-	
118	M-	Imix	adult	?	-	+	+	+	-	-	
119	M	Imix	adult	?	-	+	-	+	+	-	cranium in soil/lime/glue
120	M-	Imix	?	?	-	+	-	+	+	-	
121	M-	Imix	adult	M	C	reconstr.	-	+	-	-	tabular oblique
122	M	Imix	adult	?	-	+	-	+	-	-	cranium in block of soil
123	M-	Imix	?	?	-	-	-	+	-	-	
124	M-	Imix	?	?	-	-	+	+	-	-	
125	M-	Ik	adult	?	-	+	-	+	-	-	
126	M-	Imix	?	?	-	+	+	+	-	-	
127	M-	Imix	adult	M	C	+	+	+	-	-	
128	M-		MA	?	-	+	+	-	+	-	
129	M-		?	?	-	+	-	+	+	-	
130	M-	Imix	?	?	-	+	-	+	+	-	

131	M-	Imix	?	?	-	+	-	+	+	-	
132	M	Manik 3	adult	?	-	eroded	few	+	-	-	
133	M-		?	?	-	+	+	+	-	-	
134	M	Ik	adult	F?	C	reconstr.	few	+	-	-	
136	M-		?	?	-	+	+	-	-	-	
137	M	Caban	child	?	C	frags	good	shafts	-	-	
138A	M-	Chuen Te…	?	?	-	+	-	+	+	-	
138B	M-	Chuen Te…	adult	?	-	-	+	-	-	-	
139	M-	Manik	subadult	?	-	+	-	-	-	-	
140	M	Imiz-Eznab	adult	?	-	reconstr.	-	-	-	-	unwashed
141A	M	Manik 3	10-12 yr	?	-	reconstr.	good	good	few	hu/rad/ul	tib/fib periostitis
141B	M	Manik 3A	>10 yr	?	-	+	+	+	+	-	
142	M-	Imix	adult	?	-	-	+	-	-	-	glue, tabular oblique
143AB	M	Manik	2 adults	M, F	P	1 reconstr.	-	frags	good	-	putty; ribs/ F ilia burned dry
144	M-	Manik 3-Ik	adult	?	-	+	+	+	-	-	
145	M	Imix	6 yr?	?	C	reconstr.	good	good	good	-	in soil w glue, excavatable?
146	M	Imix	MA	F	C, P	reconstr.	good	good	few	-	tab. oblique, plasticene soil reconst.
147	M-	Imix	M/OA	M?	C	good	few	good	-	hu/rad/ul	tabular oblique, soil & glue
148	M	Imix	OA	F	C, P	good	am loss	frags	-	-	Resistol over red paint
148?	M	Imix	MA	M							lables confused with 141B?
149	M		YA	F?	P, C	reconstr.	good	good	lumbar	hum/rem	unwashed, most no glue
150	M	Manik	6 yr + 2	?	-	good	good	few	few	-	

151	M-	Imix	?	?	-	-	-	+	-	-	
152	M-	Imix	?	?	-	+	+	+	+	-	
153	M	Manik 2	2 yr ± 8 mo	?	-	good	good	good	few	humerus	
154	M	Imix	2 adults	M+?	C	frags	good	good	-	-	
156	M-	Manik 3	adult	?	-	bagged as 162					
157	M-	Manik 3	?	?	-	-	+	-	-	-	
158	M	Imix ?	adult	?	C	reconstr.	-	-	-	-	tabular oblique, lots of glue
159	M-	Manik 3	?	?	-	+	-	+	-	-	
160a	M	Manik 2	adult	?	-	-	1	-	few	-	4 individuals mixed A-D
160b	M	Manik 2	2 infants	?	-	reconstr.	good	few	-	-	4 individuals mixed A-D
160d	M	Manik 2	child	?	-	frags	few	few	few	-	4 individuals mixed A-D
161	M	Imix	OA	M	C	reconstr.	am loss	frags	-	-	
162	M	Imix	OA	F	P	complete	-	good	good	hu/fe/ul	fe/ti/fi periostitis, no defn.
163	M	Imix	adult	F?	C	frags	few	frags	-	-	
164	M	Manik	adult	?	C	good	good	-	-	-	glue and plasticene over soil
165	M-	Manik	?	?	-	+	-	-	-	-	
167	M	Manik 3- l…	adolescent	F?	C	good	-	-	-	-	glue, wire, plasticene; PH
168	M-	Manik	adult	M	C	lime/glue	+				
169	M-	Imix	adult?	?	-	-	+	-	-	-	
171	M	Manik 3	2 adults?	M, F	P, C	frags	few	frags	-	-	second?; polish boss par. & frontal
172	M-	Manik 3	adult	?	-	-	+	-	-	-	
173	M-	Imix ?	child 9 yr	?	-	-	+	-	-	-	

174	M	Manik 3	MNI = 4	?	-	soil & glue	good	frags	-	-	infant, adolescent, + adults
176	M-	Imix ?	infant	?	-	-	+	-	-	-	
177	M-	Manik 3	adult	M	C	-	+	-	-	-	
178	M	Manik 3	adult	F	C	reconstr.	-	-	-	-	occipital periostitis, sclerotic
179	M	Manik 3	adult	?	-	reconstr.	few	frags	-	-	
247	T	?	OA	?	C	excellent	am loss	good	-	-	Uaxactun/Acevedo, soil block

Table 2. Pennsylvania Tikal Project: Burial Inventory at Bodega of Parque Nacional Tikal

*Burial ID given in normal text is from Haviland's original bone lables. Italics indicate less secure identification.

P= paper note gives ID, D= drawer lable, B= plastic bag lable, copied by registro from original PTP paper bags?

						Scorable Pathology & inventory					
Burial*; Bone lables	Registro #	Gavetero	Age	Sex	Sex?	Cranium	Teeth	Longbone	Axial	Stature?	Notes
B 5; 4C-7	17.1.1.3256	52-A	M/OA	?	-	-	-	few	good	-	
B 10; P		52-C	child	?	-	-	adult??	few	-	-	L fe, red paint: 47-I
B 15	17.1.1.3259	52-D	adult	F?	C	mandible	good	-	-	-	
B 15	17.1.1.3259	52-D	4 yr ± 1	?	-	-	good	-	-	-	
B 17		52-D	M/OA	F	C	reconstr.	am loss	few	-	-	unwashed, good
B 18	17.1.1.3261	52-D	child	?	-	-	good	-	-	-	
B 20; B	17.1.1.3262	52-D	subadult	?	-	reconstr.	-	-	hips	-	
B 22; B	17.1.1.3263	52-D	2 child	?	-	-	-	few	-	humerus	
B 23; B	17.1.1.3264	52-D	adult	?	-	frags	few	-	-	-	red paint
B 26; 20B-249	17.1.1.3265	52-E	adult	?	-	-	-	few	-	-	
B 27; 20B-251	17.1.1.3269	52-F	YA	M?	size	frags	-	few	-	-	infant occip
B 28; 20B-252	17.1.1.3269	52-F	adult	?	-	reconstr.	-	-	few	-	
B 29	17.1.1.3270	52-G	?	?	-	reconstr.	-	-	-	-	
B 31; B	17.1.1.3271	52-G	adult	?F?	C	frag	-	frags	-	-	eroded, infant cranuim
B 32;	17.1.1.3272	52-G	adult	?	-	eroded frag	mand	frags	-	-	chalky, deter.

20E/238											glue
B 33; B	17.1.1.3273	52-G	adult	?	-	-	-	few	-	-	
B 34	17.1.1.3274	52-G	adult	?	-	in soil	-	-	-	-	
B 35; 20H-41	17.1.1.3275	52-H	adult	?	-	few frags	-	few	-	-	
B 36	17.1.1.3276	52-H	infant	?	-	in soil	-	-	-	-	
B 37	17.1.1.3277	52-H	adolescent	?	size	-	-	few	-	-	eroded, deteriorated glue
B 38; 20H-128	17.1.1.3278	52-I	adult	?	-	eroded frag	-	good	-	-	glue over soil, erosion
B 39	17.1.1.3279	52-I	adult	?	-	in soil	-	-	-	-	
B 40; 20L-170	17.1.1.3280	52-I	adult	?	-	-	-	frags	-	-	glue over soil
B 42; 20L-174	17.1.1.3281	52-K	adult	?	-	-	am loss	frags	-	-	extra cran, max teeth
B 43	17.1.1.3282	52-K	adult	?	-	soil block	-	few	-	-	unwashed, eroded
B 44; B	17.1.1.3283	52-I	adult	?	-	in soil	-	-	-	-	
B 49; P	17.1.1.3305	48-G	?	?	-	-	good	-	-	-	
B 63; 24F-24	17.1.1.3148	51-1A	MA	F	P,C	good/eroded	-	frags	good	-	ti/fi periost., cr: 47-D
B 69; DB (not 63)	17.1.1.3149	51-1A	OA	F	P	-	-	-	hips	-	
B 72	17.1.1.3150	51-2B	OA	M??	C	mandible	am loss	few	good	-	weathering, Mand; 47-G
B 77; BD	17.1.1.3152	51-A	adult	?	-	mandible	-	-	-	-	weathering
B 88; BD	17.1.1.3151	51-A	adult	?	-	-	-	-	ilium	-	
B 98; BD	17.1.1.3153	51-A	adult	?	-	-	good	-	-	-	
B 95		51-2B	adult	?	-	frags	-	clav	ribs	-	polished spatula

											& tube
B 102; vial lable	17.1.1.3158	51-C	adult	?	-	-	few	-	-	-	
B 104	17.1.1.3314	47-G	adult	M	C	mandible	am loss	-	-	-	
B 105	17.1.1.3313	47-F	adult	F??	C	par/oc/ter	-	-	-	-	frontal flat, glue & soil
B 107B; P	17.1.1.3159	51-C	adult	M	-	2 mandible	good	-	-	-	
B 108	-	46-A	adult	M?	C	mandible	-	L rad/ul,	-	-	mand: 47-G
B 116	17.1.1.3314	47-G	adult	M?	C	mandible	am loss?				some teeth pm loss
B 117; 12P/191		51-3C	infant	?	-	reconstr.	-	good	pedicl…	-	red paint fingerprint
B 118; B	17.1.1.3161	51-C	OA	?	-	mandible	am loss	-	-	-	
B 120; BD	17.1.1.3165	51-E	OA	M	C	reconstr.	-	few	-	-	maybe 105,6,7,8
B 121	17.1.1.3166	51-5E	child	?	-	good	-	few	good	-	lots of consolidant
B 124; B	17.1.1.3170	51-F	2 adults	?	-	mand/max	-	-	-	-	
B 125; 126-?/18		51-6F	adult	?male	size	-	-	MNI = 2	-	-	no collagen
B 126; B	17.1.1.3169	51-F	?	?	-	-	-	radius	hands	-	
B 127; B	17.1.1.3171	51-F	18 ± 6 mo	?	-	-	good	-	-	-	
B 128; B	17.1.1.3208	49-F	adult	?	-	mandible	good	-	-	-	I1 = B4, L&RI2 = A4
B 129	17.1.1.3318	47-I	adult	?	-	-	-	R femur	-	-	
B 131; B	17.1.1.3173	51-F	M/OA	?	C	reconstr.	am loss	-	-	-	
B 139; B	17.1.1.3174	51-G	?	?	-	-	3 teeth	-	-	-	
B 144; B	17.1.1.3175	51-G	?	?	-	-	-	frags	foot	-	
B 151	17.1.1.3318	47-I	?	?	-	-	-	fem, rad	-	-	

B 160; D	17.1.1.3176	51-8H	child	?	-	-	-	good	-	-	external weathering, glue
B 160B; D	17.1.1.3177	51-9I	child	?	-	good	-	few	scap,	rad/ul	hair on cranium
B 160C		51-9I	adult	M??	size	-	-	few	scap/…	ra/ul	L rad periost., glue, red paint
B 162; B	17.1.1.3179	50-A	adult	F??	size	-	-	few	good	femur	child molar, extra C2 adult
B 166; BD	17.1.1.3180	50-A	MA	F	P	-	good	few	few	-	weathering, tib periost.
B 166B(2); D	17.1.1.3182	50-B	Y/MA	F	P, C	good 48-C	-	few	few	-	weathering, red
B 166A; P	17.1.1.3181	50-A	adult	F?	C	good	good	-	-	-	calculus, cr:47-F, weather
B 167; D	17.1.1.3183	50-C	adult	?	-	mand	good	few	few	-	except teeth: B?48-C ..3295
B 168; P	17.1.1.3184	50-D	adult	?	-	-	-	frags	-	-	
B 169 or 170; D	17.1.1.3185	50-D	adolescent	?	-	reconstr.	-	-	-	-	
B 171; P	17.1.1.3187	50-E	adult	M?	C	good	good	frags	-	-	mixed with 173?, cr: 47-F
B 173; 84A-1/9	17.1.1.3187	50-E	adolescent	F??	size	front/par	-	few	-	-	mixed with 171?, cr: 47-F
B 177; 87A-11	17.1.1.3190	50-G	YA	M?	C	good	good	frags	-	-	MNI = 4 by teeth
B 180; 96M-4/4; PD	17.1.1.3191	50-H	adult	?	-	-	-	frags	good	-	
B 182; BD		50-1A	adult	?	-	-	-	frags	-	-	worked femur
B 183; 98D-72/12	17.1.1.3193	50-K	MA	M?	C	reconstr.	good	frags	-	-	chalky, erosion
B 184; BD	17.1.1.3194	49-1A	OA	F??	C	eroded	-	frags	good	-	cr: 47-D, lambdoid flat

B 185; 98D-73/21	17.1.1.3195	49-B	M/OA	?	-	-	few	frag	-	-	all surfaces eroded
B 186; BD	17.1.1.3196	49-C	adult	?	-	-	-	few	-	-	drawer lable only
B 187; BD	17.1.1.3197	49-C	OA	F	C	frags	am loss	few	-	-	consolidant over soil
B 188; 112B-10/7	17.1.1.3198	49-D	YA	M	C	good	-	-	-	-	tab. oblique, healed PH
B190; 3B-118/19	17.1.1.3199	49-D	12 yr ± 3	?	C	-	good	-	-	-	
B 192; B	17.1.1.3200	49-D	adult	?	-	-	-	L rad/ul	-	-	
B 193; P	17.1.1.3202	49-E	OA	F	P	frags	-	good	-	fe,ti,fi,hu..	very arthritic
B 195; BD	17.1.1.3203	49-E	adult	?	-	-	good	-	-	-	RP3 missing incrustation
B 205; 136H-14/12	17.1.1.3206	49-F	adult	M	C	mand/max	good	femur	-	-	fe: 47-I
B 206; 129d/8;B	17.1.1.3205	49-F	adult	?	-	-	good	-	-	-	incised L max I1 & 2, D1
B 207; 137P-1/12; P	17.1.17	49-F	adult		-	mandible	-	-	-	-	
PD 1; 27B-78/4	17.1.1.3284	48-1A	<21	M	P, C	reconstr.	-	fe only	-	-	extra cranial frags
PD 8; 31C-5/3		48-1A	MA	M?	C	oc & par	-	hu only	-	-	
PD 8; 31C-5/3			child	?	-	good	-	-			external weathering
B 8/PD 48; PD		52-C	adult	?	-	-	-	R tibia	-	-	chalky
B 111K	17.1.1.3164	51-E	YA	?	-	reconstr.	few	few	-	-	extra R mand: lable 111D
B111J	17.1.1.3311	47-B	adult	F	C	excellent	-	-	-	-	no deformation

B 111F	17.1.1.3312	47-D	adult	?	C	occip/par	-	-	-	-	no deformation
B 111G	17.1.1.3312	47-D	adult	M	C	good	-	-	-	-	tabular oblique

Table 3. Stable Isotopic Results of PNT Bone Samples

Burial	Period	Phase	Age	Sex	% yield	C:N	d13C	d15N
PNT-001	Preclassic	Chuen	young	male	0.1			11.941
PNT-002	Preclassic	Tzec	old	male	4.5	3.06	-9.031	
PNT-003	Preclassic	Tzec	young	male	6.1	3.10	-7.762	12.110
PNT-004	Preclassic	Chuen	young	female	2.4	2.75	-11.388	9.248
PNT-005	Late Classic	Imix	middle	?	9.2	2.97	-9.774	11.270
PNT-006	Late Classic	Imix	infant	?	13.2	3.06	-8.101	13.136
PNT-007	?	?	adult	?	21.8	3.14	-8.978	9.665
PNT-008	?	?	adult	male	5.7	2.97	-10.498	9.365
PNT-009	Late Classic	Imix	young	female	0.1	4.50	-17.822	
PNT-013	Late Classic	Imix	infant	?	0.3	1.25	-21.215	
PNT-015	Preclassic	Tzec	middle	female	2.2	3.08	-10.624	12.214
PNT-019	Early Classic	Manik	middle	male	1.2	0.50	3.147	
PNT-020	Early Classic	Manik	adult	male	0.0			
PNT-024	Early Classic	Manik	middle	female	0.1	3.50	-19.695	
PNT-025	Early Classic	Manik	young	male	0.0			

PNT-026	Early Classic	Manik			0.2	3.44	-11.158	
PNT-028	Late Classic	Imix	young	male	13.6	3.00	-8.539	9.524
PNT-031	Preclassic	Eb	young	female	2.0	3.09	-9.806	9.798
PNT-032	Preclassic	Cauac	adult	?	3.9	3.03	-9.930	7.795
PNT-034	Late Classic	Ik	adult	female	7.8	3.00	-8.997	7.865
PNT-035	?	?	infant	?	3.3	3.71	-7.671	11.286
PNT-036	Late Classic	Ik	young	female	0.0			
PNT-037	Terminal Classic	Eznab	adult	?	5.7	3.06	-9.917	8.528
PNT-038	Late Classic	Imix	old	female	3.1	3.02	-10.587	9.599
PNT-040	Terminal Classic	Eznab	infant	?	13.0	2.96	-7.419	9.984
PNT-041	Terminal Classic	Eznab	adult	male	7.0	2.98	-8.776	9.026
PNT-042	Late Classic	Imix	adult	?	9.6	2.86	-9.411	9.574
PNT-042R	repeat preparation						-9.907	8.692
PNT-043	Late Classic	Imix	middle	female	4.5	3.05	-10.468	8.290
PNT-046ETOH	Late Classic	Imix	adult	?	4.9	2.96	-8.105	9.597
PNT-046Super	Late Classic	Imix	adult	?	4.6	3.02	-8.215	9.634
PNT-055	Late Classic	Imix	young	male	5.5	3.08	-9.003	9.668
PNT-055R	repeat preparation				5.6	2.98	-9.148	10.099
PNT-056	Late Classic	Imix	young	?	6.9	2.95	-11.227	9.845
PNT-056R	repeat preparation				5.8	2.07	-11.119	8.771
PNT-058	Late Classic	Imix	young	?	6.6	2.92	-9.306	10.559
PNT-059	Early Classic	Manik	young	male	4.8	2.94	-11.532	9.753
PNT-059R	repeat preparation				4.0	2.65	-11.546	9.584
PNT-062	Early Classic	Manik	adult	?	0.1	2.50	-21.267	
PNT-063	Early Classic	Manik	adolescent	female	0.3	2.88	-14.233	
PNT-067	Early Classic	Manik	young	female	2.8	3.00	-12.768	8.944

PNT-072	Terminal Classic	Eznab	middle	male	10.1	2.91	-9.924	9.671
PNT-072R	repeat preparation				11.6	3.12	-10.040	9.640
PNT-073	Late Classic	Imix	adult	female	0.0			
PNT-247	Uaxactun	?	old	?	5.4	2.92	-9.867	11.414

Table 4. Stable Isotopic Results on PNT third Molar Enamel Samples

					—FTIR Spectrometry—				—Acetic Acid Treated Samples—				No Acetic Acid	
Burial	Period	Phase	Age	Sex	CI	CI sd	C/P	C/P sd	d13C 1st	d13C 2nd	d180 1st	d180 2nd	d13C	d180
PNT-001	Preclassic	Chuen	young	male	4.19	0.014	0.094	0.012	-1.98	-2.00	-0.04	-0.05		
PNT-003	Preclassic	Tzec	young	male	4.79	0.166	0.087	0.002	-1.68	-1.72	-1.01	-0.98		
PNT-009	Late Classic	Imix	young	female	4.43	0.061	0.092	0.009	-2.26	-2.26	-0.94	-0.95		
PNT-021	Preclassic	Cimi	young	?	4.64	0.012	0.094	0.000	-2.59	-2.58	-2.11	-2.11	-2.84	-2.41
PNT-025	Early	Manik	young	male	4.77	0.113	0.088	0.002	-2.16	-2.08	-2.97	-2.98	-2.53	-2.96
PNT-028	Late Classic	Imix	young	male	4.59	0.057	0.095	0.000	-3.20	-3.23	-1.12	-1.18		
PNT-046	Late Classic	Imix	adult	?	4.40	0.059	0.096	0.005	-1.00	-1.03	-1.70	-1.63		
PNT-055	Late Classic	Imix	young	male	4.54	0.251	0.095	0.001	-5.88	-5.95	-3.19	-3.16		
PNT-073	Late Classic	Imix	adult	female	4.67	0.152	0.092	0.006	-2.50	-2.46	-2.19	-2.16	-2.70	-2.39

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