ANCESTRAL ANIMACIES: TERMINAL CLASSIC MAYA PILGRIMAGES TO CARA BLANCA BELIZE AND THE GREATER THEORETICAL IMPLICATIONS OF THE CEREMONIAL HUMAN CACHES THEY INTERRED

BY

AMY LEIGH COPPER

UNDERGRADUATE THESIS

Submitted to the Department of Anthropology in the College of Liberal Arts and Sciences as part of an undergraduate research program

University of Illinois at Urbana-Champaign. 2019

Advisors:

Advisor: Professor Lisa J. Lucero
Co-Advisor: Assistant Clinical Professor Cris E. Hughes
Lab Research Director: Professor Stanley H. Ambrose

ABSTRACT

Belize is home to the Maya, a group of indigenous people that have thrived and persisted in the area for millennia. Mayanists studying the Terminal Classic (c. 800-925 CE) attribute three factors to the era's political demise: perpetual warfare, overpopulation and its associated environmental impacts, and severe drought. Scholars have suggested that this era's severe droughts occurred in tandem with the fall of the Southern Maya Lowland rulers. Prior to the Terminal Classic, rulers were believed to have been intermediaries between the commoners and their deities. When droughts destroyed significant agricultural yields during the Terminal Classic, rulers failed to uphold their duties and as a result lost their followers. The archaeological record indicates that when the commoners lost faith in their rulers, they began direct interaction with their deities themselves. M186 is a Terminal Classic site located in Cara Blanca (central Belize) that exemplifies the commoners' ideological shift. In the summer of 2018, the Valley of Peace Archaeology Project (VOPA) continued excavations at M186 because it was hypothesized to have been the first step in a ceremonial sequence for the Maya to interact with Chahk the rain god. Human remains were uncovered from this excavation that enrich the story of this site and support the hypothesis of independent spiritual communication from the common Maya. This thesis is centralized around the individual found during the 2018 excavation and aims to accomplish three things. First, to utilize standard bioarchaeological methods to thoroughly synthesize the individual interred in Room 1. Second, to discuss the Strontium, Carbon and Nitrogen isotope analyses conducted on samples of this individual in the spring of 2019. And third, to demonstrate the contextual and theoretical significance that this individual held to M186 and to the realm of Maya ritualistic burials in ritual in general.

Keywords: Terminal Classic Maya, Bioarchaeology, Belize, Ceremonial Circuit

To my perpetually supportive parents, Louis Copper and Mary Pfeiffer, for their exemplary and unwavering tenacity in pursuit of their passions

ACKNOWLEDGMENTS

This project was first and foremost made possible by the stellar support and generosity of Dr. Lisa J. Lucero, Jean Larmon, Jesann Gonzalez, and the Valley of Peace Archaeology Project (VOPA). Professor Lucero operationalized and advised this thesis from conception to completion for which I will be forever grateful. I'm also indebted to Professor Stanley Ambrose and Matthew Fort in the University of Illinois Urbana-Champaign's Paleobiogeochemistry laboratory. Without their patience and knowledge, none of the isotope analyses would have been comprehended, or even conducted. Additionally, I have immense gratitude and respect for Professors Hughes, Davis, and Shackelford at the University of Illinois, all of whom have shaped my understanding of the field of bioarchaeology and the ethics that accompany it. Lastly, I owe great thanks to bioarchaeologist Dr. Anna Novotny at Texas Tech University and Aimée Carbaugh at UIUC who not only guided my skeletal analyses, but have also served as exemplary specialists to me throughout this journey.

TABLE OF CONTENTS

Introduction

The Maya are indigenous inhabitants of Mesoamerica (present day Guatamala, southeast Mexico, and Belize) that have lived in the area as agriculturalists for more than four thousand years. By 700 CE, the Maya were at the height of their development as an exceptionally advanced society. During this time they had successfully stratified into a hierarchical political system, which enabled them to harness mass agricultural production practices to feed populations of millions. They built intricately efficient cities that featured massive pyramids, palaces, plazas and reservoir systems. They developed the most accurate calendar in the ancient world, and additionally created astronomical and hieroglyphic writing systems. The complex cosmocentric ontology which governed their daily lives yielded sustainable ecological practices that equipped them to persist in the area for thousands of years (Lucero 2018). While these accomplishments were not a unilineal cultural evolution, they were emblematic of the profound success of the Maya as a people (Coe and Houston 2015).

Table 1: Maya Chronology (from Coe and Houston 2015: Table 1)

DATES Calibrated	PERIODS	SOUTHERN AREA Pacific Coast	SOUTHERN AREA Highlands	CENTRAL AREA	NORTHERN AREA	SIGNIFICANT DEVELOPMENTS
1530	**Late Postclassic**	Aztec Xoconocho	Mixco Viejo	Tayasal	Independent states Mayapan	*Spanish Conquest* *Highland city-states* *League of Mayapan*
1200	**Early Postclassic**	Tohil Plumbate	Ayampuk		Toltec Chichen	*Toltec hegemony in Yucatan* *Toltec arrive in Yucatan*
925	**Terminal Classic**	Cotzumalhuapa	Quen Santo	Bayal/ Tepeu 3	Puuc, Maya Chichen	*Classic Maya collapse, Putun ascendancy*
800	**Late Classic**		Amatle-Pamplona	Tepeu 2, 1	Early Coba	*Bonampak murals* *Height of Maya civilization*
600	**Early Classic**	Tiquisate	Esperanza	Tzakol 3, 2, 1	Regional styles, Acanceh	*Reign of Janahb Pakal at Palenque* *Teotihuacan interference and influence*
250 AD/BC	**Late Preclassic**	Izapan styles Crucero	Aurora Santa Clara Miraflores	Matzanel Holmul I Chicanel	Late Preclassic	*First lowland Maya dated stela at Tikal* *Massive pyramid-building in lowlands, San Bartolo* *Spread of Izapan civilization, calendar, writing*
300	**Middle Preclassic**	Conchas Jocotal	Las Charcas Arévalo	Mamom Cunil Horizon	Middle Preclassic	*Earliest lowland Maya villages, temple centers*
1000	**Early Preclassic**	Cuadros Cherla Ocós Locona Barra				*Early Olmec influence on Pacific Coast* *Beginnings of social stratification* *Origins of village life, pottery, figurines*
1800	**Archaic**	Chantuto		Belize Archaic		*Some maize horticulture* *Hunting, fishing, gathering*
3000						

Perhaps the most debatable topic that contemporary Mayanists have deliberated is that of the Maya collapse during the Terminal Classic Period (c. 800-925 CE), only 100 years after the climax of their power. Recent scholarly developments have hypothesized that a trifecta of events attributed to their downfall: prolonged warfare, environmental collapse due to overpopulation, and a series of prolonged droughts are all evident within the archaeological and environmental records.

By the end of the Terminal Classic, major cities in the southern lowlands had been abandoned, and with them "an entire world of esoteric knowledge, mythology, and ritual" had disappeared (Coe and Houston 2015:177). The Maya urban diaspora had begun, and while the Maya have continued to live in this region into modernity, they never fully returned to the strict hierarchical system of ontological practices via divine rulership that defined them at their peak (Lucero et al. 2015). How could the philosophical and functional foundation of a society of this caliber transform so drastically within a matter of centuries?

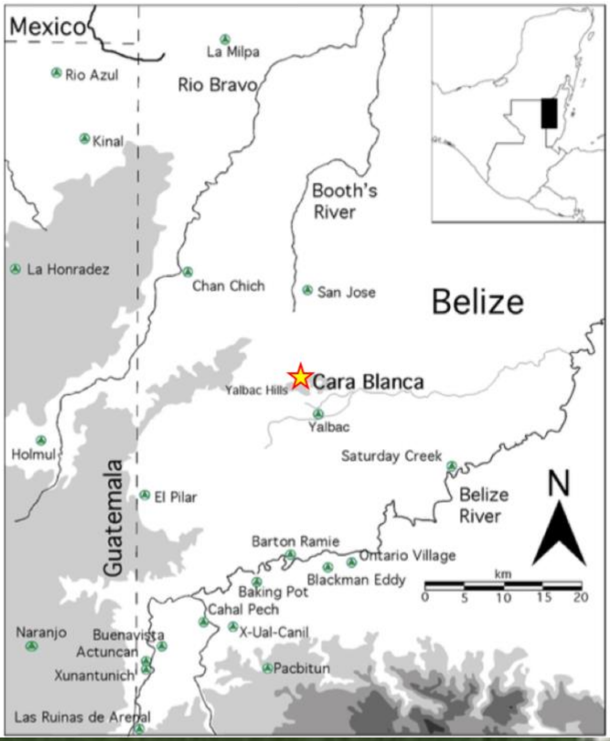
The Maya's resiliency and resourcefulness as a people allowed them to adapt to the adversities of the Terminal Classic rather than be eradicated by them. Recent archaeological excavations have suggested that the Maya continued to practice their cosmocentric ideological rituals, they just tweaked their earlier methods of doing so. As Lucero (2006) suggests, Maya kings were previously revered for their ability to interact with deities such as Chahk, the water god. Rulers utilized this spiritual connection to remain in positions of power. When the substantial and unforgiving droughts hit in the Terminal Classic and Early Post Classic eras, rulers failed to support their claims of association and interaction and in turn lost their followers. The impact of the rulers spiritual failures was foundationally jarring because the success of the Maya was grounded in their agricultural efficiency. When commoners saw that their agricultural systems began to deteriorate, it provoked the question of the legitimacy and honesty of the rulers that the Maya had so tenaciously devoted their lives to (Lucero 2006). These events led Maya commoners to reject their earlier beliefs that Kings served as intermediaries to the deities, and consequently began direct interaction with the deities themselves. This alteration of ritual practice is extremely ideologically significant as it demonstrates that the Maya did not just abandon the religious beliefs central to their identity, they just updated their practices.

Cara Blanca, the site that will be discussed in this thesis, is dated to the Terminal Classic and is particularly interesting because it could be emblematic of the how common people responded during this pivotal era. Cara Blanca is home to 25 cenotes that span along the base of a limestone cliff. *Cenotes* are naturally circular sinkholes fed by groundwater that the Maya believed were portals to the underworld. The Valley of Peace Archaeology project (VOPA) has explored the area since 1997, and in recent years has excavating a series of sacred based structures that border the cenotes. PI L. J. Lucero and the VOPA team suggest that these geographically isolated structures functioned as ceremonial circuits for people, both locals and pilgrims, to come and directly interact with Chahk and their ancestors, forgoing previous rulers serving as the middlemen (Lucero et al. 2016).

Examples such as VOPA's site are vital in understanding the Maya narrative because they demonstrate that the Maya did not disappear after the collapse. Instead, they rose to the tumultuous adversities of their time, adapting to change while retaining their core beliefs. While ancient Maya kings have disappeared, the Maya people have perpetuated into modernity. Recognizing the tenacity that exists within the Maya culture can serve as a model for current problems that modern society faces.

The Cara Blanca Pools and M186

In the summer of 2018, the Valley of Peace Archaeology (VOPA) team continued excavations in Cara Blanca, Belize. Cara Blanca is in the Maya lowlands of central Belize and is comprised of 25 pools consisting of lakes and *cenotes*, spanning east-to-west at the base of a limestone cliff. In previous field seasons, VOPA has hypothesized that structures near the deepest *cenote*, Pool 1 (c. 100 x 70 m, 60+m deep), served as a pilgrimage destination for the Terminal Classic Maya. Lucero and colleagues suggest that the non-elite Maya traveled to the area to participate in a ceremonial circuit which enabled them to interact with their deities and ancestors (Lucero and Kinkella 2015; Lucero et al. 2016; Larmon and Gonzalez 2018).



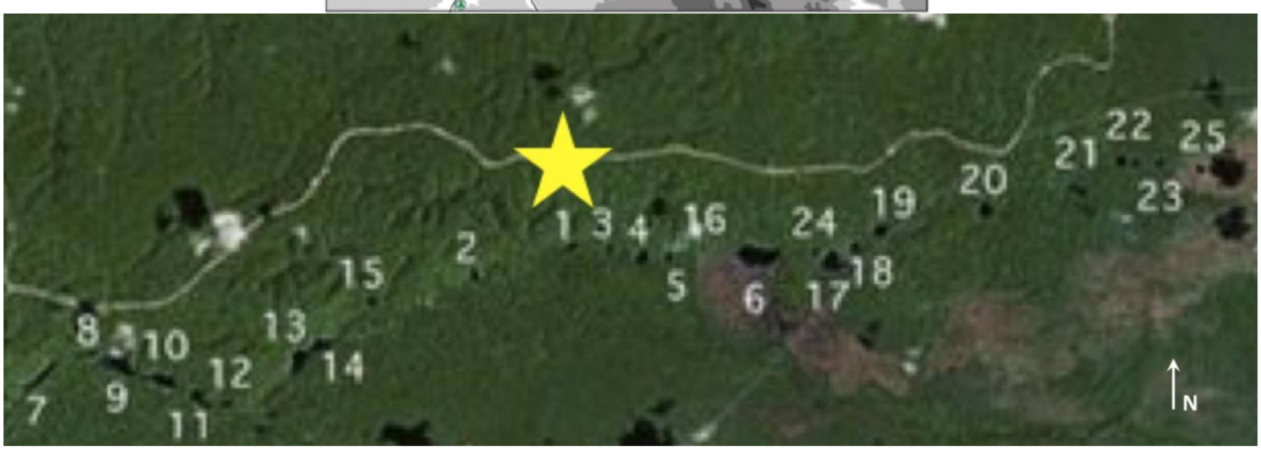


Figure 1 (Upper): Cara Blanca within Belize. Figure 2 (Lower): Cara Blanca Pools. Courtesy of VOPA.

In 2015, VOPA excavated Structure 1 at Pool 1 and concluded that the building functioned as a water temple (Harrison 2015). Next to Structure 1 is Strucure 3, a ceremonial platform that has steps leading directly into the pool. Three individuals in tightly flexed burials were uncovered underneath this platform (Figure 3). While thousands of terminated ceramic sherds were recovered above the platform and throughout the termination fill of the room, no burial goods were directly associated with these individuals. Termination refers to the Maya process of deanimating an object or place, often by breaking the object or filling the space so it can no longer function. Termination rituals were common sacrificial practices of the Maya. The lack of terminated sherds or grave goods near the bodies at Structure 3 is significant because it suggests that these individuals were interred underneath this platform to serve as the animate offering themselves (Carbaugh 2016).

To continue investigating this theory in 2018, VOPA focused their efforts on M186, a ritually significant structure c 450m west of Pool 1. M186 is a long, multi-roomed structure consisting of six narrow rooms with thick (nearly 1m) walls and an attached sweatbath (estimated to have been in use between 800 and 900 CE). Lucero et. al (2015) suggests that the M186 sweatbath was used by the Maya as a cleansing space, after which they proceeded to the water temple and platform (Structure 3, next to Pool 1, less than a ten-minute walk) to perform water rituals (Lucero and Kinkella 2015). VOPA's objective in 2018 was to better understand the functionality of M186 within the larger context of the hypothesized ceremonial circuit, so excavations were focused on the unexplored rooms. The remains of an individual were uncovered on the first day of excavations in Room 1, the only room bordering the sweatbath as denoted by the yellow star in Figure 3. To learn more about this person, tooth and long bone samples were taken for several isotopic analyses that were later conducted in the spring of 2019.

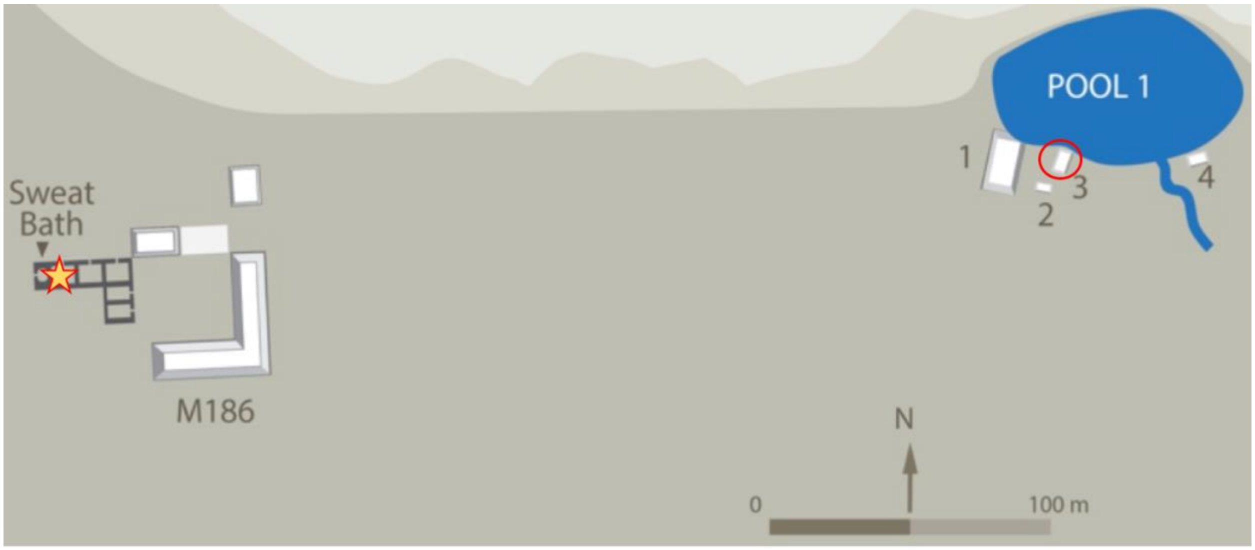


Figure 3: Plan view of Structure 3 in relation to M186 and the Individual in Room 1. Image adapted from VOPA 2016 figure. Courtesy of VOPA

M186 Human Remains

Field assistant Tilo Luna uncovered the individual (HR 1) while removing the termination fill of Room 1 on May 28, 2018, the first day of excavation (Figure 4). Although the original plan was to leave any encountered human remains in situ, the skeletal material was on top of a loose, rocky fill. To protect the remains and continue excavations in Room 1, Principal Investigator L. Lucero made the decision to extract the remains. The remains were dispersed vertically throughout the termination fill of the room.

The largest remaining bone consisted of two femurs, a tibia and a humerus at the highest elevation (0.70 mbd). Further down in Fill 105 (a cobble and boulder fill, 1.20 mbd) Luna found smaller epiphyseal and long bone fragments (Figure 5). Even lower, nearing the bottom of the room fill 107 (a pebble and cobble fill) teeth were located at the lowest elevation point (1.76 mbd). Figure 6 details the fill profile of the trench dug in Room 1 .

"Disarticulated remains were clustered together within the termination fill, but dispersed in depth. Major missing elements include the cranium, mandible, all vertebrae, scapula, both radii, ulnas, the pelvis, sacrum, coccyx, patellae, and most of the humeri and fibulas. Due to the nature of the rocky fill, the remains were poorly preserved and extremely fragmentary. No complete elements were recovered. Taphonomic changes included significant brown staining and weathering on several of the long bones" (Copper 2018:52-53).

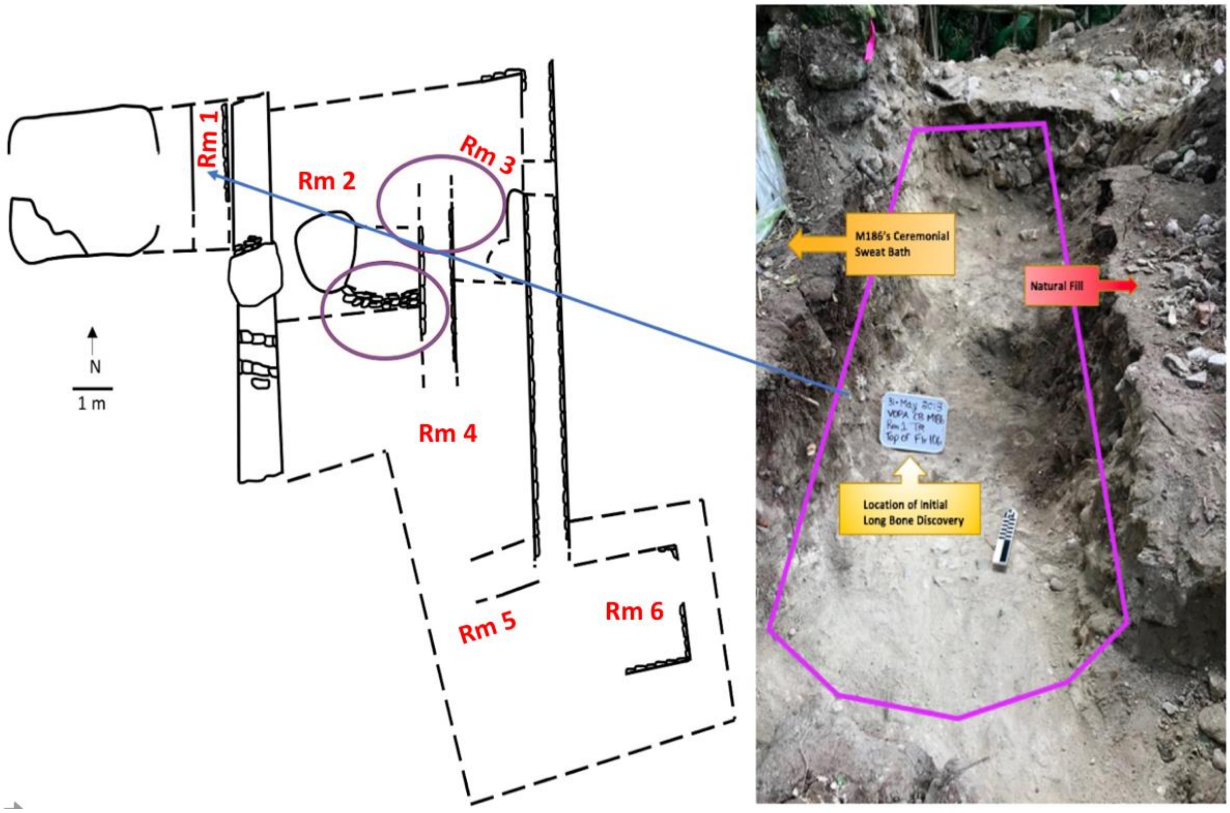


Figure 4 Left: Plan View of Room 1 with blue circle indicated areas of disturbance. Right: Room 1 Trench 1 after long bone excavation. Purple outline denotes rocky fill from which HR 1 was excavated and red line shows trench location on planview. Courtesy of VOPA 2018.

Figure 5: Room 1 HR 1 Bone Bundle Exposed. Bones from left to right: right femur, tibia (probable right), left femur (2 fragments), bone fragments. Courtesy of VOPA.

Figure 6: M186 Room 1 north to south Trench profile of fills, facing west. F104 contained the long bones, Fill 105 had some smaller bone fragments, and the teeth were found in Fill 107. Courtesy of VOPA

Bioarchaeological Analysis of the Individual in Room 1

MNI and Initial Inventory

Because there were no obvious burial goods with the remains, we hypothesize that this individual was the offering. For this reason, these remains will be referred to as a cache rather than a burial throughout this report (Carbaugh 2017). The MNI for this cache is 1. There are no indications that this burial consisted of multiple individuals, as there were no redundant skeletal elements or dental remains. All human remains recovered were consistent in size, robusticity, and overall taphonomic patterns. A detailed inventory was taken on site of the collected skeletal material, as seen in Table 2 below.

Table 2: Measurements of HR 1

Catalog # and ID	Site, Feature, Provenience, Excavation Date	Meters Below Datum	Description	Measurements		
				max diam. (mm)	min diam. (mm)	length (cm)
2288 Long Bone #1	CB M186 Room #1 HR #1 29 May 2018	0.70	Femur, probable left	Wider end: 34.1 Rounder end: 28.9	Wider end: 23.1 Rounder end: 24.7	19.2
2289 Long Bone #2	CB M186 Room #1 HR #1 29 May 2018	0.70	Femur, probable right Smaller piece 36.8mm long	Smaller piece end: 28.7 Larger piece end: 28.8	Smaller piece end: 24.2 Larger piece end: 22.5	12.6
2290 Long Bone #3	CB M186 Room #1 HR #1 29 May 2018	0.70	Tibia, probable right	Complete end: 29.9	Complete end: 18.7	13.6
2291 Bone frags	CB M186 Room #1 Below HR #1 29 May 2018	1.20	Prob. Humerus 5 prob. femur frags that average 36.4 x 19.9 3 prob. fibula frags that average 32.9 x 10.6 23 unidentified long bone frags that average 23.0 x 12.6	Prob. Hum. Narrow end: 19.4 Prob. Hum. Wide end: 18.2	Prob. Hum. Narrow end: 13.1 Prob. Hum. Wide end: 15.7	Prob Hum.: 7.4
2292 Bone frags	CB M186 Room #1 w/HR #1 29 May 2018	0.70	Prob. fibula 6 prob. femur frags that average 36.2mm x 18.8 3 prob. tibia frags that average 36.5 x 21.1 8 unidentifiable long bone frags that average 25.2 x 15.5 13 unidentifiable small frags that average 12.9 x 5.1	Prob fib. end that opens to the groove: 13.1 Prob fib. end that opens away from the groove: 15.1	Prob fib. end that opens to the groove: 11.2 Prob fib. end that opens away from the groove: 11.4	Prob. fib.: 18.9
2293 Bone frags	CB M186 Room #1 above HR #1 29 May 2018	0.60	11 long bone body frags that average 23.8 x 14.8 7 epiphyseal head frags → femur? That average 17.1 x 12.1 24 unidentifiable frags that average 18.8 x 9.4 2 prob. clavicle frag 2 ceramic body sherds (tan paste sand/volcanic ash temper)	NA	NA	NA

2295 Bone frags	CB M186 Room #1 Trench fill 107 5 June 2018	1.76	1 prob. femur shard 17.3 x 25.7 4 long bone frags that average 14.6 x 12.9 2 probable clavicle frags that average 16.7 x 7.9 13 unidentifiable frags that average 21.6 x 9.4 1 tiny animal femur 28.2mm in length, femur ball max length: 2.8mm, end near patella max width: 4.7mm	NA	NA	NA
2295 Teeth	CB M186 Room #1 Trench fill 107 5 June 2018	1.76	12 total teeth: LM^2, LM^1, LC^1, I^2, LI^1, I^2, RC^1 LM_2, RP_2, C_1(R?), RM_1, RM_3	Measurements in Table 3	Measurements in Table 3	Measurements in Table 3
2297 Phalange	CB Structure. #3 Trench #3 Fill 104 6 June 2018	-	1 Phalange toe from size?	15.5	11.6	27.4 mm
2296 Bone frags	CB Structure #3 Trench #3 fill 103 end 6 June 2018	-	6 unidentifiable frags that average 15.3mm by 6.5mm these bones were **very** dry	NA	NA	NA

Ancestry

Dental evidence strongly suggests that these remains are of Native American ancestry, as the recovered incisors were shovel shaped, shown in Figure 7 (Gill and Rhine 1990). Additionally, the remains are indicative of Maya descent based on location and style of interment. Lastly, the overall small stature and robusticity of the bones is consistent with Maya skeletal materials (Maggiano 2008). It is likely this person was Maya.

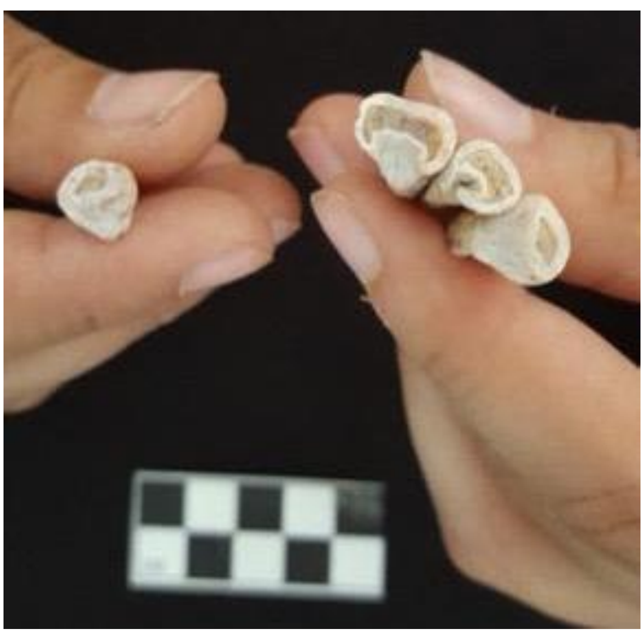


Figure 7: HR 1 Occlusal View of Maxillary Teeth. Courtesy of VOPA

Age

Based on the general size of this individual's long bones, as well as the attrition on their dental remains, it is likely that they were a young adult when they died. We chose to do age estimations via Lovejoy's (1985) occlusal dental wear method because we had appropriate skeletal material for this test and Lovejoy is widely used as an aging standard in bioarchaeology. Analysis via the Lovejoy dental method yielded an even more specific age range estimate of 16-22 years of age. The molars have minimal attrition while the anterior teeth have heavy wear, which indicates that the anterior teeth were used as tools and probably sped up their wear process. Because of this imbalance, the anterior teeth are likely not an accurate reflection of age (Figure 8). Only the molar teeth were utilized in these analyses for this reason.

Figure 8: HR 1 Profile of maxillary teeth wear on incisors leave very sharp and straight edges. Courtesy of VOPA.

Two different series of teeth, the right mandibular side and the left maxillary side, were analyzed in these comparisons. Two sets were utilized, opposed to one, to increase the likelihood of accurate range estimation. Figure 9 is a comparison of the recovered lower-right molars of the individual to the closest likeness on Lovejoy's functional attrition stages mandible chart (stage C). Figure 9 shows wear on the first molar, with small amounts of dentin, while the other molars showed minimal wear on the cusps. Additionally, the M_3 has erupted and the P_2 shows little wear. For these reasons, the right mandibular teeth were matched stage C, dating this individual between 18-22 years of age.

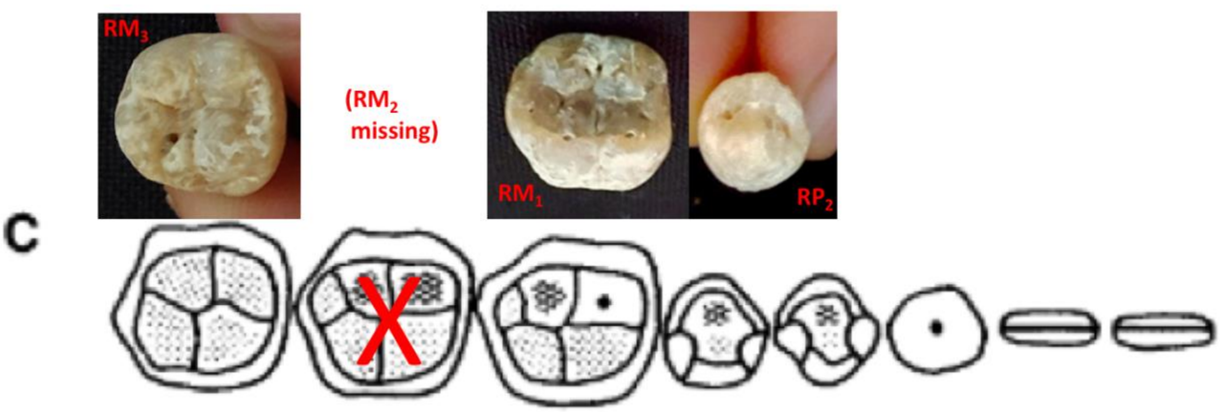


Figure 9: Comparison of HR 1's right mandibular teeth (mirrored) to Lovejoy's functional attrition stages of the mandibular dentition, Stage C. Top photos courtesy of VOPA. Bottom image adapted from Lovejoy (1985:Figure 2).

The second set of teeth examined were the recovered left maxillary molars. Similarly to Figure 9, Figure 10 compares the individual's left maxillary teeth with the two Lovejoy stages that were the most similar. This set of teeth also demonstrates more wear on the first molar, as some of the second molar cusps look more rounded with fewer defined ridges. This set falls in between two stages, which broadens the age range to 16-22 years.

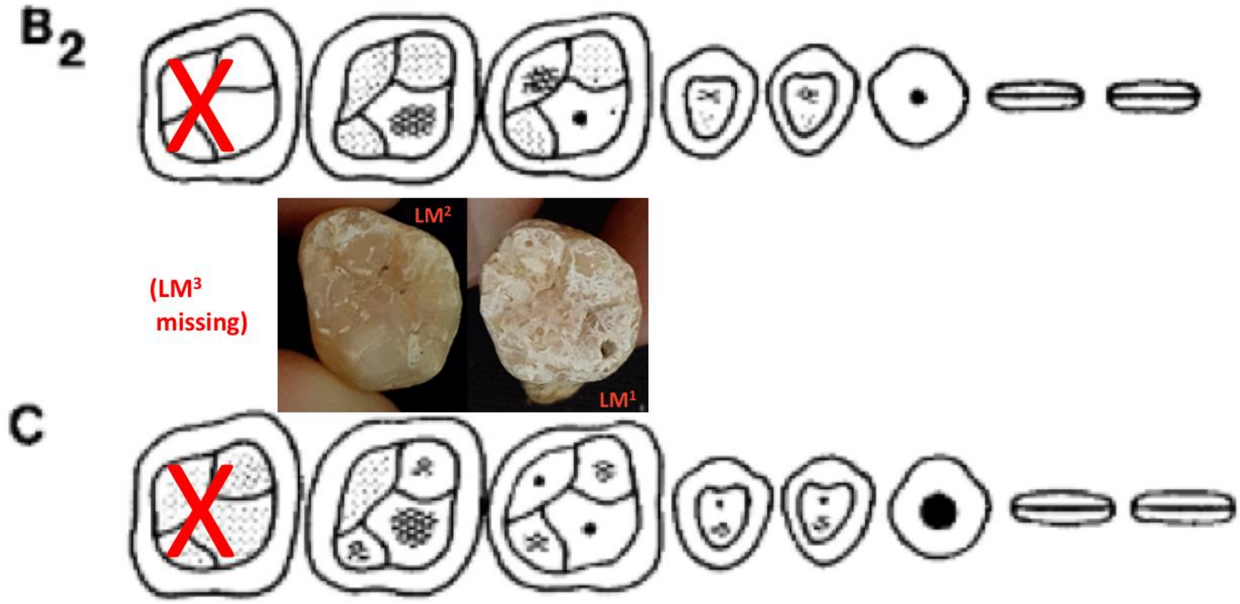


Figure 10: Comparison of HR 1's left maxillary teeth to Lovejoy's functional attrition stages of the mandibular dentition, Stages B_2 and C. Middle photo courtesy of VOPA. Top and bottom images adapted from Lovejoy (1985:Figure 1).

Stature and Sex

Unfortunately, both the stature and the sex of this individual could not be bioarchaeologically estimated due to the overall low preservation quality and major missing elements. The crania and pelvis, two of the primary skeletal elements utilized in sex estimations, were missing. Although long bones were recovered, all epiphyseal ends had been severed, which disqualified them from bioarchaeological sex and stature estimations. Considering the cultural context also yields indeterminate probabilities, as it was common for both males and females to be sacrificed. If further investigations wish to determine the sex of this individual, Ancient DNA analysis would be able to reliably accomplish this.

Teeth

Twelve teeth were recovered from the rubbly Fill 107 near the floor of Room 1. Table 3 inventories all of the teeth. The arrows in Table 3 are indicative of re-identifications that occurred during the tooth's second analysis in the lab.

Table 3: HR1 Tooth Identifications and Measurements

Tooth	Max Length (mm)	Max Width (mm)	Tooth Height (mm)
RM_2 □ RM_3	10.9	9.9	4.4
LM^2 (broken)	10.9	9.8	5.2
LM^1	11.5	11.6	6.0
RM_1	12.0	10.8	5.6
LM_2	11.0	10.4	5.9

P_2□ RP_2	7.6	7.7	5.7
LC^1	8.2	7.8	6.5
I^2 (round one)	6.9	6.1	5.0
LI^1	9.2	5.8	7.4
I^2 (blockier one)	6.8	5.4	5.4
RC^1	8.2	8.4	6.8
C_1 (R?)	7.0	5.2	7.5

In addition to the teeth being cleaned and measured, they were also photographed and selected for sampling. Each tooth was photographed medial, lingual, distal, buccal, and occlusal viewpoints. Figure 11 is the total inventory from an occlusal view. All of the teeth in the front row were selected for sampling.

Figure 11 Room 1 Trench Fill 107 Total Teeth Content. Back Row (Left to Right): RC^1, I^2, C_1 (R?), LI^1, I^2, LC^1. Front Row (Left to Right): RM_3, LM^2, LM^1, RM_1, LM_2, RP_2. Courtesy of VOPA

Isotope Analyses

Isotope analyses were conducted throughout the spring of 2019 to gain a better understanding of who this individual was in relation to the other Maya interred at Cara Blanca and the greater Maya civilization.

Learning about this individual's diet was one of our primary goals, as understanding what this person was eating throughout their lifetime would aid in linking them to food customs of a greater group (i.e., regional or potentially migratory). To examine this individual's diet, carbon and oxygen isotope ratios were measured via bone and tooth apatite samples. In 2017, skeletal analyst A. Carbaugh conducted similar light isotope analyses on the individuals that VOPA's 2016 excavation team uncovered at Structure 3 and several other individuals from settlement mounds in the local area (between Cara Blanca and the nearest Maya center, Yalbac). We intend to cross examine the carbon and oxygen isotope ratios of M186's HR1 with all of the individuals in the area that Carbaugh tested.

Carbaugh also measured nitrogen isotope ratios in the bone collagen of the individuals from 2016. Nitrogen and carbon isotope ratios in the bone collagen indicate how carnivorous these people were. Many Maya scholars have done pioneer work in stable isotope dietary analyses. For the purposes of this thesis, I will be utilizing comparative data from Rand (2015) based on his/her work in the Cayo District (just south of the pools) to compare Carbaugh's dietary isotope results with other Maya people from the southern lowlands in the Terminal Classic. While Nitrogen isotopes were not tested for the individual at M186, examining these dietary practices is still crucial as it will heighten our understanding of the people interred at Cara Blanca within the greater Maya area.

The last series of isotope testing that have been initiated are strontium isotope ratios in HR1's teeth. When an individual is growing up, their teeth erupt and mineralize at different stages of development. As their bones and teeth grow, they absorb different elemental isotopes from their local environments. Different geographic areas have different ratios of strontium isotopes in their atmosphere and environments. So hypothetically, if a person's early erupting teeth (e.g., a premolar) mineralized in one location, and their later teeth (e.g., a third molar) mineralized in a different location, strontium ratios the two different teeth would be different and as a result be reflective of the geographic regions in which they had grown. Through strontium isotope testing analysis, the premolar and third molar of HR1 from site M186, it may be possible to generate any migration that this individual may have undertaken during their life (Freiwald 2011, 2014; Hodell 2004).

Lucero's (Lucero and Kinkella 2015; Lucero et al. 2016) pilgrimage hypothesis cannot be confirmed based off just one individual, it requires testing a multitude of individuals do demonstrate that groups of people from distant regions were traveling to the site to interact with the ceremonial circuit. Carbaugh has conducted Strontium analyses for the 2016 individuals, so contextualizing HR1 in relation to Cara Blanca's other individuals will test this hypothesis. This thesis intends to utilize the regional Strontium standards that were published in bioarchaeologist Carolyn Freiwald's 2011 dissertation to place Cara Blanca's individuals' migratory patterns within the larger Maya landscape.

Was HR 1 eating a similar diet to the other people buried at Cara Blanca? Were the diets of the people at Cara Blanca consistent with the other people in the region? Was HR1 a migrant? Were the people at Cara Blanca religious pilgrims? These are the questions that these isotope analyses hope to answer.

Materials and Methods

Of the 25 bone fragments collected as potential samples, a probable left fibula fragment was selected for collagen and apatite testing (Figure 12). Additionally, 5 molars were selected to test from (Figure 13). Unfortunately, the left maxillary 1st molar was too rotten and not sampled. All the sampled teeth were run for dietary and migratory analyses.

Figure 12: Unidentified Bone Fragments. Total content with HR1 long bones. The top and bottom rows were sent to UIUC for sampling. The fibula fragment circled in yellow was selected for sampling. Courtesy of VOPA.

Figure 13: (Left to right): RM_3, LM^2, LM^1, RM_1, LM_2, RP_2. Courtesy of VOPA

All samples were prepared in the University of Illinois Paleobiogeochemistry Laboratory under the supervision of Professor Stanley Ambrose. The lists following synopsize the steps taken for preparing each sample. Tables 4 and 5 are verbatim instructions that the Paleobiogeochemistry Laboratory uses to prep isotope samples of this nature (Ambrose 2014).

Table 4: Tooth Enamel Carbonate Analyses Preparation Procedures

Step #	Phase	Instructions
1	Pretreatment with Clorox and Acetic Acid	Drill 5-15 mg bone or tooth powder with diamond burr rotary tool (slowest speed). Enamel chips can be hand-ground in agate mortar
2		Label and weigh empty 1.5 ml microcentrifuge tubes. Record wt to 0.1 mg
3		Place 5-15 mg powder in micro-centrifuge tube. Record tube + sample wt
4		Add ~15 ml 2.63% Clorox solution. Close tubes, Agitate with vortexer. *Open* tubes; Put in fume hood covered with loose sheet of foil. Treat overnight (≥12 hr).
5		Decant samples using pipette. Rinse pipette twice with dH_2O between samples (separate beakers for first and second rinse). Replace pipette and rinse water in both beakers after 8 samples (to prevent cross contamination, particularly for ^{87}Sr). Place tubes in centrifuge, *hinge down*. Centrifuge (5 minutes speed 5). Rotate tube 180° and maintain tilt. Decant supernatant using pipette. For bone and dentine, add 15 ml Clorox again. Vortex to suspend all powder. Let stand overnight. For tooth enamel, do not repeat Clorox step. Go to step 6 after 1st day Clorox treatment
6		Begin dH_2O rinse: Add 15 ml distilled water; Vortex after adding water, then centrifuge (speed 5, 5 minutes). Repeat rinse 3 more times (4 rinses total).
7		Add 0.1 M acetic acid (0.1 ml acid per 1 mg of sample); vortex briefly. Let stand open, **exactly** 4 hours *from time that acid was added to the first sample* in a set.
8		Vortex, centrifuge and decant; Add 1.5 ml distilled water. Repeat four times.
9		**Open tubes** and place in freezer for at least 40 minutes. Open freeze-drier desiccator lid before removing samples from freezer.
10		Place *immediately* in freeze drier (tubes *still* open). **Do not allow samples to melt before placing in freeze-drier**. If samples melt they will explode from tubes when the desiccator is evacuated. Samples will be drying ~12-15 hrs.
11		Reweigh centrifuge tube with dry sample; calculate and record % loss or % yield
12		Check labels on tubes for legibility: if illegible then relabel them
1	Reaction with Phosphoric Acid in Kiel Device or Gas Bench	Weigh ~650 µg bone or tooth powder in reaction vessel (min ~600, max ~750 µg).
2		Enter data in UIA register and CS standard, and lab notebooks. Enter sequence in computer. Computer file name format: Ambrose_Kiel_YYMMDD_lab notebook initials. For example: Ambrose_Kiel_181211_SA-MAL

Table 5: Bone/Tooth Collagen Purification and Preparation

Step #	Phase	Instructions
1	Decontaminate Surfaces; Grind and Sieve	Remove obvious surface contamination (rootlets, dirt, adhering tissues, etc.) with scalpel, diamond burr or carbide rotary tool, including cancellous bone. Bone preservation is often best in the dense outer lamellar bone below the periosteum, so do not remove too much discolored subsurface bone. Sonicate bone or tooth in distilled (and UV-treated - if required) water *after* adhering sediment and surface contamination has been removed.
2		Dry samples in freeze-drier 24-48 hours. Heat damages DNA and may degrade collagen. Do not use heat lamp or oven to dry samples if DNA analysis or ultrafiltration is planned.
3		Freeze-dry for at least 12 hours. Freeze-dried bone is easier to crush and grind
4		Crush bone *gently* with clean mortar and pestle if bone is soft, chalky and friable; if bone is fresh, then grind in Wiley Mill with coarse screen. Bone powder should pass through 1 mm sieve. Retain >1.0 mm to <0.25 mm fraction (1000-250µm) for collagen, and <250 µm fraction for apatite analysis. If bone is very weathered then use 2 mm sieve (and 0.1 M HCl).
5		Store ground bone fractions in clean glass scintillation vials or plastic

		microcentrifuge tubes. Indicate fraction size on label.
1	Purify Collagen	Assemble annealed filter funnels. Place a **very loose** clump of annealed Pyrex glass wool fibers in funnel (handle wool with plastic gloves and tweezers; do not rub eyes). Purpose of wool is to evenly suspend particles in cup because they may clog the frit filter.
2		Place 0.5-1.0 g of powder (>0.5 - <1.0 mm mesh fraction) **evenly** on Pyrex wool. For 15 ml funnel place a maximum of ~0.25 g of powder. Add the >0.25 mm and >0.117 mm fractions if weight is inadequate. Record weight to 0.1 mg.
3		If bone is fresh and greasy add ~40-50 ml petroleum ether ***in fume hood***. Other organic solvents, including the standard Bligh and Dyer chloroform + methanol method may remove some proteins. Let stand overnight in fume hood. Repeat ether soak for 2 hours. Drain funnel with vacuum. Dry by pumping vacuum through funnel, then in drying oven at **40°C** for 1 hour. Store waste ether in labeled glass bottle. **Do not breath the fumes.**
4		Add ~50 ml 0.2 M HCl to filter funnel; use 0.1 M HCl if bone is poorly preserved. Stir occasionally with clean glass rod if clumped. Leave overnight on counter. Drain funnel and replace HCl twice daily until demineralization is complete. Demineralization is complete when slow bubbling stops and translucent isomorphs appear, which may take 2-3 days. For samples that demineralize quickly, rinse (see step 5) and fill funnel(s) with distilled water. When all samples are demineralized and rinsed then go to step 6.
5		Rinse to neutrality by repeated draining of funnels with distilled water (about 7-10 times). Rinse top edge of funnel and glass wool with every rinse. Place glass baking dish or pan under rack when draining and rinsing.
6		Add ~50 ml 0.125 M NaOH to large funnel or ~ ~15 ml to small funnel. Use 0.0625 M NaOH if bone is poorly preserved. Cover with Al foil, let stand overnight (~20 hours).
7		Rinse to neutrality with distilled water (about 7-10 times), including top inner and outer edge of funnel. Place glass baking dish or pan under rack when draining and rinsing.
8		Add 50 ml 10^{-3} M HCl (pH 3) to filter funnel. Mark level of liquid. Cover with foil. Place in gravity oven at 70-75°C for 5 hours or overnight.
9		Add 100 µl (0.1 ml) 1M HCl to 50 ml filter funnel, or 150 µl 0.2M HCl to 15 ml funnel, and replenish evaporated liquid with 10^{-3} M HCl. Return to oven for 5 more hours, or overnight. Steps 8-9 should be at least 10 hours in oven. Longer times will increase collagen yield. Well-preserved collagen may not dissolve for more than a day – be patient.
10		Drain hot solution into acid-washed, annealed, labeled Erlenmeyer flask (**uncovered**). Condense solution in oven at 65-75°C (about 18-20 hours). If solution dries, add a few squirts of distilled water and swirl liquid until collagen redissolves. Disassemble funnels; remove tape gum; Soak in water with Alconox soap.
11		Record weight of empty, annealed, labeled, 20 ml scintillation vial **without cap**; label cap.
12		When solution condenses to ~2 ml, transfer to scintillation vial. Rinse flask with a few squirts of distilled water, swirl, and add to vial; repeat rinse 1-2 more times. Return to oven to condense to <2 ml. If solution dries in vial, reconstitute with ~1 ml distilled water.
13		Freeze condensate in freezer (> 1 hr). When frozen, place in freeze-dryer for ~48 hours
14		Record weight of scintillation vial with dried residue. Calculate collagen concentration (wt %). If collagen concentration is below 2% and the residue is powdery rather than translucent yellow, then it may not be collagen. Cover tightly with **labeled** vial lid.
15		Soak flasks in water for more than 1 hr with Alconox soap to loosen tape gum from flasks. Soap wash and ACID WASH glassware: Wash filter funnels and flasks with Alconox soap. Scrub interiors thoroughly. Rinse thoroughly with tap water. Soak stopcock parts in soapy water, then rinse with tap water and then with distilled water. Place funnels and flasks in Nochromix tank for >4 hours (WARNING: full strength sulfuric acid with added oxidizer: wear lab coat, gloves, goggles, neoprene apron). Drain acid from funnels into Pyrex baking dish. Thoroughly rinse glassware with tap water and then with distilled water. When dry (*check frit filters – they will not dry if not thoroughly rinsed!)*, cover all funnel and flask openings with aluminum foil.
16		Anneal glassware in kiln (1 hour at 900°F/500°C). Mark the foil on **one** piece with black marker before starting kiln. If mark remains after firing then the kiln did not fire.
1	Sample Combustion	Homogenize sample by scraping all residues from the sides and bottom of the scintillation vial. Weigh 250-450 µg of freeze-dried collagen into tared foil capsule at mass spec lab. If residue is powdery and collagen yields are <~2% then increase weight to 900-2000 µg. Record weights, etc in lab notebook, UIA record book and EA run book. Weigh one replicate every 10th sample.

		Thiourea, serine and hydroxyproline standards are run at the beginning, and after 10 samples and at the end of the run.
2		Enter sequence in Mass spec computer; Sequence file names all start with Ambrose EA YYMMDD. Proofread and print the sequence list; run sequence. Before clicking OK, enter sequence name in Results file name field. The results will appear in an XLS file in the results folder. Sample run takes about 9 hours
3		Enter data in lab notebook, UIA and EA log books. Enter standards in ST record book. **Transcribe all records from original PDF file of results** (prevents copying mistakes).
4		Enter data on Excel master spreadsheet with sample collagen and apatite on same line. Add C:N ratio to notebook record.
5		Store copies of PDF file outputs on lab computer in EA outputs folder, and send a copy to me by e-mail (ambrose@illinois.edu). Backups of these files are important!

The dietary light isotope samples (Table 4 and 5 preparations) were run at the Illinois State Geological Survey (ISGS) in the Stable Isotope Laboratory. The Gas Bench II, instead of the Kiel, was utilized to yield the δ^{13}C and δ^{18}O ratios necessary for examining the amount of C_4 plants (e.g., corn) the individual was eating. The Strontium samples (Table 4 only) were run at the Multicollector Inductively Coupled Plasma Mass Spectrometry (ICPMS) Laboratory in the Natural History Building. The tooth apatite samples that were taken to the ICPMS laboratory for Strontium testing required further preparations. Table 6 details the further chemical preparations that were required for the spectrometer run. Instructions verbatim (Johnson 2017).

Table 6: Purifying Sr for Sr Isotope Analyses. Standard Operating Procedure in the ICPMS Laboratory, Version 6.0 Johnon 2017: Table 1

Prep Columns	1 reservoir 0.05 N HNO_3	Wash
	1 reservoir 0.05 N HNO_3	
	1/2 reservoir 3 N HNO_3	Condition
Sample	Load Samples	Sample
Wash 1	0.3 ml 3N HNO_3	Removes other cations
	0.3 ml 3N HNO_3	
	0.3 ml 3N HNO_3	
Wash 2	0.5 ml 8N HNO_3	
	0.5 ml 8N HNO_3	
	0.5 ml 8N HNO_3	
	0.3 ml 3N HNO_3	
Switch Waste beakers to 4 mL austosample vials		
Elute Sr- make sure to switch waste beakers to 4 ml vial!	1 ml H_2O	Sample Sr
	1 ml0.05 N HNO_3	Collection
	2 ml H_20	

Dietary (Carbon and Oxygen Isotope Ratio) Results

The two questions regarding diet that we intended to answer were: Was HR 1 eating a similar diet to the other people buried at Cara Blanca? Were the diets of the people at Cara Blanca consistent with the other people in the region? Figure 14 is a graph of the initial $\delta^{13}C_{VDB}$ Carbonate ratios in each of the samples.

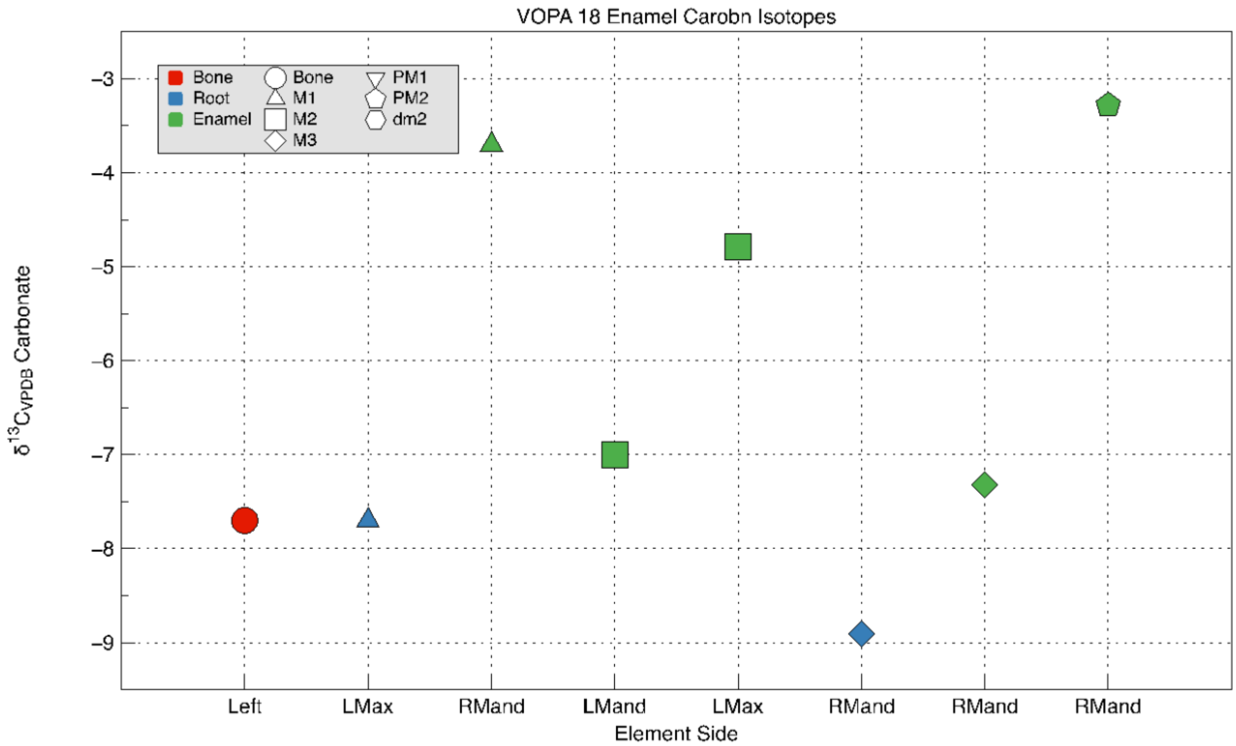


Figure 14: Teeth $\delta^{13}C_{VDB}$ Carbonate ratios. Graph generated by Matthew Fort of the Illinois State Geological Survey (ISGS)

Figure 15 takes the initial information illustrated in Figure 14, and compares it to the enamel carbon isotope ratio to the ratios of Carbaugh's 2016 tested individuals. Each vertical line of shapes represents one individual's enamel results (typically each shape is just reflective of different teeth). The horizontally colored lines are estimated standards of significant dietary practices. Dark green is reflective of the range in which a sample would be considered to have been statistically significant C_4 amounts, light green indicates a lesser amount of C_4, and pink shows a mix of C_4 and C_3 concentrations. Individual 13 on this graph (boxed in yellow) is HR1 from M186. The figure demonstrates that nearly all of the enamel samples from VOPA's 2016 and 2018 individuals had significant concentrations of C_4. This indicates that nearly all of these people, including HR 1, were eating a C_4 heavy diets. This also indicates that Individual 1 was eating a similar concentration of C_4 foods as the other Cara Blanca individuals.

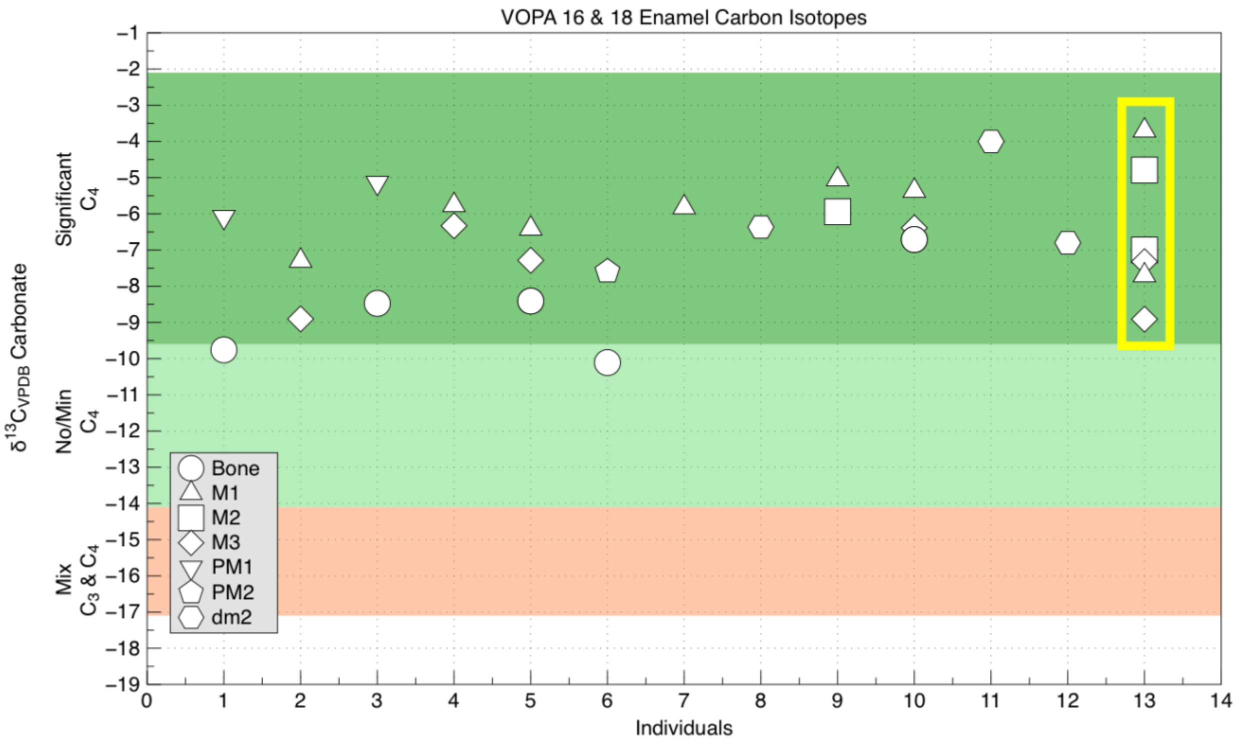


Figure 15: VOPA 2016 and 2018 Enamel Carbon Isotopes. Graph generated by Matthew Fort of the ISGS Lab Team.

To examine the Cara Blanca individuals' diet in relation to the other Maya that lived in the Cayo district in Belize, I utilized a well cited article on ancient Maya diet stable isotope analysis (Rand 2015). The article's second figure plots Maya that were isotopically tested within the regional foodweb. I generated a table of Cara Blanca's 2016 individual's $\delta^{15}N$ and $\delta^{13}C$ ratios (Table 7). Utilizing this Table 7, I generated and plotted points on a graph that I then overlaid with Rand's graph (Figure 16). As Figure 16 demonstrates, the individuals of Cara Blanca (the red dots) were eating more inshore fish, but were overall clustered in the same general area as the individuals in the greater Cayo district area (the black X's).

Table 7: VOPA's 2016 Light Isotope Individual's $\delta^{13}C$ to $\delta^{15}N$ Ratios

$\delta^{13}C$‰pdb	**$\delta^{15}N$‰**
-11.29	9.00
-13.73	10.09
-12.44	9.45
-14.74	10.01
-11.58	9.20
-26.27	0.09
-24.47	0.93

-22.63	8.50
-13.94	8.82
-13.00	7.70
-12.9	8.22
-19.63	4.45
-10.94	10.05
-13.75	10.29
-13.81	10.22
-16.716	8.09

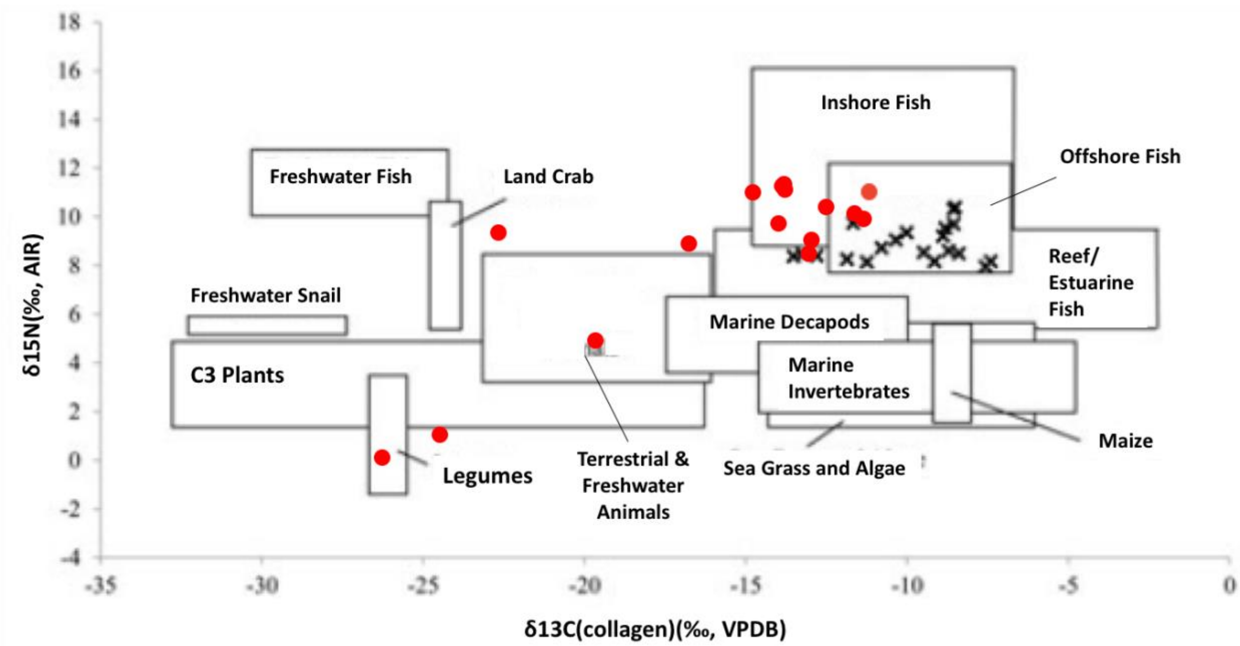


Figure 16: Cara Blanca's 2016 Individual's $\delta^{13}C$ to $\delta^{15}N$ Ratios (Red dots) Plotted onto Rand's Food Web Graph of the Cayo District. Adapted from Rand (2015:Figure 2).

These cumulative results indicate that HR 1 was eating a similar diet to the other individuals at Cara Blanca, and that the Cara Blanca as a whole were eating similar diets as the Cayo district in general (Rand 2015). It is quite possible that people from fairly wide regions had similar C_4, heavy diets, however, so we cannot rule out that they were from a local or non-local area for certain.

Migratory (Strontium) Isotope Results

With Strontium isotope analyses, we hoped to answer the questions: was HR1 a migrant? and were the people at Cara Blanca religious pilgrims?

Table 8 details the strontium isotope ratios in the tooth apatite samples. The table was organized by tooth eruption age, beginning with the earliest erupting teeth and ending with the latest (Nanda 1960). AEC 72A (the right mandibular premolar) was run twice, so an average was taken of 72A for graphing purposes. Figure 15 plots the strontium ratios of HR's teeth in order of their eruption.

Table 8: Strontium Isotope Results

Sample	Estimated Age of Eruption	Tooth	87/86 Sr Ratio Normalized
AEC 75	6-7	RM_1	0.70782
AEC 72A (run twice)	11-12	RP_2	0.70785 (averaged)
AEC 73	11-13	LM_2	0.70776
AEC 76	12-13	LM^2	0.70782
AEC 74	17-21	RM_3	0.70774

To contextualize these results, I have included standards of environmental $^{87}Sr/^{86}Sr$ ratios in the Maya northern and southern lowlands which have been calculated with the inclusion of two standard deviations (Hodell 2004). I used the averages that excluded the water samples in Hodell's chapter.

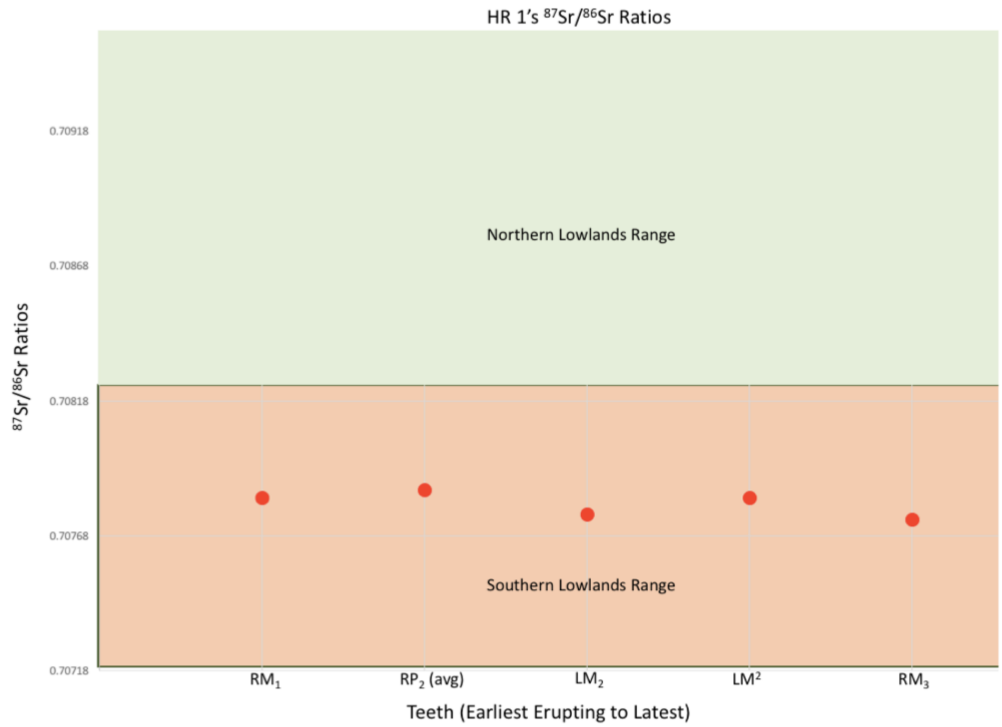


Figure 17: HR1's $^{87}Sr/^{86}Sr$ in Eruption order. The light green shading is the Northern Lowlands Strontium range with two standard deviations. The peach shading is the Southern Lowlands Strontium range within two standard deviations.

Figure 17 suggests that HR1 lived the southern lowlands for the duration of the time that their teeth were erupting and mineralizing. The range of these results is quite narrow, and because of this it is probable that this individual’s teeth mineralized in the same geological zone. The narrow range of strontium ratios for HR1 also suggest that all of this individual’s teeth mineralized in the same geological zone, which suggests that they lived in the same geographic area for the duration of their life.

Based on our age estimation (16-22 years), HR1 was also likely in the southern lowlands around the time of their death. This is supported by the right mandibular third molar (which erupts in the age range at which this individual likely died) having a strontium ratio that is consistent with southern lowland range.

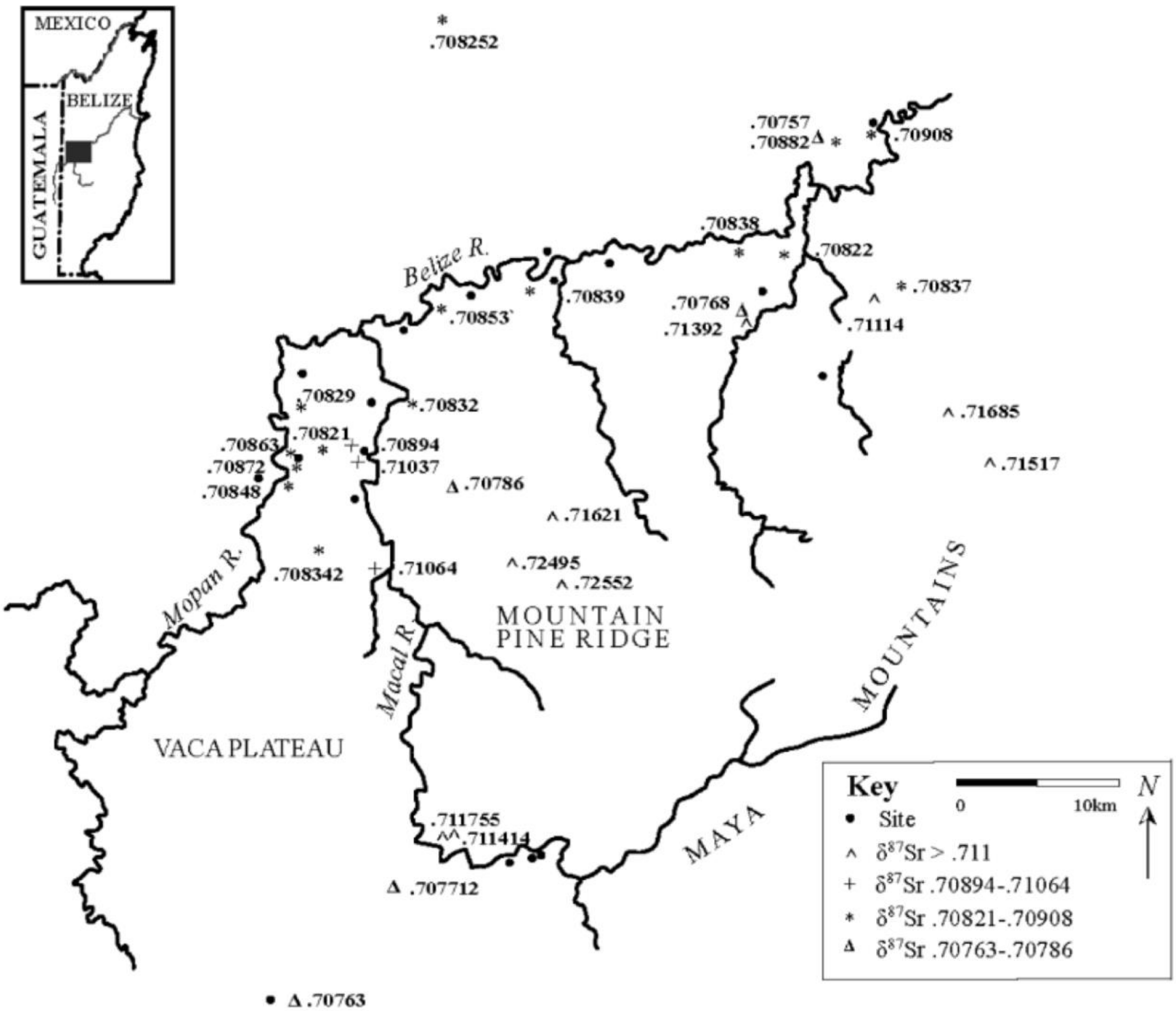


Figure 18: Strontium isotope samples in the Belize Valley and neighboring regions from Freiwald (2011:Figure xx).

The average ratio of individuals living in the Yalbac settlement was 0.70802 (Freiwald 2011); HR 1’s average was significantly below this, at 0.70780. This indicates that the individual was likely not from Yalbac. Figure 18 shows the strontium variation in the Belize valley, Cara Blanca is not pictured on this map but is located slightly North of this area. All five of HR1’s samples fall within the same range (triangle markers). This individual could have resided in one of the triangle-marked areas for the duration of their life.

Carbaugh also ran strontium analyses on the individuals of VOPA’s 2016 excavation. Table 9 is a cross examination of HR 1’s Sr ratios with the individuals Carbaugh tested. The individuals she examined ranged from 0.70733 to 0.70838 $^{87}Sr/^{86}Sr$. Most of these individuals fell within the same range as HR 1, but in certain cases the 2016 individuals' ratios were slightly higher, which could indicate that some of these individuals spent portions of their lives in multiple locations. On Figure 18, the 2016 individuals' ratios span between the triangle, asterisk, and plus signed markers.

Table 9: M186's HR 1 $^{87}Sr/^{86}Sr$ Ratios compared to VOPA's 2016 $^{87}Sr/^{86}Sr$ Individuals' Ratios

Provenience	Individual	Early tooth $^{87}Sr/^{86}Sr$	Late Tooth $^{87}Sr/^{86}Sr$	Difference between Early and Late Teeth
M186 Room 1	HR1	0.70782	0.70774	0.00008
Pool 7 MF, Mound 4, Burial 1	A	0.70804	0.70773	0.00031
Pool 7 MF, Mound 4 Burial 1	B	0.70838	-	-
Pool 7 MF, Mound 4 Burial 1	C	0.70794	-	-
Pool 7 MF, Mound 4 Burial 1	D	0.7077	-	-
Pool 7 MF, Mound 4 Burial 1	E	0.70786	0.70790	0.00004
Pool 7 MF, Mound 4 Burial 1	F	0.70808	0.70802	0.00006
Pool 7 MF, Mound 4 Burial 1	G	-	0.70801	-
Pool 7 MF, Mound 4 Burial 4	A	-	0.70778	-
Pool 7 MF, Mound 1 Burial 2	A	0.70800	High Rb/Sr	
MF 4, Mound 1 East Structure	A	0.70818	0.70828	0.00010
MF 4, Mound 1 North Structure	A	0.70836	-	-
Pool 1 Structure 3	2	0.70779	-	-

Interestingly, the individual that Carbaugh tested from Pool 1 Structure 3 (Individual 2) has a very similar strontium ratio to the M186 individual. While the individuals associated with the water temple have lower strontium ratios, the people tested from the Pool 7 mound field site had a higher average of 0.70795. The mound field site was a settlement area, and the individuals interred here had many associated burial artifacts. The cumulative results of burial context and the strontium ratios suggest that the individuals interred at the water temple could be from a different place and were buried to serve different purposes than the individuals at the mound field site. We cannot say for certain that the groups interred at the mound sites are from different geographic areas because the ratios have a decent amount of overlapping statistics. While a distinction exists between the groups' averages, it is not substantial enough to completely segregate them.

With strontium analyses, we have been able to suggest that HR 1 was likely not a migrant during their lifetime as their strontium ratios of their mineralized teeth are in such a narrow range, despite different eruption ages. Additionally, this individual's home was probably not Yalbac, but likely one of the smaller sites in the surrounding area (as indicated previously on Figure 18, any of the triangle markers are very plausible).

Another important takeaway from this study is that individual B at Structure 3 and HR1 had very similar strontium ratios, which could suggest that they were from the same area. If they were from the same geographic area, why were they both placed in the water temple ceremonial circuit, just in different areas? Additionally, do the other two individuals interred at Structure 3 reflect the same Strontium ratio range? Further investigation is necessary for more confident linking between the two tested individuals, and all of the individuals interred within the circuit in general. Finally, while there is a distinction between the averages of individuals interred with the water temple versus the mound sites, the difference is not substantial enough to completely and officially segregate them. More samples would need to be tested to confidently distinguish geographic separation.

Discussion

M186's HR1 holds substantial significance to Cara Blanca's ceremonial circuit. Similarities between HR1 and Structure 3 further link the sites together and support the connection of M186 being part of the ritual process. HR1 was a young adult likely between the ages of 16-22 and of Maya ancestry. HR1's age is consistent with the general age group (16-24) of the three Maya individuals at Structure 3. Additionally, HR1's absence of grave goods is also parallel with the nearby Structure 3, which further supports a potential linkage of the two structures and ultimately supports the hypothesis of M186 functioning within the ceremonial circuit at Cara Blanca. The dietary light isotope analysis of HR1 indicates that HR1 also had a similar diet to the Structure 3 individuals, the individuals at the mounds between Cara Blanca and Yalbac, and the Cayo district generally.

Since the Structure 3 individuals were uncovered in the fill of a terminated room, and there were no burial goods associated with them, it is likely that this was a secondary burial and that they were brought to M186 with the intention of being left there to serve as the offering themselves (Carbaugh 2016). Due to the consistencies between the Structure 3 and M186 burials, it can be suggested that HR1 was also serving as an offering to function in this ceremonial circuit.

HR1 likely was non-migratory and likely resided their whole life, including the time of their death, at one of the smaller sites in the strontium range of .70763 to .70786 (Figure 18). Because of the strontium results, the fact that HR1 was interred at M186 is extremely significant because this burial would have required the re-burier to have undergone a generous amount of future planning and effort to accomplish the recovering, transporting, and reburying this individual.

Carbaugh 2016 provides an insight regarding the human remains that were unearthed during the 2016 field season, both at Structure 3 at Cara Blanca Pool 1 and the nearby settlement areas. She states,

> …there is a difference between the burial practices associated with the interment of individuals within Str. 3 at Cara Blanca Pool 1 and those recovered from the mounds in the Mound Fields. Non-perishable grave goods, primarily ceramics, were found in association with all except two of the individuals from the settlement area, while no non-perishable ceramic grave offerings were placed with the Cara Blanca human caches. This difference supports the idea that the individuals interred in Str. 3 at Pool 1 were not there to provide continuity between the past and present for a single lineage. Instead, the human caches created a way to access the underworld by turning Str. 3 into a threshold for the portal to the underworld, Pool 1. Perhaps the construction of ceremonial structures—at a place already designated as sacred within the Maya landscape as an opening in the earth through which the worlds of the gods could be

> accessed—was a place that the nearby inhabitants of Yalbac turned to as the continued droughts challenged their resources, and likely became a place of pilgrimage for those further away (Carbaugh 2016:142).

The important message to take away from Carbaugh's quote is that even if Cara Blanca was only a local site of ritual practice, that doesn't dismiss its relevance to the Terminal Classic Period. If anything, it just reinforces that everyday people had taken their religious affairs into their own hands. Thanks to HR1, we now know that people brought remains to the site from other locations to inter them within these ritual structures. The Maya created spaces of significance that enabled them to independently interact with their ancestors and Chahk. This is a remarkable demonstration of agency and self-reliance.

While more questions were conceived as a result of this thesis, e.g., was HR1 interred at the sweatbath instead of Structure 3? and were the individuals from Structure 3 originally from the same site as HR1? , this study has allowed us to more confidently say that M186 functioned within the sacred pools of Cara Blanca during such a pivotal era in Maya history.

References Cited

Ambrose, Stanley H.

1990 Preparation and Characterization of Bone and Tooth Collagen for Isotopic Analysis. In *Journal of Archaeological Science*. 17(4). 431451.

1991 Effects of Diet, Climate and Physiology on Nitrogen Isotope Abundances in Terrestrial Foodwebs. In *Journal of Archaeological Science.* Volume 18 Issue 3: 293-317. Elsevier Ltd.

1993 Isotopic Analysis of Paleodiets: Methodological and Interpretive Considerations. In *Investigations of Ancient Human Tissue Chemical Analyses in Anthropology.* Gordon and Breach Science Publishers.

1993 Experimental Evidence for the Relationship of the Carbon Isotope Ratios of Whole Diet and Dietary Protein to Those of Bone Collagen and Carbonate. In *Prehistoric Human Bone.* 1-37. Springer. Berlin, Heidelberg

Ambrose, Stanley H., Jane Buikstra, and Harold W. Krueger

2003 Status and Gender Differences in Diet at Mound 72, Cahokia, Revealed by Isotopic Analysis of Bone. In *Journal of Anthropological Archaeology.* Academic Press.

Ambrose, Stanley H. and Lynette Norr

1993 Experimental Evidence for the Relationship of the Carbon Isotope Ratios of Whole Diet and Dietary Protein to Those of Bone Collagen and Carbonate. In *Prehistoric Human Bone: Archaeology at the Molecular Level.* Chapter 1: 1-37. Springer Press, Heidelberg, Berlin.

Benson, Erin M.

2016 Results of the 2016 Valley of Peace Archaeology Project Salvage Excavations. In *Results of the 2016 Valley of Peace Archaeology Project: Cara Blanca Pool 1 Excavations and the Yalbac Salvage Archaeology Program.*, edited by L. J. Lucero, J. T. Larmon, and E. M. Benson. Chapter 4: 43-72. Report submitted to the Institute of Archaeology: National Institute of Cultural and History. Government of Belize.

Bhattacharyya, Tiyas.

2017 Dietary Analysis of Classic Maya from Central Belize. Honors thesis For degree of Bachelor of Arts at the University of Illinois at Urbana-Champaign.

Carbaugh, Aimée E.

2016 Analysis of Human Skeletal Remains from Cara Blanca Pool 1 and the Yalbac Salvage Program. In *Results of the 2016 Valley of Peace Archaeology Project: Cara Blanca Pool 1 Excavations and the Yalbac Salvage Archaeology Program*, edited by L. J. Lucero, J. T. Larmon, and E. M. Benson, pp. 107-157. Report submitted to the Institute of Archaeology National Institute of Culture and History, Belize.

Coe, Michael D., and Stephen Houston

2015 The Maya. 9th Ed. Thames and Hudson Inc, New York.

Copper, Amy L.

2018 Analysis of the 2018 Field Season Human Remains. In *2018 Valley of Peace Archaeology Project:Cara Blanca Pool 1 Excavations and Beyond.*, edited by L. J. Lucero. Chapter 5: 52-58. Report submitted to the Institute of Archaeology: National Institute of Cultural and History. Government of Belize.

DeNiro, Michael J. And Samuel Epstein

1978 Influence of Diet on the Distribution of Carbon Isotopes in Animals. In *Geochimica et Cosmochimica Acta.* Volume 42 Issue 5: 495-506. Pergamon Press Ltd., Great Britain.

1981 Influence of Diet on the Distribution of Nitrogen Isotopes in Animals. In *Geochimica et Cosmochimica Acta.* Volume 45: 341-351. Pergamon Press Ltd., Great Britain.

Freiwald, Carolyn

2011 *Maya Migration Networks: Reconstructing Population Movement in the Belize River Valley During the Late and Terminal Classic*. PhD Dissertation, University of Wisconsin, Madison.

Freiwald, Carolyn, Jason Yaeger, Jaime Awe, and Jennifer Piehl.

2014 Isotopic Insights into Mortuary Treatment and Origin and Xunantunich, Belize. In *Wrobel G (ed) The Bioarchaeology of Space and Place.* Springer, New York, NY.

Gill, George and Stanley Rhine

1990 Skeletal Attribution of Race: Methods for Forensic Anthropology. In *Maxwell Museum of Anthropology, Anthropological Papers No 4*: 1-26.

Gillespie, Susan D.

2008 Body and Soul Among the Maya: Keeping the Spirits in Place. In *Anthropological Papers of the American Anthropologica Association.* Volume 11, Issue 1: 67-78. Wiley and Sons, Inc.

Hodell, David A., Rhonda L. Quinn, Mark Brenner, and George Kamenov.

2004 Spatial Variation of Strontium Isotopes ($^{87}Sr/^{86}Sr$) in the Maya Region: a Tool for Tracking Ancient Human Migration. In *Journal of Archaeological Science*.31 (5) 585-601.

Knockaert, J, M. Balassee, and D. Fiorillo.

2018 Mountain adaptation of caprine herding in the eastern Pyrenees during the Bronze Age: A Stable Oxygen and Carbon Isotope Analysis of Teeth. In *Quaternary International.*

Kosakowsky, Laura J.

2018: VOPA 2018 Ceramics: General Summary. In *2018 Valley of Peace Archaeology Project: Cara Blanca Pool 1 Excavations and Beyond.,* edited by L. J. Lucero. Chapter 3: 18-20. Report submitted to the Institute of Archaeology: National Institute of Cultural and History. Government of Belize.

Larmon, Jean T.

2016 Cara Blanca Exavations: Pool 1 Structure 3 and Related Investigations. In *2016 Valley of Peace Archaeology Project: Cara Blanca Pool 1 Excavations and the Yalbac Salvage Archaeology Program.,* edited by L. J. Lucero, J. T. Larmon, and E. M. Benson. Chapter 6: 86-106. Report submitted to the Institute of Archaeology: National Institute of Cultural and History. Government of Belize.

Larmon, Jean T., and Anuj Amin

2016 The Cara Blanca Sweatbath: Ritual Purification on the Ceremonial Circuit. In *2016 Valley of Peace Archaeology Project: Cara Blanca Pool 1 Excavations and the Yalbac Salvage Archaeology Program.,* edited by L. J. Lucero, J. T. Larmon, and E. M. Benson. Chapter 5: 73-85. Report submitted to the Institute of Archaeology: National Institute of Cultural and History. Government of Belize.

Larmon, Jean T., Jesann Gonzalez Cruz, and Amy L. Copper

2018 The 2018 Excavations of Pool 1 Structure 3 and M186. In *2018 Valley of Peace Archaeology Project: Cara Blanca Pool 1 Excavations and Beyond.,* edited by L. J. Lucero. Chapter 4: 21-51. Report submitted to the Institute of Archaeology: National Institute of Cultural and History. Government of Belize.

Larmon, Jean T., and Thomas Franklin

2018 The eDNA Analysis Survey of the Cara Blanca Region and Beyond. In *2018 Valley of Peace Archaeology Project: Cara Blanca Pool 1 Excavations and Beyond.,* edited by L. J. Lucero. Chapter 2: 7-17. Report submitted to the Institute of Archaeology: National Institute of Cultural and History. Government of Belize.

Lentz, D.

1991 Maya Diets of the Rich and Poor: Paleoethnobotanical Evidence from Copán. In *Latin American Antiquity* 2(3):269-287.

Lovejoy, Owen C.

1985 Dental Wear in the Libben Population: Its functional pattern and role in the determination of adult skeletal age at death In *American Journal of Physical Anthropology*. 68 (1) 1-14.

Lucero, Lisa J.

2018 A Cosmology of Conservation in the Ancient Maya World. Journal of Anthropological Research 74(3):327-359.

2018 Valley of Peace Archaeology (VOPA) 2018: Introduction to Cara Blanca Pool 1 and Beyond. In *2018 Valley of Peace Archaeology Project: Cara Blanca Pool 1 Excavations and Beyond.*, edited by L. J. Lucero. Chapter 1: 1-16. Report submitted to the Institute of Archaeology: National Institute of Cultural and History. Government of Belize.

2016 Introduction to the Results of the 2016 Valley of Peace Archaeology Project: Cara Blanca Pool 1 Excavations and the Yalbac Salvage Archaeology Program. In *2016 Valley of Peace Archaeology Project: Cara Blanca Pool 1 Excavations and the Yalbac Salvage Archaeology Program.*, edited by L. J. Lucero, J. T. Larmon, and E. M. Benson. Chapter 1: 1-10. Report submitted to the Institute of Archaeology: National Institute of Cultural and History. Government of Belize.

2006 *Water and Ritual: The Rise and Fall of Classic Maya Rulers.* University of Texas Press.

Lucero, Lisa J., Jean T. Larmon, and Aimée E. Carbaugh

2017 The Ancient Maya Ceremonial Circuit of Cara Blanca, Belize. *Research Reports in Belizean Archaeology* 14: 249-259.

Lucero, Lisa J., Jessica Harrison, Jean Larmon, Zachary Nissen, and Erin Benson

2016 Prolonged Droughts, Short-Term Responses, and Diaspora: the Power of Water and Pilgrimage at the Sacred Cenotes of Cara Blanca, Belize. *WIRES Water* doi:10.1002/wat2.1148.

Lucero, Lisa J., Roland Fletcher, and Robin Coningham

2015 From "Collapse" to Urban Diaspora: The Transformation of Low-Density, Dispersed Agrarian Urbanism. Antiquity 89(347):1139-1154.

Lucero, Lisa J., Scott L Fedick, Andrew Kinkella, and Sean M. Graebner

2004 The Ancient Maya Settlement in the Valley of Peace Area. In *the Ancient Maya of the Belize Valley: Half a Century of Archaeological Research.* 6: 86-102. University Press of Florida.

Maggiano, Isabel S., Michael Schultz, Horst Kierdorf, Thelma Sierra Sosa, and Corey M. Maggiano.

2008 Cross-sectional Analysis of Long Bones, Occupational Activities and long-distance Trade of the Classic Maya from Xcambó- Archaological and Osteological Evidence. In *American Journal of Physical Anthropology*.136(4): 470-477. Wiley-Liss, Inc.

Maring, R., and Riede, F.

2019 Possible Wild Boar Management During the Ertebølle Period. A Carbon and Nitrogen Isotope Analysis of Mesolithic Wild Boar from Fannerup F., Denmark. In *Environmental Archaeology*. Taylor and Francis Ltd.

Miller Wolf, Katherine A.

2019 Curating Large Skeletal Collections: An Example from the Ancient Maya Site of Copán, Honduras. In *A Journal of the Society for American Archaeology.* 30-39.

Miller Wolf, Katherine A. and Carolyn Freiwald

2018 Re-Interpreting Maya Mobility: a Strontium Isotope Baseline for Western Honduras. In *Journal of Archaeological Science*. Reports 20: 799-807. Elsevier Press.

Minagawa, Masao and Eitaro Wada.

1984 Stepwise Enrichment of ^{15}N Along Food Chains: Further Evidence and the relation Between δ^{15}N and Animal Age. In *Geochimica et Cosmochimica Acta* 48:1135-1140. Pergamon Press Ltd., U.S.A.

Nicholas, George.

2011 Being and Becoming Indigenous Archaeologists. Left Coast Inc Press.

O'Leary, Marion H.

1988 Carbon Isotopes in Photosynthesis: Fractionation Techniques May Reveal New Aspect of Carbon Dynamics in Plants. In *Bioscience.* Volume 38 No. 5: 328-336. Ad Council Publication.

Panagiotopoulou, Eleni, Janet Montgomery, and Geoff Nowell

2018 Detecting Mobility in Early Iron Age Thssaly by Strontium Isotope Analysis. In *European Journal of Archaeology Vol. 21 Issue 4.*

Price, T. Douglas, Seiichi Nakamura, Shintaro Suzuki, James H. Burton, and Vera Tiesler.

2014 New Isotope Data on Maya Mobility and Enclaves at Classic Copan, Honduras. In *Journal of Anthropological Archaeology*. Volume 36: 32-47. Elsevier Press.

Price, T. Douglas, James Burton, Andrea Cucina, Pilar Zabala, Robert Frei, Robert Tykot, and Vera Tiesler
2012 Isotopic Studies of Human Skeletal Remains from a Sixteenth to Seventeenth Century AD Churchyard in Campeche, Mexico. In *Current Anthropology*. Volume 53 No. 4: 396-439. The University of Chicago Press.

Rand, A. J., P. F. Healy, and J. J. Awe
2015 Stable Isotopic Evidence of Ancient Maya Diet in Caledonia, Cayo District, Belize. In *International Journal of Osteoarchaeology*. John Wiley and Sons, Ltd.

Ricketson, O.
1925 Burials in the Maya Area. In *American Anthropologist.* Peabody Museum, Harvard University: Cambridge, Mass. 381-401.

Somerville, Andrew D. Margaret J. Schoeninger and Geoffrey E. Braswell
2016 Political Alliance, Residential Mobility, an Diet at the Ancient Maya City of Pusilha, Belize. In *Journal of Anthropological Archaeology*. Volume 41: 147-158. Elsevier Press.

Vogt, Evon Z.
1969 *Zinacantan: A Maya Community in the Highlands of Chiapas.* The Belknap Press of Harvard University Press, Cambridge

White, C.D. and H.P. Schwarcz.
1989 Ancient Maya Diet: As Inferred from Isotopic and Elemental Analysis of Human Bone. In *Journal of Archaeological Science.* Volume 16, Issue 5: 451-474.

White, C., P. Healy and H. Schwarcz
1993 Investigative Agriculture, Social Status, and Maya Diet at Bacbitun, Belize. In *Journal of Anthropological Research*. Volume 49, Issue 4: 347-375.

White, Tim, Michael T. Black and Pieter A. Folkens
2011 *Human Osteology*. 3rd Ed. Elsevier Academic Press, Oxford.

Wright, Lori E.
2012 Immigration to Tikal, Guatemala: Evidence from Stable Strontium and Oxygen Isotopes. In *Journal of Anthropological Archaeology*. Volume 31: 335-352. Elsevier Press.