Ethnicity and Isotopes at Mayapán

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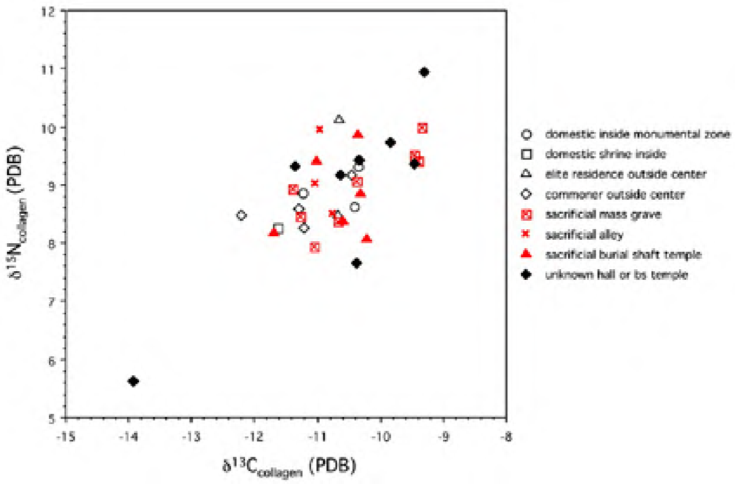

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Culture: Maya
Chronology: Post Classic
Location: Yucatán, México
Site: Mayapán

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Abstract

This report describes the results of a pilot study examining the potential of stable isotopic analysis of human bone to examine social and ethnic composition of the ancient Maya city of Mayapán. The study involved the analysis of stable carbon and nitrogen isotopes in bone collagen, stable carbon and oxygen isotopes in bone apatite, and stable strontium isotopes in tooth enamel and bone. These data were obtained for skeletal remains recovered from a variety of archaeological contexts at the city. Although dramatic dietary differences are not evident among burials thought to belong to individuals of distinct social classes, interesting patterning among the data suggest the presence of immigrants to the city from several distinct sources. These immigrants include individuals buried in primary domestic contexts as well as disarticulated remains, presumed to be the victims of human sacrifice.

Resumen

Este informe presenta los resultados de un estudio preliminar que investiga la potencial del análisis isotópico de restos óseos humanos para examinar la composición social y étnica del antiguo pueblo maya de Mayapán. El estudio involucró el análisis de los isótopos estables del carbono y nitrógeno en el colágeno óseo, del carbono y oxígeno en el mineral óseo, y del estroncio en el esmalte dental y el hueso. Esta información fue obtenida para restos óseos recuperados de una variedad de contextos arqueológicos en el sitio. Aunque diferencias dietéticas marcadas no son evidentes entre los entierros interpretados como miembros de las distintas clases sociales, hay evidencia en los resultados que sugiere la presencia de inmigrantes a la ciudad de varias fuentes diferentes. Estos inmigrantes incluyen individuos que fueron enterrados en contextos domésticos primarios además de cómo restos desarticulados, quienes se presume fueron las víctimas del sacrificio humano.

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Introduction

This report describes preliminary results of stable isotopic analyses of human skeletal remains from the ancient Maya city of Mayapán, located in the state of Yucatán, México. Occupied from ca. 1200-1450 C.E., Mayapán is known historically to have been a multiethnic city (Milbrath and Peraza 2003), yet the archaeological literature for this site has done little to help identify distinctive material patterning that may be associated with ethnic groups within the city walls. This project aimed to test the feasibility of identifying ethnohistorically documented multiethnic composition of the city of Mayapán through the chemical analysis of human remains. This report describes patterning in the dietary stable isotope data from the analysis of human bone collagen and apatite samples, as well as the strontium isotope data from tooth enamel, and bone samples.

Stable carbon and nitrogen isotope ratios are measured in bone collagen, and reflect a long term average of the diet consumed by the individual, with emphasis on the last 10 or more years of life. Stable carbon isotopes ($\delta^{13}C$) measure the sources of dietary carbon with some emphasis on dietary proteins. In the Maya area, maize is the primary food that can be identified through high $\delta^{13}C$ signatures in bone collagen, however, tropical reef fishes also contribute to high $\delta^{13}C$. Carbon isotopes can also be measured in bone mineral (apatite), wherein the ratios average all dietary sources, but may be more susceptible to contamination from the burial environment. Stable nitrogen isotopes ($\delta^{15}N$) reflect the origin of dietary proteins, and are higher with increased consumption of high trophic level foods such as meat and fish (1991). These paleodietary methods have been widely applied in the Maya area (Wright and White 1996). Stable oxygen isotope ($\delta^{18}O$) ratios are measured in bone apatite, and may reflect the sources of water imbibed during bone formation, but are also subject to soil contamination. Humid tropical climates and evaporative enrichment of stored water can contribute to high $\delta^{18}O$ ratios. Oxygen isotope ratios have been shown to differ across Mesoamerica, and may shed light on movement of individuals from distant hydrological regions, however, the mapping of $\delta^{18}O$ ratios across the Maya area is as yet incomplete (Valdés and Wright 2003; White *et al.* 1998). Strontium isotope ratios ($^{87}Sr/^{86}Sr$) in bone reflect the geological origin of bedrock and soils where foods are grown. Young volcanic rocks and their overlying soils have low values, while sedimentary and older rocks and soils have higher values. Considerable work in mapping $^{87}Sr/^{86}Sr$ has been carried out in Mesoamerica, allowing these data to aid study of migration (Hodell *et al.* 2004; Price *et al.* 2007; Wright 2005a; Wright 2005b).

Human remains have been encountered during excavations at Mayapán from a variety of contexts, ranging from domestic to clearly public, ritual deposits. These include a number of deposits with disarticulated skeletons. It is difficult to determine whether many of the burials in nonresidential structures from the Main Plaza at Mayapán were local individuals or not using archaeological criteria. Warfare was endemic during the time of Mayapán’s dominance in Yucatán. The practice of captive, slave, criminal, and child sacrifice has been well described in documentary sources (Scholes and Roys 1938) and may be reflected in the mortuary patterns of the city. The most likely burial samples to represent local residents are those interred at domestic structures or shrines within domestic groups. We have coded the samples according to these expectations, and they are classified in the following groups:

1. domestic burial from small domestic structure in monumental zone (social status unknown)

2. burial from a domestic shrine

3. elite residence located outside of site center

4. commoner residence located outside of site center

5. sacrificial–mass grave (probable sacrificial victims interred near surface at either northwest entrance to Main Plaza at Q-79/79a or at southwest entrance to outlying civic group Itzmal Ch'en)

6. sacrificial–alley (probable sacrificial victims interred in alleys between major structures of site center)

7. sacrificial–burial shaft temple (possible sacrificial victims–remains on surface of temples from burial shafts that were previously excavated or looted)

8. unknown–individuals interred in vicinities (e.g., group parameter walls, floors, sanctuaries) of either colonnaded halls or burial shaft temples, but not within either the halls or burial shaft temples themselves

We use the stable isotopic composition of the bone collagen to test for dietary distinctions between these groups, that might signal differences in consumption according to social status among these mortuary groups. Oxygen isotopes and strontium isotopes in bone and tooth enamel apatite shed light on possible immigration to the city of individuals who had spent most of their lives in distant areas. Because the number of burials sampled for each isotopic measure is small, these results should be seen as a pilot study, aimed to evaluate the feasibility of identifying social and ethnic variation among the Mayapán remains.

Materials and Methods

A number of bone and tooth enamel samples were collected from Mayapán skeletal remains by Masson, and forwarded to Wright for analysis. Collagen was prepared from bone samples using traditional methods. Ultrasonically cleaned samples soaked in 0.25M HCl to dissolve the bone mineral. Collagen was rinsed to neutrality and soaked in 0.125M NaOH to remove humic acids. Collagen pseudomorphs were solubilized in pH 3 water at 90°C and freeze-dried. Stable carbon and nitrogen isotope ratios were measured using continuous flow mass spectrometry in the Department of Rangeland Ecology at Texas A&M, and are reported in units permil (‰) relative to the PeeDee Belemnite standard (PDB).

Bone and tooth enamel apatite was finely ground, and soaked in 1.5% sodium hypochlorite for 24 hours to eliminate organic materials, then rinsed in distilled water.

To remove soluble carbonate contaminants, the powder was treated with 1M acetic acid solution (buffered with sodium acetate to pH 4.5), rinsed to neutrality, and dried. Stable carbon and oxygen isotope ratios of bone and tooth enamel were measured in the Department of Geology at Texas A&M, and are reported in units permil (‰) PDB.

Strontium isotope ratios were measured at the University of North Carolina, using thermal ionization mass spectrometry (TIMS). To remove soluble carbonates, powdered bone and enamel was treated with 5% ultrapure acetic acid for 24 hours at 80°C. The dried samples were ashed in sterile silica glass tubes in a muffle furnace for 8 hours at 825°C. The samples were hot-digested with ultrapure concentrated HNO_3 in sterile savilex digestion vials, dried in a sterile laminar flow drying box, and re-dissolved in ultrapure 2.5 N HCl. Using 2.5 N HCl as the mobile phase, Sr was isolated with cation exchange chromatography.

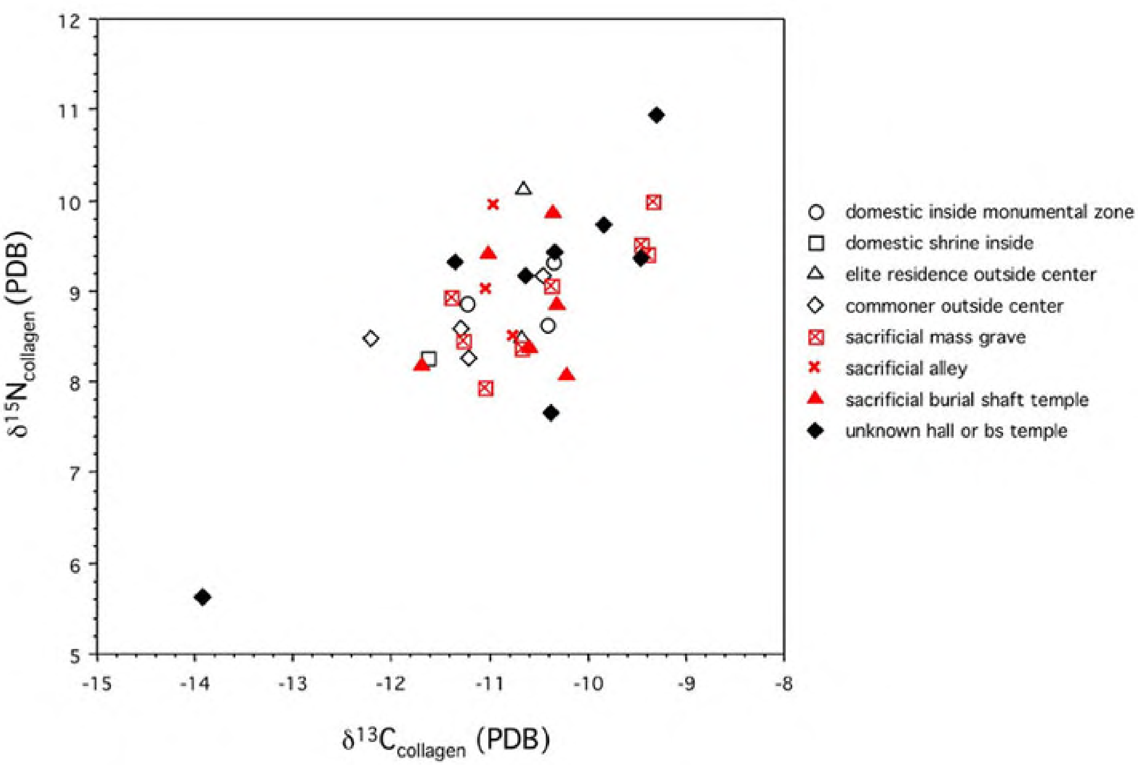

Figure 1. Stable carbon and nitrogen isotopic composition of human bone collagen from Mayapán, by burial context.

Results

The stable carbon and nitrogen isotopic composition of human bone from Mayapán is broadly similar to that found at other Maya sites (Tykot 2002; Wright 2004; Wright and White 1996), indicating a diet that was heavily reliant on maize. Figure 1 shows the

$\delta^{13}C$ and $\delta^{15}N$ composition of bone collagen from 34 human samples. Only samples with acceptable C:N ratios are included in the results described here. A number of samples did not yield sufficient collagen due to poor preservation. The majority of the samples cluster between -9‰ and -12‰ in $\delta^{13}C$, and between 7.5 and 11‰ in $\delta^{15}N$. The carbon isotopic composition is somewhat lower than that shown for most Classic period skeletons from the Southern Maya lowlands, suggesting slightly less maize than was consumed at inland sites, but is within the range of Classic period Lamanai. The nitrogen isotope data are similar to those from other Maya cities, and imply a reliance on terrestrial protein sources. One sample of white tailed deer bone from Mayapán shows a $\delta^{13}C$ of –21.1‰ and a $\delta^{15}N$ of 5.3‰. These values are comparable to those of deer from the Petén (Emery et al. 2000; Wright 2006), suggesting that meat values can be considered to be broadly comparable across the lowlands.

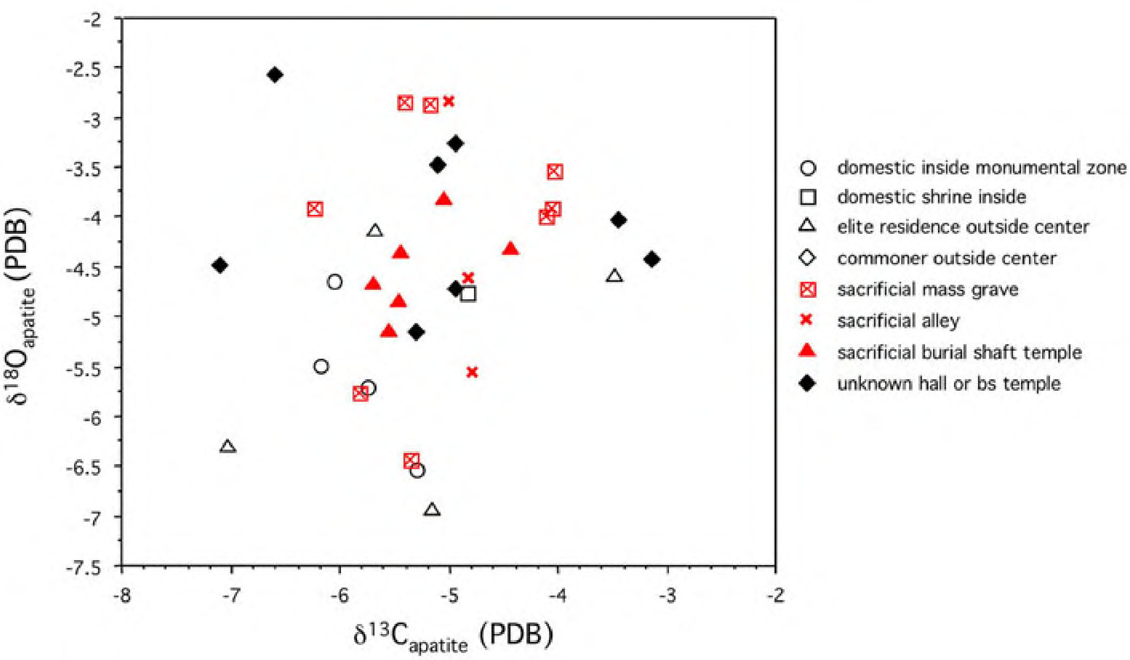

Figure 2. Stable carbon and oxygen isotopic composition of human bone apatite from Mayapán, by burial context.

One individual is markedly lower in both $\delta^{13}C$ and $\delta^{15}N$ (with values of -13.93 and 5.63 respectively), however, the C/N ratio (2.86) is at the lower end of the range expected for well-preserved bone, so it may be affected by diagenesis. This sample is from the vicinity of a colonnaded hall (Q-97). Figure 2 shows the $\delta^{13}C$ and $\delta^{18}O$ of bone apatite from these same samples. The aforementioned sample is located in the top left corner of the graph. Its $\delta^{18}O$ value is the highest measured in the series, and raises the possibility that this individual was not local, but spent most of its life in a different rainfall regime than the majority of the individuals sampled, where it consumed a low-maize diet. The low $\delta^{15}N$ value also suggests that plant foods provided the majority of its dietary proteins, and that fish were not an important part of its diet. There are often individuals of unknown origin buried in the floors or supporting shrines of such colonnaded halls, and in many other nooks and crannies of the monumental center. For example, they are present in filled in alleys between buildings Q-152 (Round Temple) and Q-152c (adjoining hall), and also between Q-162 (Kukulkan Temple) and Q-162c (adjoining sanctuary), and they are within the parameter wall of Temple Q-58, and in the vicinities of halls Q-97, Q-54, and Q-72. Oddly, however, sample #M052 is the only one of eight such burials sampled to exhibit a highly divergent isotopic composition, suggesting these individuals were most often local or came from towns where the diet was isotopically indistinguishable from Mayapán–M052 is an exception to this pattern.

Figure 1 also illustrates that there is considerable overlap in the collagen isotope ratios of the burial groups as classified above. However, the samples from domestic structures inside and outside of the monumental zone cluster tightly together, with no evident social patterning of dietary signals in this small sample. Skeletons from elite contexts outside the monumental center have comparable $\delta^{13}C$ and $\delta^{15}N$ as domestic skeletons from small domestic structures inside the center and commoners from outside. There is no evidence here for significant status distinctions in diet in the Mayapán polity, however, it is important to note that the sample does not include individuals from secure undisturbed contexts in colonnaded halls in the monumental zone that would presumably be the burials of the highest elite stratum. Several samples recovered from the surface in the proximity of such structures are here coded as "unknown", and several of these do show fairly high $\delta^{15}N$ ratios, however these are matched by samples from secure non-elite domestic contexts. It is possible that the "unknown" burials represent looted primary burials, hence they may have come from high social status. The highest of these $\delta^{15}N$ ratios, which reflects considerable fish consumption, is a sample from disarticulated remains in Structure Q-54 (Group Q-72). Although we do not have strontium isotope data for this sample, although its $\delta^{18}O$ value (-4.5‰) does not suggest an extremely divergent water regime.

Skeletons that are not articulated, and which may be those of sacrificial victims come from a variety of contexts. These show quite similar dietary isotope ratios to the primary burials, and the collagen $\delta^{13}C$ and $\delta^{15}N$ do not provide any evidence that they may have derived from distant sites. However, the bone apatite data in Figure 2 do hint at geographic distinctions. The skeletons that may be sacrificial victims, shown in red, average higher $\delta^{18}O$ values than the articulated burials from domestic structures, shown in open symbols in black. Similarly, samples from bones classified as "unknown" that may be from colonnaded halls or burial shaft temples are also rather high in $\delta^{18}O$, suggesting a different water source. Two samples from a mass grave in Structure Q-79 have low $\delta^{18}O$ consistent with the primary burials. These are Burials 19 and 24. However, the remainder of the individuals from this mass grave show higher $\delta^{18}O$. These burial contexts are similar to a mass grave encountered in a 2x2m excavation of the Itzmal Ch'en group. The Itzmal Ch'en outlying temple/hall group has long been thought a likely candidate for an ethnic faction at Mayapán, perhaps the K'owoj, who later migrated to the Petén lakes. One sample (Burial 03-08) from this context shows higher $\delta^{18}O$ values that would be consistent with time spent in a more humid zone, such as the southern Maya lowlands or the Gulf coast, however quite broad ranges of $\delta^{18}O$

have been reported from sites in the southern Maya lowlands, so it is not advisable to simply identify foreign status based on these oxygen results alone.

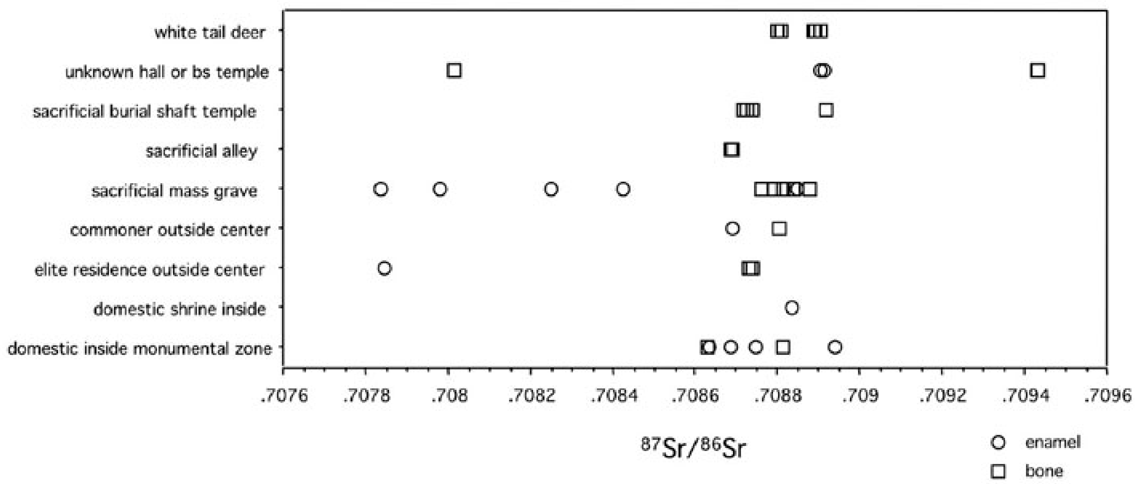

Figure 3. Strontium isotopic composition of tooth enamel and bone from human skeletons and white tailed deer from Mayapán, by burial context.

Figure 3 contains the results of strontium isotopic analyses of 14 tooth enamel samples and 25 bone samples, including 5 bone samples of white-tailed deer. The deer bones average 0.70886, which can be presumed to be a local value for the Mayapán area, given the close agreement among the five samples. Moreover, these values match data obtained on soil and water samples from the Mayapán area obtained by Adrian Gilli and colleagues (personal communication, 2007). The human remains show a distinct patterning when divided into social groups. Two bone and four enamel samples from burials in domestic structures located inside the monumental zone show a closely grouped signature, between .7086 and .7089. These samples include five small houses near temples in the monumental zone (house Q-68, house Q-67, house Q-92, house Q-94). A similar value is found in a burial from a domestic shrine inside the site center (Q-57). Two samples from outlying commoner houses (P-11 and R-112) show a similar value, as do two bone samples taken from elite residences outside the center (Y43b and R-106). Because these values match those measured on deer bones, and since these data are from contexts where a local origin is likely, i.e. primary burials in domestic contexts, it is reasonable to interpret this data as describing the local isotope signal for Mayapán. However, it is important to recognize that nearby sites lie on soils of equivalent geological origin, and will have similar strontium isotope ratios, so it is not possible to identify shorter distance movement using $^{87}Sr/^{86}Sr$.

Some nondomestic burials from the site center also show $^{87}Sr/^{86}Sr$ values in this range, implying that they may be local individuals. These include sacrificial victims from the Main Plaza mass grave (Q-79a), the alley behind the Round Temple (Q-152), and from the Itzmal Ch'en group. Likewise, two enamel samples from "unknown" contexts in the vicinities of burial shaft temples or colonnaded halls also show values consistent with Mayapán, including bone found near Str. Q-72 and Q-152. Given their similar $^{87}Sr/^{86}Sr$ ratios to the local domestic burials, these individuals likely came from Mayapán itself or from towns in northwest Yucatán with similar geological environments and subsistence patterns that would not be distinguishable isotopically.

Six samples show much lower $^{87}Sr/^{86}Sr$ ratios. One individual from an outlying elite residence shows a tooth enamel value consistent with the cretaceous limestones of the central Maya lowlands, Palenque or the gulf coastal area. This skeleton is from Structure Y-43b, and it may have been part of a family with close ties to the central Maya lowlands. Unfortunately we did not sample bone from this skeleton, which would help determine whether the migration was recent or much earlier in life. Note, however, that bone from a neighboring burial in the structure shows a local Mayapán value. Masson and Peraza (Masson and Peraza Lope 2005) excavated a nearby house, Y-45a, located about 300m to the south of Y-43b. Residents of Y-45a discarded many vessels on the floors of Rooms 1 and 2 prior to abandoning their house, and many of these vessels of the Buff Polbox group bear resemblances to Petén lakes red on cream pottery types from Topoxte Island, according to Prudence Rice during her visit to the Mayapán laboratory in July, 2004. Ceramicist Leslie Cecil is planning some chemical analysis of pottery to compare the Mayapán and Petén Lakes types to determine whether or not there are any direct exchange relationships. Y-43b is similar in form and size to Y-45a, and also to Y-41a, located about 100m to the north (and mapped by Masson and Peraza's Proyecto Económico de Mayapán investigations as part of Milpa 33). The similarity in form of these houses, located in proximity to one another, at least as viewed from the surface, suggests they may have formed part of a neighborhood. The distinctiveness of the Y-45a vessel assemblages suggests this neighborhood may have been either ethnically distinct or its residences had close trading ties with distant partners. The additional data from the skeleton from Y-43b thus complements previous information suggesting that something may have been different about individuals from this area.

Along with the Y-43b sample, five other individuals had lower strontium ratios; these include four individuals who were interred in the passageway between the site's main pyramid (Kukulkan Temple, Q-162) and a frontal sanctuary (Q-162c). These samples are likely sacrificial victims (Burials 25, 17, 8/9, 10). Two of them have ratios quite near that of the Y-43b individual (.7078, .7079). Two others are slightly higher (.7082, .7084), but all are lower than the range of the higher cluster of values (.7086 - .7089) previously discussed. These values match those found in the southern Maya lowlands, especially in the central lowlands, the Usumacinta and Pasión river valleys. Other areas with Cretaceous and Paleocene limestone would also have similar $^{87}Sr/^{86}Sr$ ratios. It is not possible to determine whether the Y-43b sample originated from the same location as these sacrificial victims, since large areas of the Maya lowlands show equivalent strontium isotope ratios. That they did derive from the same location seems implausible given that the former sample was an upper status resident of the city and the latter likely lived in a region hostile to Mayapán. Nonetheless, fluctuating regional relationships could account for such odd scenarios, where migrating elites or merchants could have taken up residence in a city before or after war broke out between the areas.

Unfortunately, there were few grave goods recovered with Burials 25, 17, 8/9, and 10 that could provide more information regarding their town or region of residence. The most we can say at this point is that it is possible that Mayapán was at war with regions to the south, and that one or more individuals from a similar area resided at the city.

Although two of the "unknown" remains found near burial shaft temples or colonnaded halls showed local values in their enamel, one bone sample from an "unknown" deposit at a skull platform/shrine (Q-89) near a burial shaft temple (Q-95) also shows a low value, indicating a non-local individual, consistent with a southern lowland origin, similar to the remains discussed above. By contrast, a second individual buried near the same structure shows a much higher strontium isotope ratio, of .7094. This value is essentially the same as modern seawater, .7092, and suggests a coastal origin where soils are derived from Pleistocene deposits. Surprisingly, however, this individual does not show a high $\delta^{15}N$ value. It has the second lowest value measured, 7.7‰, implying a diet virtually devoid of marine fish. Its $\delta^{18}O$ value lies in the middle of the measured range and is not informative as to origin.

Conclusions

These data demonstrate a considerable proportion of foreign individuals among the Mayapán skeletons sampled, and demonstrate the potential of isotopic analysis to identify outliers at Mayapán. The strontium isotopic data is the most straight-forward to interpret in terms of identifying possible migrants. Oxygen isotopes vary with rainfall composition both seasonally and annually. Moreover, evaporative enrichment of water reservoirs may affect oxygen isotope ratios, so access to different water catchment systems within the same site might also contribute to variation. Both methods shed some light on non-local individuals at Mayapán, and should be considered as complementary, rather than competing methodologies. The dietary stable isotope data, however, do not suggest dramatic dietary differences among burial types at Mayapán. This is rather surprising given the density of the city's occupation, the lack of intensive agricultural techniques in the area, and the ethnohistoric descriptions of status differences in diet, and stands in contrast to the dietary differences previously documented at various Late Classic lowland sites (Chase and Chase 2001; White et al. 1993; Wright 2003). It is possible that the sample size is somewhat too small to identify systematic dietary distinctions in this study, or that any social patterning is confounded by the presence of migrants from diverse dietary backgrounds into the sample. Certainly, these results suggest that further work on isotopic analysis of Mayapán skeletons would be profitable.

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