CHAPTER

14

The Importance of Maize in Initial Period and Early Horizon Peru

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Glossary

Cardal A late Initial Period complex site in the lower Lurin Valley with maize phytoliths recovered from a public center.

Early Horizon First millennium BC period in Peru characterized by such complex sites as Chavin de Huantar.

Mina Perdida The oldest of the Initial Period U-shaped centers in the lower Lurin Valley, with special packets of preserved hair found in a ritual context.

Pacopampa A large late Initial Period–Early Horizon public center in the northern highlands with evidence for significant contact with Chavin de Huantar.

Tablada de Lurin An extensive cemetery complex in the lower Lurin Valley dating to the final centuries of the early Horizon to the initial centuries of the Early Intermediate Period.

The relationship between food production and the development of complex societies has been an important focus of anthropological research in Peru, where maize traditionally was assumed to have been an important staple crop for Chavín civilization (ca. 850–200 BC) along the coast and in the highlands. Recent macrobotanical and chemical investigations have raised doubts about this hypothesis.

In this study the relative contributions of maize and marine resources to pre-Hispanic Peruvian diet was determined through stable isotope analysis of human bone collagen and apatite from **Pacopampa** in highland northern Peru, and **Cardal** and **Tablada de Lurin** in the Lurin Valley on the central coast. Measurement of $\delta^{13}C$ in apatite, which reflects the whole diet, is now recognized as an essential complement to $\delta^{13}C$ and $\delta^{15}N$ determinations for collagen, which represent only dietary protein, especially when both maize and marine foods may have been consumed. Hair segments from **Mina Perdida,** near the coast, are being analyzed to assess short-term or seasonal variations in diet.

The Pacopampa results are consistent with data from Chavín de Huantar and Huaricoto, indicating that maize was of secondary importance in highland subsistence systems during the Initial Period and **Early Horizon** Period. Near the coast in Lurin, marine foods were dietary staples, although maize consumption increased during the first millennium BC. These dietary reconstructions are important for understanding the development of intensive agricultural systems in coastal and highland Peru and the complex relationship between the subsistence economy and the emergence of early civilizations.

INTRODUCTION

In Burger and van de Merwe's 1990 article, it was concluded that maize was not the staple of highland Chavin civilization in the Mosna Valley or for the highland populations prior to this time in the neighboring Callejon de Huaylas [8]. However, it was recognized that this conclusion was not assumed to be valid for the other regions that played a role in stimulating Chavin civilization during the Initial Period or that interacted with it during Early Horizon. The different ecological conditions further to the north in the highlands of the Department of Cajamarca and in the arid coastal drainages of the Pacific created different challenges for farming from those at Chavin de Huantar and could have led to the incorporation of maize into the diet at different times and in different ways. In recognition of this, Burger and van der Merwe [8] wrote:

> Moreover, the far northern highlands are better suited for maize cultivation and less well suited for camelid herding because they are lower and moister. Until additional research is carried out, the role of maize in the development of the pre-Chavin and Chavin-related cultures in these highland areas and on the coast remains very much an open question.

The analysis of the samples reported and discussed in this chapter are an attempt to use isotope analysis to address the question of maize consumption in some of the coastal and northern highland sites that played such an important role in the development of Chavin de Huantar. Although the number of samples is limited due to the scarcity of osteological and other human remains recovered from these archaeological centers, the findings shed light on dietary patterning and can serve as the basis for hypotheses that will be tested in the future as additional samples become available for study.

ARCHAEOLOGICAL SITES TESTED

Pacopampa

Pacopampa is a large public center established during the late Initial Period and occupied continuously through the Early Horizon. Its most conspicuous remains consist of a series of terraced stone platforms with rectangular plazas, stone sculpture, masonry columns, and an elaborate stone-lined drainage system. Pacopampa was considered to be a “colony” of Chavin de Huantar by Rebecca Carrion Cachot [10], but subsequent excavations at the site by Rosas and Shady [27, 28], Flores [16], Fung [17], and Morales [24, 25] have established the local character and development of this northern site, which is located only 150 kilometers south of the Ecuadorian border. Nevertheless, there seems to have been significant contact between Pacopampa and Chavin de Huantar throughout its occupation, and the ties between the sites were particularly close during Early Horizon.

Today, Pacopampa is found within the District of Querocoto, Province of Chota, in the Department of Cajamarca at an elevation of 2140 meters above sea level (masl). The ceremonial core of Pacopampa covers approximately 10 hectares, an area comparable to the monumental core of Chavin de Huantar. As at Chavin de Huantar, some residential occupation exists at the site, although its full extent has yet to be determined. Morales [25, p. 117] estimates that if the residential areas are included, Pacopampa would cover an area 400 meters wide and 1000 meters long. Located roughly equidistant from the Pacific shores of northern Peru and the heavily forested tropical banks of the Marañon River, Pacopampa had strong exchange ties with coastal and eastern lowland peoples as well as the highland peoples further to the south, and these links have been confirmed by archaeological research [13, 31].

Unlike the formative center at Chavin de Huantar, which is located at the bottom of a deep valley at 3150 masl, Pacopampa is placed on the crest of a hill in the jalca zone (2000–2900 masl), about 1000 meters above the deeply entrenched Chotano River. As a consequence, most of the agricultural land within Pacopampa’s catchment area is in the surrounding quechua zone or the lower yunga-like temple zone (1200–2000 masl). These lands are suitable for

FIGURE 14-1 Map showing archaeological sites in Peru with stable isotope analyses.

FIGURE 14-2 Panorama of the Pacopampa platforms and surrounding environment. Photo: R. Burger.

maize, manioc, sweet potato, fruit trees (such as chirimoya), and other crops that cannot thrive in the Chavin de Huantar area. Some native crops, such as arracacha, are popular in the Pacopampa area but are absent in the more southern highlands of Ancash. Because of this ecological setting, it is a distinct possibility that maize was a more important crop at Pacopampa than at Chavin de Huantar. Moreover, sites dating to the beginning of the Initial Period have only been found on steep slopes below the higher but more level lands surrounding Pacopampa [30]. Morales [25, p. 120] writes:

> Maize is a special case given that the geographic location of Pacopampa and the climate are the most apt for its cultivation. It is a seasonal cultivar using a dry farming technique, and each region produces two different varieties: a small hard one from the temple zone and a soft large one from the quechua zone. Maize never is grown alone since in the *temple* it is always grown with beans and in the *quechua* it is always together with squash.

German archaeologist Kaulicke [21, pp. 10–16] has suggested that the establishment of the large center at higher elevations in the quechua zone could have reflected a shift to an agricultural system emphasizing maize. It is also worth noting that the high altitude grasslands in far northern highlands around Pacopampa are moister than those around Chavin de Huantar and farther south, and the presence of camelids there appears to have first occurred as a result of the relatively late introduction of the domesticated llama *(Llama glama)* [23]. As a consequence of this ecological and historical pattern, the availability of large mammals in the Pacopampa area seems to have been somewhat restricted at least through the late Initial Period, and this may have had some effect on the introduction of maize into the diet.

The samples analyzed were taken from an area known as El Mirador (the Lookout) located to the east of Pacopampa's public architecture. Although some have treated El Mirador as a site separate from Pacopampa, its excavators have generally considered it to be one of the residential sectors surrounding the monumental core. El Mirador (PA–003) has been investigated by a series of archaeologists from the Universidad Nacional Mayor de San Marcos, first under the direction of Flores [16] and subsequently under the direction of Morales [24]. It has been described by Morales [25, p. 116] as containing the remains of worked stone, hearths, and kilns for making ceramics. Judging from their results, El Mirador was occupied from the late Initial Period until the Early Intermediate Period. The work has been limited in scope, but excavations of the lowest cultural level revealed a large ovoid structure that had been cut into bedrock. The edges of the floor were ringed with stones, which may have once supported a conical thatch roof covering the building. The structure was associated with abundant food refuse, broken pottery, and elaborate shattered figurines. Morales (personal communication) interpreted this building as the residence of religious specialists serving the temple area and given the presence of cut and burnt human bone amidst the faunal remains, hypothesized that ritual cannibalism took place. The pottery associated with the ovoid building and human remains falls within the Pacopampa Pacopampa Phase of Rosas and Shady or the Fase Apogeo of Morales, tentatively dated to the late Initial Period. He estimates the date of this phase to 1000–800 BC [25, p. 118]; judging from the style, it appears to be at least partially coeval with the Urabarriu Phase at Chavin de Huantar, dating to roughly between 900–600 BC.

From the large sample of human remains recovered by Morales [25] at El Mirador, 11 rib samples were selected and exported with permission of the Instituto Nacional de Cultura for isotopic analysis. The samples came from units 4–6 in layer C and were associated with Fase Apogeo (or Pacopampa Pacopampa Phase) pottery. An effort was made to select ribs that, based on their size, color, and other features, represented different individuals. In addition, one large mammal rib, probably from a deer, was also analyzed for comparison with the human remains.

The Manchay Culture Sites of the Lurin Valley

The Lurin Valley is a medium-sized valley on Peru's central coast that is best known for the archaeological site of Pachacamac, one of the most important pilgrimage centers in late Pre-Hispanic times. At present, the valley is located immediately to the south of Lima, although it is quickly being incorporated in the capital's sprawling suburbs. Long before Pachacamac was established, the Lurin Valley was characterized by the Manchay culture, a pre-Chavin cultural pattern that extended from Lurin through the Rimac Valley, the Chillon Valley, and the Chancay Valley. The most conspicuous expression of this culture was numerous public centers with monumental terraced platforms arranged in a U-shaped ground plan around a large rectangular plaza area. The Manchay flourished in the lower and middle valley areas of the central coast during the Initial Period (1800–800 BC, uncalibrated) and survived at some sites into the first centuries of the Early Horizon (800–650 BC, uncalibrated). In the Lurin Valley, seven civic–ceremonial centers have been identified in the lower valley and three in the middle valley. The centers of the Manchay culture seem to have been established at different points during the Initial Period, and this pattern has been interpreted as reflecting the gradual settlement of the valley by irrigation-based farmers as newly constructed gravity canals gradually brought the valley's bottomland into cultivation, thus allowing the population to rise. The Manchay culture has been hypothesized to have been one of the principal sources of inspiration for highland Chavin culture, and contact existed between the central coast centers and Chavin de Huantar at the end of the Initial Period [2, 7].

Since 1985, Burger and Salazar have been conducting research on the Manchay culture centers in the Lurin Valley, carrying out excavations at three of the civic–ceremonial centers. The arid climate of the central coast favors good preservation of the floral remains, but the intensive irrigation that has gone on in this area probably since late Pre-Ceramic times has offset these favorable environmental conditions. Macrobotanical studies of remains from the Manchay centers in the Lurin Valley by Umlauf [40] and Chevalier [11] have identified a wide range of cultivated and wild plants of economic value. Although these include macrobotanical maize remains, they are extremely rare and appear to be of secondary importance. However, in a phytolith study of one U-shaped center, Cardal, maize phytoliths proved to be abundant and widespread in all of the excavation units sampled. Given the preservation and sampling bias of the macrobotanic and phytolith studies, it would be premature to generalize about the importance of maize to Initial Period diet without additional kinds of analyses. Of the three centers investigated, Manchay Bajo has yet to yield human remains of any kind. Burials were found at Cardal on the summit of its central pyramid and in the residential area behind it, and 38 individuals were sampled for isotopic analysis.

Mina Perdida

The site of Mina Perdida (PV48–117) is located 7.5 kilometers inland from the Pacific Ocean at 100 meters above sea level. Situated only 0.5 kilometer from the modern town of Pachacamac, which was established in colonial times following the destruction and abandonment of the Pre-Hispanic temple and settlement of the same name, Mina Perdida is the largest and oldest of the U-shaped centers in the Lurin Valley. The badly damaged site covers approximately 30 hectares, and its central terraced pyramid rises 22 meters above the valley floor. Judging from 18 C14 measurements, the site was established around 2000 BC and continued to thrive until 900 BC, in calibrated radiocarbon years. The site appears to have been abandoned before the emergence of Chavin civilization in the highlands. Excavations behind the central pyramid encountered evidence of temporary residential occupation during the late Initial Period, but there is little surviving evidence of a permanent population at the site. In the residential area, abundant shellfish and fish remains were recovered, but no fishing paraphernalia was recovered. This has led Burger [7] to suggest that the people associated with Mina Perdida, like those associated with Cardal, were probably farmers who obtained their marine foods by trading with fishermen and fisherwomen living along the shoreline at sites such as Curayacu or Chira-Villa. Abundant fish and shellfish remains have been encountered in all of the midden strata at Mina Perdida, Cardal, and Manchay Bajo, and it can be assumed that these marine animals were the principal sources of protein for the population [3, 18]. Occasional bones of ocean birds, inland birds, sea mammals, and wild large mammals (deer and wild camelid) were also encountered in small quantities.

FIGURE 14-3 Central platform mound at Mina Perdida, Valley of Lurin. Photo: R. Burger.

The hair samples analyzed for this study come from the 1991 excavations in the low stone-faced platform that constitute the left arm of the U-shaped complex. This area, known as sector IA, had been damaged by heavy machinery, but excavations revealed a complex series of small incremental additions that resulted in the growth of the platform both horizontally and vertically. Most of these additions consisted of the creation of stone retaining walls holding back stone, gravel, and/or earth. These artificial fills rarely contained cultural materials of any kind. During its final widening, coarse stone walls were built at short intervals perpendicular to the older platform wall; one of these small additions was unique because it included large quantities of cultural materials such as ceramics, textiles, fragments of native copper foil, and shell and plant remains [4, 6, 7]. Also in this fill were small packets of hair carefully secured by wrapping horizontal hairs around the packets. The reason for creating these packets of hair is unknown, but it is worth noting that hair has special symbolic power in the central Andes, and the first hair cutting ceremony remains an important rite of passage for children in traditional Quechua households. In contemporary Peru, hair is sometimes used in witchcraft and other rituals, so it retains some of its power even after it has been cut.

All of the materials in the fill appear to be homogeneous and to date to the late Initial Period. A sample from a fiber bag that held the fill that included the hair samples produced a date of 2870 ± 90 BP (1210–920 CAL BC), and the hair should predate this time. Carbon sample taken from the fill in which the hair was found dated to 3050 ± 90 BP (1430–1160 CAL BC), and a sample taken from a wall built immediately before the deposition of the materials yielded

FIGURE 14-4 Beginning of excavations in Sector IA, the damaged left arm of the U-shaped complex of Mina Perdida, where the hair samples analyzed were recovered. Photo: R. Burger.

a date of 2960 ± 90 BP (1320–1040 CAL BC). Although it is possible that the hair samples could have been taken from an older context and redeposited, it is likely that they date sometime between 1410–1090 CAL BC. In the selection of the nine samples, an effort was made to select hair samples with diverse visual characteristics from different contexts, and it is assumed that the nine samples represent nine separate individuals.

Tablada de Lurin

In the lower Lurin Valley, extensive cemeteries exist on a sandy plateau at 100 meters above sea level above the north banks of the drainage. This area has been intensively studied by scholars from the Pontificia Universidad Catolica del Peru, Lima, beginning in 1958 and, thus far, half a hectare has been exposed revealing 437 burials [9]. The cultural affiliation of these burials pertains to the pre-Lima culture of the late Early Horizon–early Early Intermediate Period, and the date of the materials is estimated as falling between 200 BC–AD 200 [22, p. 92]. This culture followed the collapse both of the Manchay culture in the valley and of the Chavin culture whose influence is evident on those groups still living in the lower reaches of the valleys on the central coast. Although the Tablada de Lurin does not include residential or public architecture, relatively nearby sites with such remains have been documented for Lurin, most notably in the area of Villa Salvador [32, 33]. The cemetery is only 12 kilometers from the Pacific, and marine foods feature prominently in the burials and the midden of the coeval residential zone at Villa Salvador, so it can be assumed that marine foods remained an important part of diet.

The sample of human bone analyzed from Tablada de Lurin came from burials excavated by the PUC project under the direction of Makowski [22]. An attempt was made to select individuals whose sex and approximate age was known and to draw upon the full range of individuals along these two dimensions.

STABLE ISOTOPE ANALYSIS

The extraction and preparation of all 71 samples (69 human, 2 deer) was performed in the Archaeometry Laboratories, Harvard University, using well-established methods [35, 38]. The isotopic analysis was done on a VG Prism II stable isotope ratio mass spectrometer using an on-line Carlo Erba CHN analyzer for sample combustion. Carbon and nitrogen isotope data (Table 14-1) are reported relative to the PDB and AIR standards respectively using the delta (δ) notation with units in parts per mil (‰). Precision is ± 0.1 for $\delta^{13}C$ and ± 0.2 for $\delta^{15}N$. The integrity of individual samples was assessed from their collagen yield (≥1%) and the ratio of elemental C:N produced by combustion (accepted if between 2.9 and 3.8). Although all 11 of the Pacopampa samples produced reliable isotope results, only 5 of the 12 Tablada de Lurin samples produced reliable collagen values, with three samples yielding no collagen at all, and 4 resulting in unacceptable C:N ratios when analyzed on the mass spectrometer. Data were also produced for the two deer samples from Pacopampa and Tablada de Lurin. Preservation was much worse for Cardal, with only 2 of the 38 individuals yielding any organic sample, and the isotopic results for both of those were rejected based on their unreliable C:N ratios.

In contrast, reliable results were obtained, as expected, on the hair samples from Mina Perdida, which were carefully cleaned before isotopic analysis. In addition to carbon and nitrogen isotope results for homogenized samples from all nine individuals, reliable carbon isotope values were obtained for small, short-length increments for three individuals to investigate potential seasonal variation in diet. Because empirical evidence indicates that hair is about 1‰ lighter than bone collagen for $\delta^{13}C$, this difference has been taken into account in making comparisons with isotopic values of bone collagen in the discussion later.

To also supplement the collagen data, which mainly reflects dietary protein, bone apatite samples were subsequently prepared in the Laboratory for Archaeological Science at the University of South Florida (USF) from all of the individuals from Pacopampa and Tablada de Lurin, and from a subset of 10 individuals from Cardal. These samples were analyzed at USF on a Finnigan MAT Delta Plus XL mass spectrometer equipped with a Kiel III individual acid bath system.

Collagen carbon isotope values of about −20‰ are generally predicted for omnivorous human diets on the basis of direct or indirect consumption of C3 plants, whereas bone

TABLE 14-1 Isotope Results for Peru Samples Tested in this Study

Context/Sample No.	Description	$\delta^{13}C_{co}$	$\delta^{15}N_{co}$	$\delta^{13}C_{ap}$
El Miradaor, Pacopamapa				
Pp-c5	human rib	−19.6	6.5	−10.8
Pp-c5	human rib	−19.6	6.7	−10.5
Pp-c5	human rib	−18.9	7.0	−11.4
Pp-c6	human rib	−18.4	7.2	−10.0
Pp-c6	human rib	−19.1	5.7	−10.1
Pp-c6	human rib	−19.4	6.9	−9.8
Pp-c4	human rib	−19.0	6.8	−9.6
Pp-c4	human rib	−19.1	6.9	−13.1
Pp-c4	human rib	−19.6	6.5	
Pp-c4	human rib	−19.6	7.6	−9.0
average		*−19.3*	*7.6*	*−9.0*
std. dev.		*0.4*	*0.5*	*1.2*
Tablada de Lurin				
N169-173/E178-191, context 47	adult male	−12.9	14.1	−8.4
N595-100/E55-60, context 38	adult male 21–23		14.0	−4.9
N171-174/E177-180, context EF#3	adult female #4			−7.8
N125-135/E127-133, context 19	adult female			−5.9
N590-95/E65-70, context 150EE	male, 17–20	−9.1	13.2	−4.8
S104-107/E6S-70, context 234	adult female	−12.0	15.2	−5.0
N171-174/E177-189, context GF31	adult female			−4.3
N169-173/E178-181, context 47II	adult male			−4.6
Recinto 4, context 1	male 19–22			
S104-107/E65-70, context 29III	female > 30	−11.5	14.6	−6.2
N125-135/E1227-133, context 17-I	adult female	−10.4	15.4	−4.9
average		*−11.2*	*14.4*	*−5.7*
std. dev.		*1.3*	*0.7*	*1.3*
N123-126/E127-134,context 48-cc3	deer?	−19.6	11.5	−11.5
Cardal				
SM16	human bone			−9.1
SM23	human bone			−12.0
SM24	human bone			−14.1
SM25	human bone			−12.0
SM26	human bone			−12.9
SM28	human bone			−13.3
SM30	human bone			−13.6
SM31	human bone			−13.1
SM32	human bone			−14.1
SM33	human bone			−13.6
average				*−12.8*
std. dev.				*1.4*
Mina Perdida				
Sector IA, unit 186, lens 6	human hair	−17.9	9.8	
Sector IA, unit 204, fill 10	human hair	−21.0	12.7	
Sector IA, units 167/188, lens 4	human hair	−18.2	8.7	
Sector IA, exc. 2, lens 8	human hair	−17.7	9.3	
Sector IA, unit 194/200, lens 11	human hair	−17.9	10.5	
Sector IA, unit 167, lens 4	human hair	−17.9	11.0	
Sector IA units 153/165, lens 3	human hair	−17.9	10.2	
Sector IA unit 167, lens 4	human hair	−17.4	11.2	
Sector IA units 194/206, lens 16	human hair	−17.0	12.0	
average		*−18.1*	*10.6*	
std. dev		*1.1*	*1.2*	
Sector IA, unit 204 fill 10	hair segments	−20.4/−20.5/−21.0/−20.7/ −20.1/−20.5		
Sector IA, units 194/200, lens 11	hair segments	−17.7/−17.8/−17.9/−18.5		
Sector IA, unit 167, lens 4	hair segments	−16.7/−16.7/−16.1/−16.8		
Sector IA, unit 167, lens 4	hair segments	−16.9/−16.8/−16.6/−16.9		

apatite carbon isotope values for C3 consumers are thought to be in the range −16 to −14‰ on the basis of empirical data and on carbon isotope fractionation studies done on rats [1]. For inland sites where consumption of marine foods was unlikely, more positive values would strongly suggest the presence of maize in the Andean diet.

RESULTS AND DISCUSSION

Although maize has been described as "the grain that civilized the New World," [12, p. 1792] it is already clear that there was considerable variability in Pre-Columbian subsistence patterns, both in time and space. Coastal populations in Peru [14, 15, 34] and Ecuador [36, 41] relied extensively on marine foods and on maize in later periods. Similarly, although noticeable quantities of maize were consumed by highland populations in both the central [8] and northern Andes, its importance varied geographically and chronologically [37, 39]. Significant change over time in the importance of maize was in fact expected based on the ethnohistorical evidence [26, 29], which indicates that maize was the preeminent crop at the time of Spanish contact in the early sixteenth century AD. This has now been supported by stable isotope analyses of Inca period samples from Machu Picchu and Jauja [5, 19, 20], where maize does appear to have composed the bulk of their subsistence base. Our data (Table 14-1; Figure 14-5) further amplify the variability in Pre-Columbian Peruvian subsistence patterns and also illustrate the importance of isotopically analyzing both bone collagen and bone apatite when addressing the importance of plant foods in the diet.

Pacopampa

The collagen carbon isotope results for Initial Period Pacopampa ($\delta^{13}C = -19.3 \pm 0.4‰$, $n = 11$) at first suggest a pure C3 diet, with insignificant contributions from maize or marine foods. The bone apatite results ($\delta^{13}C = -10.3 \pm 1.2$, $n = 10$), however, strongly support an estimate of maize and maize by-products representing at least 25% of the whole diet. Because maize is only about 10% protein, the negative carbon value for collagen can best be explained by the consumption of a significant amount of animal protein. Besides domesticated llama, wild deer, guinea pigs, and other animals may have been consumed regularly.

There is little collagen carbon isotope difference between the Pacopampa individuals and the earlier study of four individuals from Chavin de Huantar ($\delta^{13}C = -18.9 \pm 0.1‰$) [8], but without bone apatite analyses from the latter, it is not possible to state that maize was of similar importance at both sites. In comparison with data available for highland

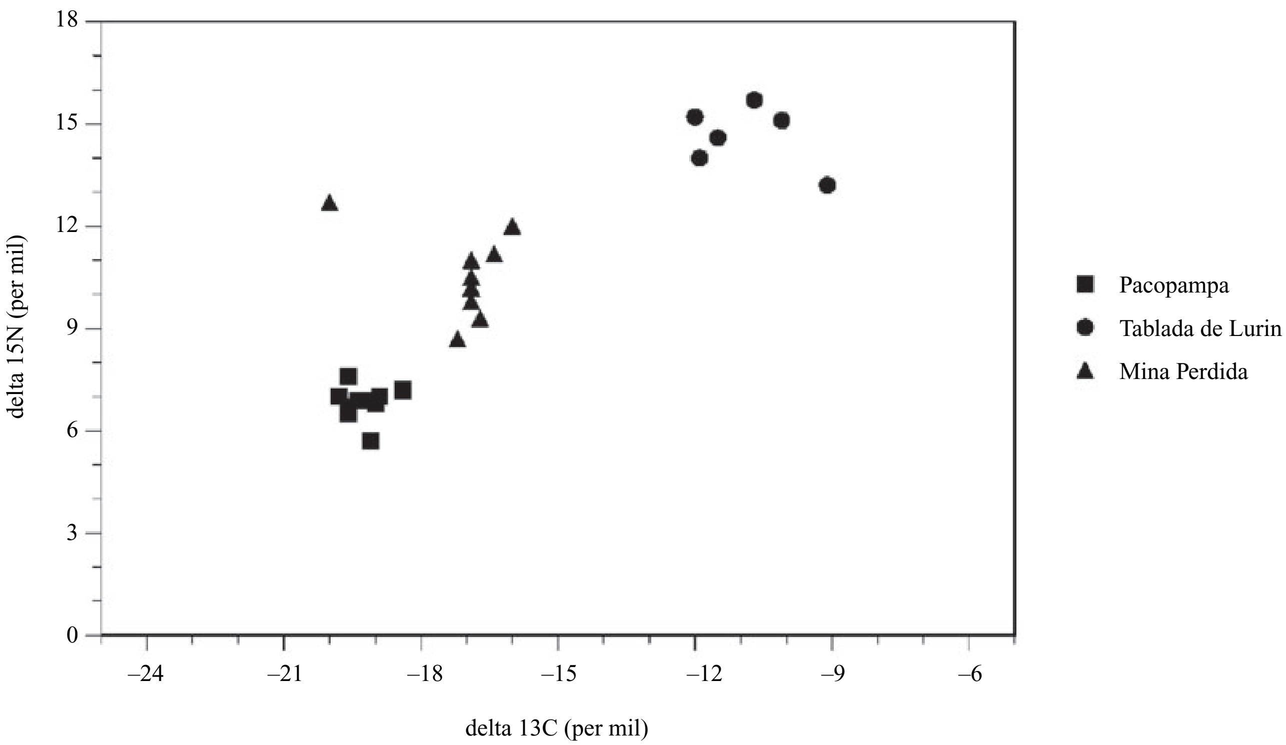

FIGURE 14-5 Carbon versus nitrogen isotope values for bone collagen from sites in this study. Stable isotope ratios for hair corrected +1.0‰ to simulate collagen values.

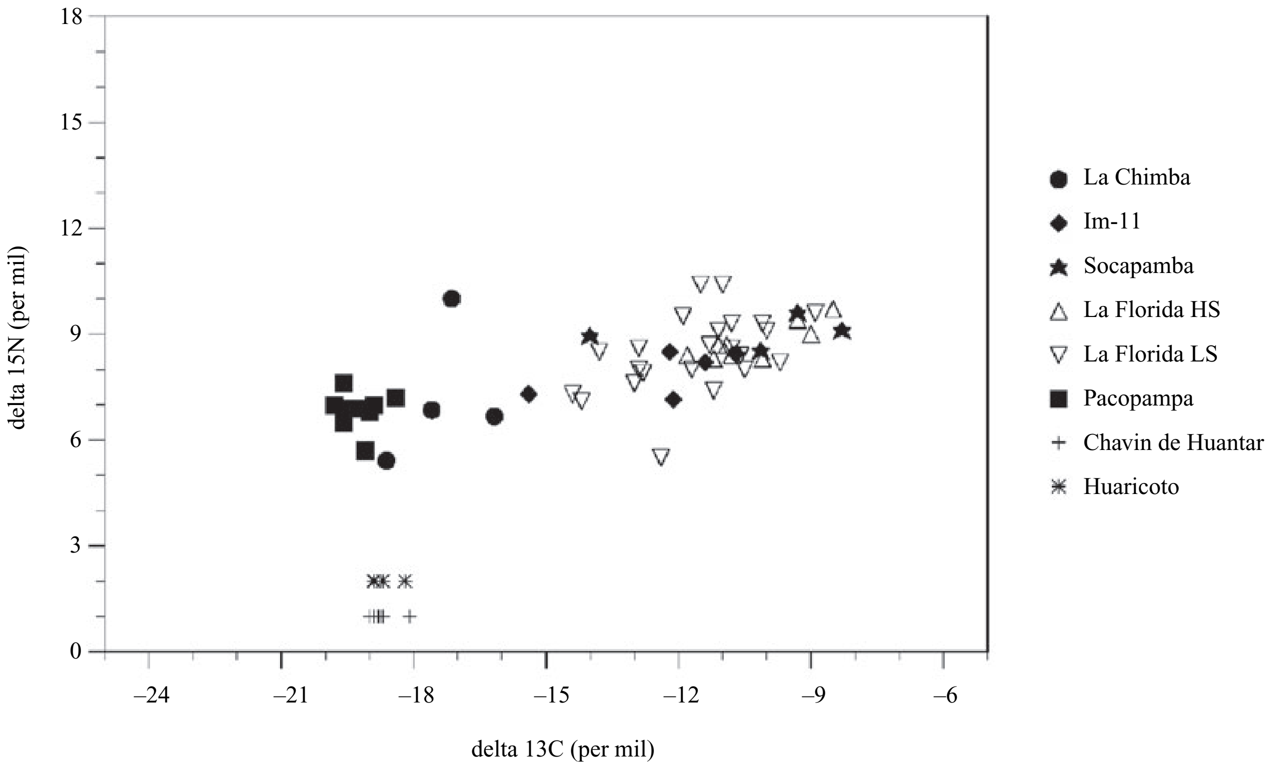

FIGURE 14-6 Comparison of isotope data for sites in highland Peru and adjacent regions.

Ecuador (Figure 14-6), we see far less intrasite variability in the isotopic values for these two highland Peruvian sites. Individuals at the roughly contemporary site of La Chimba in northern highland Ecuador, at a considerably higher elevation (3200 masl), have not only noticeable quantities of maize in their protein diet but also considerable variation in its representation [37]. Later period sites in northern Ecuador exhibit even greater intrasite variability in maize consumption, in one case (La Florida) correlating to status differences [39].

Cardal

Although it is unfortunate that no isotopic data for bone collagen from the Cardal samples were produced, the bone apatite results ($\delta^{13}C = -12.8 \pm 1.4‰$, $n = 10$) are directly relevant to the whole diet and therefore the importance of maize and marine foods. Although one individual has a more positive carbon isotope value (–9.1‰), it is at first surprising that the bone apatite values are more negative than those obtained for the highland Pacopampa site, especially considering the abundance of maize phytoliths found and the proximity of the Pacific, not to mention the large amount of fish and shells recovered at Cardal. The limited isotope data for Cardal, therefore, strongly suggest less maize consumption than at Pacopampa and other sites, indicating that there was significant variation in local agricultural and dietary practices. The significance of nonanimal dietary protein (e.g., from domesticated maize) is also expected to have been much greater in the highlands because wild mammals were scarce in most highland valleys.

Mina Perdida

The isotopic values for the hair samples tested for nine individuals from contemporary Mina Perdida, close to Cardal and even closer to the Pacific coast, may be directly compared with the collagen results for the highland sites, again considering the impact of marine foods on isotope ratios. But first, an offset adjustment must be made because $\delta^{13}C$ for hair is 1–2‰ more negative than collagen. The uncorrected values on the homogenized hair samples ($\delta^{13}C = -18.1 \pm 1.1‰$, $\delta^{15}N = 10.6 \pm 1.2‰$, $n = 9$) suggest fairly consistent dietary practices among the individuals represented. Whereas the noticeably enriched average carbon isotope ratio, compared with the highland sites, could be explained by greater significance of maize in the diet, the significantly enriched nitrogen isotope ratios strongly suggest that these values are due to marine foods contributing to the protein diet. This is supported by the finds at Mina Perdida, which, like Cardal, include refuse with huge amounts of shell, fish bone, and other marine products. With only hair samples for Mina Perdida, it is not possible to estimate the importance of low-protein maize in the diet. Somewhat surprisingly, there were negligible carbon isotopic differences for the sequential hair subsamples for the three individuals tested, suggesting little seasonal variation in the consumption of marine foods. The noticeable range in $\delta^{15}N$ values for the nine individuals, however, does infer some variation in marine food consumption, perhaps in the particular kinds of fish and shellfish. Overall, because the Mina Perdida data are from hair samples, the heterogeneity observed may be a result of short-term dietary variability rather than different overall subsistence habits.

Tablada de Lurin

The smaller sample of five individuals from the much later site of Tablada de Lurin is heavily enriched in both carbon and nitrogen isotopes for collagen and in carbon isotopes for bone apatite. Although the higher nitrogen values most likely reflect an even greater percentage of seafood (or at least of higher trophic-level fish and sea mammals), the even greater shift in collagen and apatite carbon isotope values strongly supports the idea that maize had become a significant dietary complement to marine foods by this time. This is not surprising considering that contemporary sites in coastal Ecuador [41] have much more enriched—and variable—$\delta^{13}C$ values, and at least in Ecuador have a history three millennia long of increasing maize reliance (Figure 14-7). The isotopic values of the Chorrera phase sites are instead similar to later Early Intermediate Period coastal sites in Peru, including Tablada de Lurin, Villa El Salvador [15], and Viru Valley sites 11 and 59 [14]. Significant dietary variation among sites is also not surprising, especially for Late Intermediate Period and Late Horizon societies where the local economy (and thus food availability) was politically controlled, as demonstrated by stable isotope studies at Pacatnamu [42] and several sites in the Osmore Valley [34]. Nevertheless, this considerable delay in the shift to intensive maize agriculture in Peru should be explored further.

CONCLUSION

Other than stable isotope indications of maize consumption, the specific foods contributing to human diet can be positively identified mainly from faunal and archaeobotanical remains and ceramic residues found at archaeological sites. Along with ethnohistoric information, the entire process of food production, distribution, storage, ritual use, and so forth is best understood through the integration of such data. Stable isotope analyses provide significant, quantitative data,

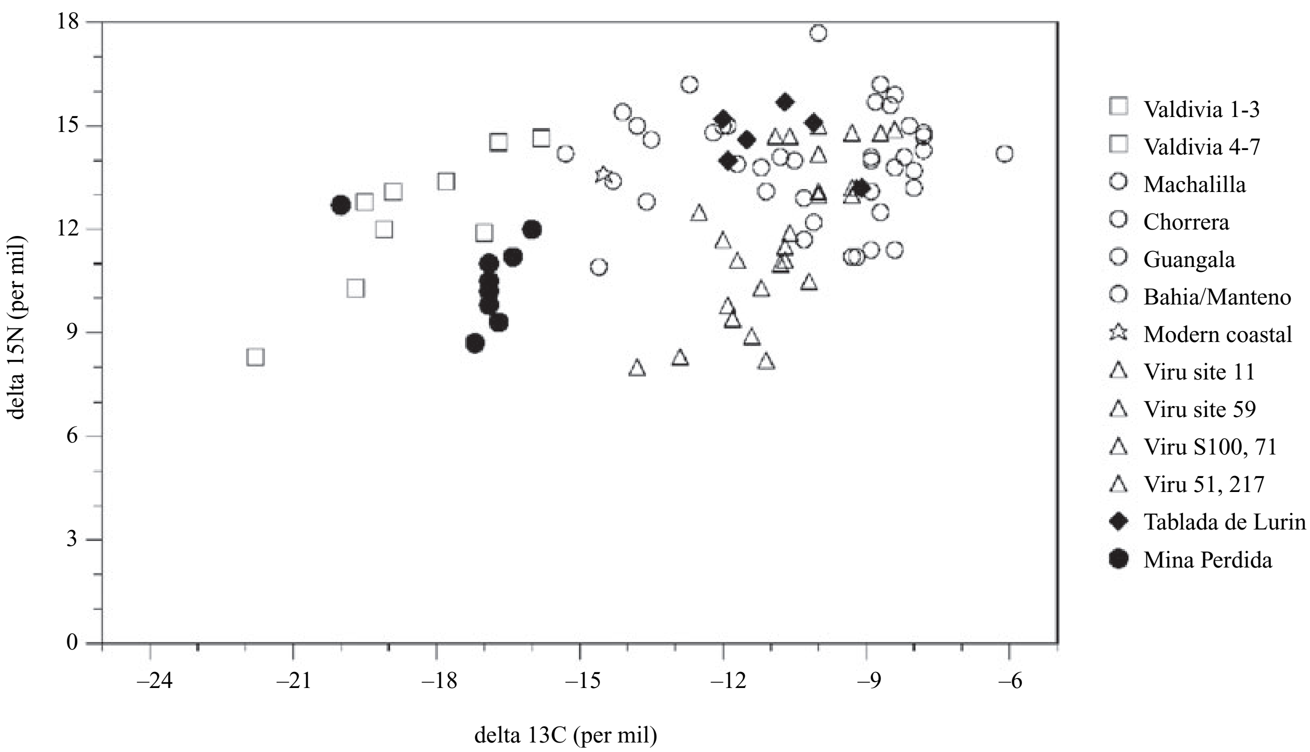

FIGURE 14-7 Comparison of isotope data for sites in coastal Peru and adjacent regions.

especially about the importance of maize and its variation among sites and individuals. Further research on available domesticated plants, and on both wild and domesticated fauna, at the sites investigated in this study would add to the precision of our interpretations. Until then, we may tentatively conclude that domesticated maize was a significant and regular contributor to human diet by the late Initial Period, at least at some highland Peruvian sites when complex societies such as Chavin de Huantar developed; but it was not the dietary staple that it became in later prehistoric times. We can also observe that the stronger reliance on maize in the diet appears to have occurred in Ecuador centuries before it did in Peru, where it seems to have had a more important role in the highlands before it did along the coast.

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