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Short Paper

A late Pleistocene human presence at Huaca Prieta, Peru, and early Pacific Coastal adaptations

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ABSTRACT

Archaeological excavations in deep pre-mound levels at Huaca Prieta in northern Peru have yielded new evidence of late Pleistocene cultural deposits that shed insights into the early human occupation of the Pacific coast of South America. Radiocarbon dates place this occupation between ~14,200 and 13,300 cal yr BP. The cultural evidence shares certain basic technological and subsistence traits, including maritime resources and simple flake tools, with previously discovered late Pleistocene sites along the Pacific coast of Peru and Chile. The results help to expand our knowledge of early maritime societies and human adaption to changing coastal environments.

Introduction

Some coastal archaeological sites of the late Pleistocene period are located on now submerged continental shelves (Fladmark, 1979; Gruhn, 1994; Erlandson et al., 2007; Meltzer, 2009). Recent discoveries on narrow shelves minimally displaced by rising sea levels or on uplifted shorelines along the Pacific coast of South America have documented human maritime occupations radiocarbon-dating between ~13,000 and 11,000 cal yr BP at Las Vegas in Ecuador (Stothert, 1985), Quebradas Tacahuay (Keefer et al., 1998), Jaguay (Sandweiss et al., 1998), and de los Burros (Lavallée et al., 2011) in southern Peru, and the Quebrada de Las Conchas and Huentelauquén sites (Llagostera, 1979, 1992; Llagostera et al., 2000) in north and north-central Chile, respectively (Fig. 1). These sites were located within 1 to 8 km from the sea at the time of occupation and invariably contain the remains of marine fish, shellfish and birds, as well as stone tools and debitage indicative of unifacial and bifacial technologies. Not only do these discoveries indicate that marine resources were important to the economy of early foragers but the Pacific coastline and coastal plains also may have been used as an initial dispersion route in South America. However, it has not been clear whether these sites were occupied by the first migrants arriving along the coast or from interior areas and developing into specialized maritime foragers or by generalized foragers moving back and forth between coastal and inland zones. Also located close to the north central Chilean shoreline during the same period are non-maritime oriented sites associated apparently with only terrestrial resources (e.g., Quebrada Santa Julia, Jackson et al., 2007; possibly Quereo, Núñez et al., 1994).

Prior archaeological research by Junius Bird (Bird et al., 1985) in the 1940s at Huaca Prieta, a large preceramic mound site located on the southern tip of an ancient terrace in the present-day delta of the Chicama River Valley on the north coast of Peru (Fig. 1), yielded a long presence of maritime foragers and part-time horticulturalists initially radiocarbon dated between ~5500 and 4200 cal yr BP. Our recent work at the site has excavated numerous mound and off-mound areas, including several units penetrating through more than 32 m of cultural deposits to reach the original surface of the terrace. In three of these units, we recovered small numbers of stone artifacts and faunal and mollusk remains associated with burned cultural features, which radiocarbon dated to late Pleistocene times (Fig. 2; Table 1; Supplementary material). We also have carried out paleoecological studies of the area to reconstruct the local environment and economy of the site at the time of human use.

The full horizontal extent of early human activity along the 2 km long Sangamon terrace where the site is located is difficult to determine not only because the archaeological materials are buried under several large artificial mounds at minimum depths of 5 to 50 m but also because so much post-depositional disturbance has

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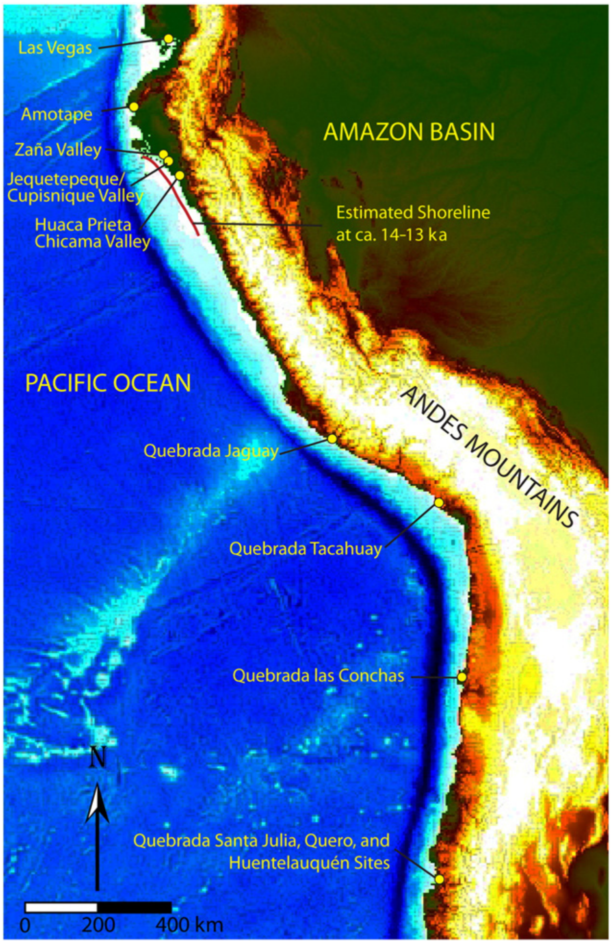

Figure 1. Location map of Huaca Prieta and other coastal sites along the Pacific rim of South America.

occurred as a result of this extensive mound-building and human occupation along the terrace over the past fourteen millennia (Fig. 2). Of the approximate 200 m^2 of the ancient terrace surface intermittently exposed by our deeper excavation units at Huaca Prieta and at nearby sites (Dillehay et al., 2012), intact late Pleistocene cultural evidence was documented in only 16 m^2 distributed across Units 9 and 15 and TP-22 along the southeastern edge of the mound and terrace (Fig. 2). The sizes of the exposed areas were 2×2 m in Unit 9, 1×6 m in Unit 15, and 2×3 m in TP-22. The intact Pleistocene levels in these units revealed light scatters of stone tools and debitage, fractured marine shells, and fragments of animal remains associated with stratified, thin lenses of ash and charcoal (0.5–2 cm thick) and occasionally powdered hematite and burned sediments (Fig. 3; Supplementary Fig. S1 and Tables S1 and S2). The ashy charcoal lenses and associated artifacts range in size between 20 and 80 cm. They do not form discrete, bounded hearths or features. The burned sediments are spotty across the excavations and range in color from a pinkish gray (7/5YR N/2) to a strong brown (7/5YR 5/6).

Paleoenvironmental setting and history

During the late Pleistocene, the world sea level was rising and between 70 and 81 m lower than it is today (Ortlieb, 1989; Lea et al., 2003; Siddall et al., 2003), placing the shoreline of this sector of the Peruvian coast minimally 20 km farther west (Fig. 1). Today, the shoreline is 150 m from Huaca Prieta. Our geologic cores in the site area reveal an arid coastal alluvial plain fed by a sandy, braided-river at the time of site occupation. The sediments deposited at this time comprise non-fossiliferous sands and silty sands that overlie a gravelly lowstand fan surface. This transition from gravel fan to aggrading river plain suggests a changing climate and landscape in the Andes catchment feeding the river system, with an increased sediment yield from mountain hillslopes and possibly an increase in water discharge. The change to an aggrading plain could also be a consequence of rising sea level, although this is unlikely as these deposits were still 60–70 m above sea level. The aggrading sands at this time are similar to those forming modern river bars and bars tops in the lower reaches of the Chicama River, suggesting a shallow, braided channel. However, unlike the modern system, the latest Pleistocene sands extend several kilometers across the lower river valley, suggesting that the fluvial system was mobile and likely sediment laden.

By 8300 cal yr BP the aggrading fluvial sands are replaced by well-dated fossiliferous lagoon deposits. These alternating siliciclastic muds and oligohaline carbonates likely represent the type of shallow coastal lagoon that existed seaward of Huaca Prieta in the preceding

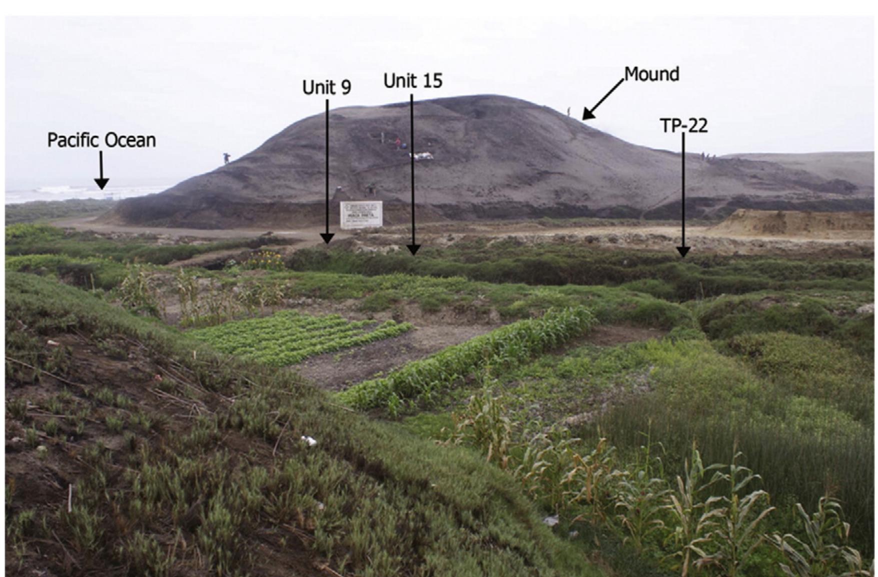

Figure 2. Mound and Sangamon terrace at Huaca Prieta. Note the seashore in the background. The arrows point to places on the eastern side of the terrace where the research team excavated through the mound to reach the deeper late Pleistocene deposits. The light brown basal deposit underneath the mound is the ancient surface of the Sangamon terrace.

Table 1
Radiocarbon dates from Units 15 and TP-22 at Huaca Prieta.

Sample no.#	Provenience	δ13C	Conventional 14C age (14C yr BP)	1σ-calibrated age range (cal yr BP)	2σ-calibrated age range (cal yr BP)	Material
Unit 15 (Unit 21)						
AA85507	Basal mound stratum: Unit 15 (1)	−25.6	6522 ± 54	7429–7323	7474–7268	Wood charcoal
AA75327	Pre-mound occupation: Unit 15-interface between strata 4-5	−29.5	7226 ± 44	8019–7947	8156–7871	Wood charcoal
Beta290621	Pre-mound occupation: stratum 9, buried terrace	−25.6	11,500 ± 50	13,403–13,294*	13,420–13,260*	Charred wood
Beta299536	Pre-mound occupation: stratum 13, buried terrace	−28.3	11,800 ± 50	13,757–13,517*	13,794–13,459*	Wood
Beta 310272**	Pre-mound occupation: top of stratum 13a	−22.8	12,280 ± 60	14,477–14,005**	14,867-13,924**	Deer bone
Beta310273	Pre-mound occupation: bottom of stratum 13a	−29.0	12,240 ± 50	14,184–13,991*	14,530–13,891*	Charred wood
TP 22						
AA86947	Basal mound: stratum 16 (1)	−24.0	4898 ± 49	5644–5483	5711–5335	Wood charcoal
Beta210862	Pre-mound occupation: stratum 20 (4a)	−27.4	9530 ± 50	[11,000]–10,501	[11,000]–10,579	Wood charcoal
AA75326	Pre-mound occupation: stratum 22 (5a)	−26.8	10,770 ± 340	13,096–12,164*	11,508–13,344*	Wood charcoal
Beta310274***	Pre-mound occupation: stratum 25 (8b)	−21.7	12,950 ± 50	13,828–13,454***	14,034–13,301***	Sea lion bone
Beta290620	Pre-mound occupation: stratum 28 (11a)	−28.3	11,780 ± 50	13,732–13,510*	13,720–13,440*	Wood

#Unless otherwise noted, all dates are calibrated using shcal04 calibration curve.
*Calibrated using Intcal09 calibration curve.
**Calibrated using marine 09.14c calibration curve with delta uncertainty of 725 ± 173 (Jones, 2009). Date as originally calibrated using Intcal09 calibration curve: 1σ 14,477–14,005; 2σ 14,867–13,924.
***Calibrated using marine 09.14c calibration curve with delta uncertainty of 725 ± 173 (Jones, 2009). Date as originally calibrated using Intcal09 calibration curve: 1σ 15,836–15,164; 2σ 16,157–15,077.
[ ] = calibrated range impinges on end of calibration data set for the Southern Hemisphere.

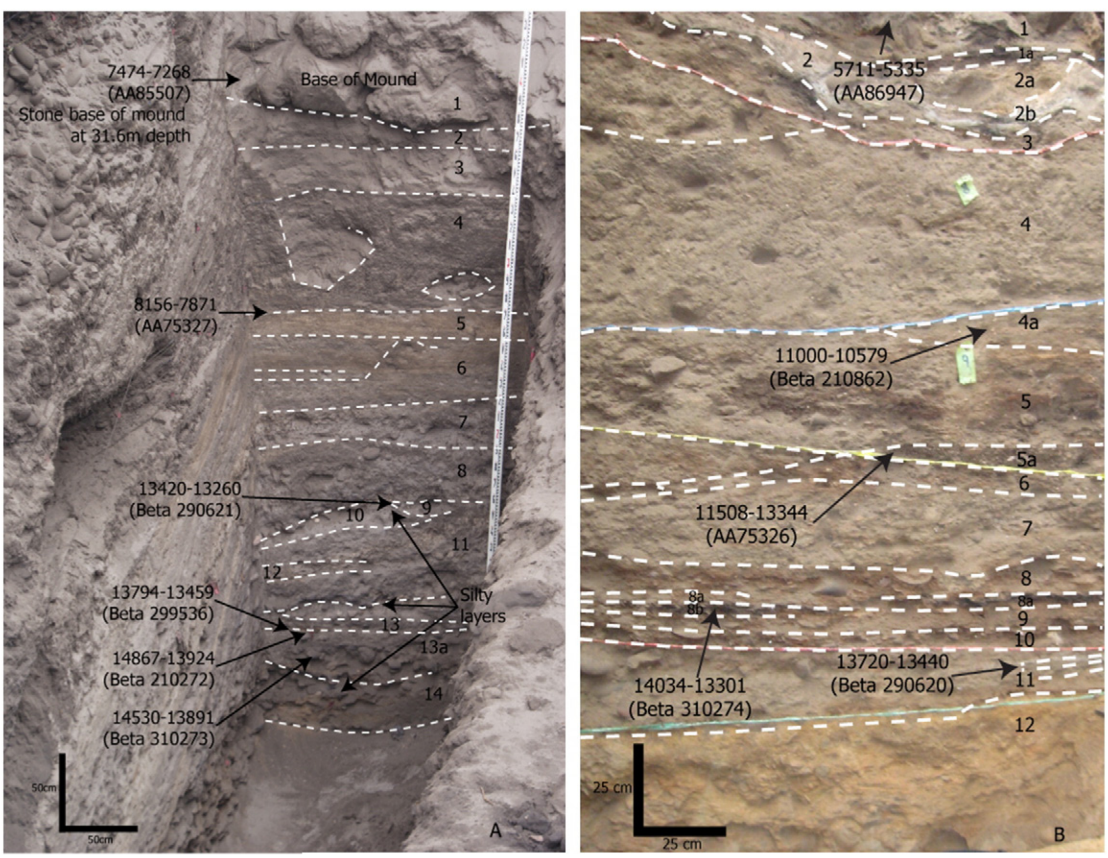

Figure 3. Stratigraphic profile of excavation units. a) Unit 15 showing cultural layers and radiocarbon dates (presented in 2σ cal yr BP): 1, basal mound layer of stone foundation at ~28 m in depth; 2–3, culturally sterile aeolian sand deposits and downslope cultural deposits, with varying amounts of gravel; 4, cultural layer of sandy midden debris; 5, culturally sterile aeolian sand deposit; 6, culturally sterile deposit of aeolian sand; 7, culturally sterile, compacted aeolian sand deposit and light gravel lenses; 8, cultural layer of sand, coarse gravel debris; 9, cultural layer; 10 and 12, culturally sterile silt layers; 11, culturally sterile aeolian and gravel deposit; 13, culturally sterile alluvial sand and gravel deposits; 13a, ashy cultural layer; 14, intermittent thin layers of culturally sterile alluvial sand and gravel; 15, culturally sterile surface layer of the Sangamon terrace. b) Unit 22 showing cultural layers and radiocarbon dates (presented in 2σ cal yr BP): 1, basal mound layer of stone foundation and midden debris at ~30 m in depth; 2-2a, culturally sterile aeolian sand deposit, 2b, thin culturally charred layer and artifacts; 3, culturally sterile aeolian sand deposit and downslope movement of cultural debris; 4, culturally sterile layer of compacted aeolian sand and light gravel lenses; 4a, cultural deposit of aeolian sand, median to coarse gravel deposit and artifacts; base of 5, cultural layer; 5a, ashy cultural layer; 6, culturally sterile deposit of eolian sand and various gravel sizes; 7, culturally sterile alluvial sand and gravel deposits; 8, culturally sterile gravel and alluvial sand deposit; 8a–b, ashy cultural layer with artifacts; 9, culturally sterile sand and gravel layer; 10, culturally sterile sand and gravel layer; 11, intermittent thin layers of culturally sterile alluvial sand and gravel and ashy cultural layer with artifacts; 12, culturally sterile surface layer of the Sangamon terrace.

few millennia. At this time the fluvial channels likely discharged to a shallow, wetland-fringed estuary on the low-gradient coastal plain situated between 10 and 20 km west of the site. The continental shelf along this portion of the Peruvian margin is comparatively broad (20–30 km) and flat (~0.25% slope), making it more conducive to wetland and lagoon development during early transgression than the steep, narrow margins to the south. Located between these maritime and terrestrial ecotones, the ancient remnant terrace on which Huaca Prieta sits would have been a prominent, isolated feature on the landscape with access to a variety of juxtaposed resource-rich habitats, including the sandy, braided-river plain, associated fluvial wetlands and arid aeolian plains, as well as the more distal (~15–20 km) marsh- and lagoon-fringed littoral plain. Mollusca, fish, sea-mammals, waterfowl, and terrestrial animals would have provided an abundant source of food in the area, along with tubers, rhizomes and other wild plants in the marshes.

Geologically, the remnant terrace on which the site sits is approximately 3 km long and has a maximum width of 0.5 km. It is composed of a monotonous bed of andine gravels and sands cemented by calcite. The surface of the terrace is crusty and defined by ~1 m of weathered clasts and cement. The south end of the terrace, where the mound was built at Huaca Prieta, is ~4.5 m above the present-day sea level (m asl). Approximately 2 km north of the site, the terrace surface is 10.9 m asl. The degree of weathering (Leverett, 1898; Lauer, 1968) and the variable height of the terrace suggest an interglacial age, most probably the Sangamon interglaciation (~125–75 ka). The terrace is more than 2 m above the accepted international sea level in Sangamon times (Wells, 1986; Lambeck et al., 2002; Lea et al., 2003; Siddall et al., 2003) probably due to local and regional tectonic uplift along the Peruvian coast (Wells, 1986; Goy et al., 1992; Saillard et al., 2011). The low height and relative flatness of the terrace and the absence of a weathered surface under the mound indicate its anthropogenic transformation by extensive human occupation and land modification over the past 14 cal ka BP.

The sediments that contain the early cultural finds at Huaca Prieta accumulated during an intermittent series of successive thin aeolian sand layers, sheets of colluvial sand and gravel from slight downslope movement of surface debris of the terrace, and possibly light overbank deposits of silt and gravel from the Chicama River that might have once run along the eastern edge of the terrace, as indicated in TP-22 (Fig. 3b). 2–8 cm of culturally sterile windblown sand overlay and interfinger with thin cultural lenses (~0.5–2 cm thick) of charcoal flecks and scorched sediments (see Supplement Fig. S1 for stratum 13a in Unit 15). Light scatters of stone tools and faunal remains lay upon or are encased within these lenses in TP-22 and Unit-15 (Fig. 3; Fig. S1). The lenses and associated scatters are interpreted as cultural layers representative of intermittent episodes of food preparation by terrestrial and maritime foragers. Thin debris layers of silt represent breaks between the aeolian deposits. The interfingering contact between the layers of silt and sand suggests that the ages of the layers overlap in time. The silt layers reflect low energy, slackwater overbank deposits from adjacent fluvial channels, with the various depositional events sealing each cultural episode defined by the presence of stone tools, faunal remains, charcoal and burned sediment without displacing them. The absence of weathering or paleosols within the alternating sand and silt layers suggests that they are largely conformable and deposited without lengthy interruptions. There are no interfingering silt and sand deposits and multiple cultural layers in Unit 9, which is lower in elevation and closer to the eastern edge of the terrace.

All three units are deeply buried underneath the thicker, more centralized portions of the mound at approximate horizontal intervals of ~20–32 m. A 92–130 cm thick disconformable upward sequence of culturally sterile fine aeolian sands and finer gravel layers overlies the late Pleistocene cultural layers in all units. There appears to be a cultural hiatus between ~10,500 and 12,000 cal yr BP, although this must be confirmed by future work at the site. Overlying the sterile layers are ~15–32 m of pre-mound and mound cultural strata containing later early and middle Holocene assemblages associated with the construction of Huaca Prieta, which dates between ~7700 and 4200 cal yr BP (Fig. 3; Dillehay et al., 2012). The deep, long term, stratified sequence in these units emphasizes the long-term attractiveness of this site environment. This depth also makes it difficult to expose large horizontal areas of the archaeological excavation.

Archaeological findings

In three of our 64 excavation units (Units 9 and 15, TP-22) and additional geological cuts in and around Huaca Prieta (Figs. 2–3), late Pleistocene assemblages were encountered discontinuously within the buried deposits of the ancient surface of the terrace. Eleven radiocarbon determinations on charred to uncharred pieces of wood, on one deer bone, and on one sea lion bone directly associated with the stone tools and burned features from the deeper levels of Unit 15 and TP-22 range from 13,420 to 13,260 cal yr BP (Beta-290621), 13,794–13,459 cal yr BP (Beta-299536), 14,530–13,891 cal yr BP (Beta-310273), and 14,867–13,924 cal yr BP (Beta-310272) in Unit 15; and 13,344–11,508 cal yr BP (AA-75326), 14034–13301 cal yr BP (Beta-310274: see Supplementary text), and 13,720–13,440 cal yr BP (Beta-290620) in TP-22 (Table 1; Figs. 3a–b). These ages are corroborated by results from a continuous profile involving 120 additional radiocarbon samples collected down the 15–32-m-deep stratigraphic sections of excavation units in the site and nearby geological areas (Dillehay et al., 2012). Our dates also are contemporary with the aforementioned late Pleistocene sites along the Pacific coast of Peru and Chile and a few hundred years earlier than other early forager sites located in the Andean foothills between 25 and 50 km east of Huaca Prieta (Dillehay, 2000, 2011; Chauchat and Pelegrin, 2003).

All artifactual debris and features recovered from the late Pleistocene cultural lenses in Units 9, 15 and TP-22 are stratigraphically associated along the buried surface of the southeast point of the Sangamon terrace. The late Pleistocene cultural materials are embedded in or resting on intact thin lenses (see Fig. 3a, strata 8, 9 and 13a in Unit 15; Fig. 3b, strata 4a, 5 and 5a, 8a–b and 11a in Unit 22) of charcoal flecks, scorched sediment, faunal remains, and the stone tools, all intact and encased in the stratigraphically intermittent sand layers (~2–8 cm thick). A thin layer of hematite (~0.8 cm thick), a non-local material, ash, and light scatters of charcoal and wood flecks were associated with several stone tools and faunal remains in stratum 13a, Unit 15 (Fig. S1). The light burning episodes scattered along the buried edge of the terrace suggest repeated ephemeral use of the area by foraging groups over several centuries, and most likely the partial disturbance, removal or reuse of that evidence by subsequent occupants. Macro-plant, starch grains, and phytoliths, if ever present, were not preserved in these levels.

The late Pleistocene cultural deposits yielded 42 flake tools and flaked debitage, in addition to 36 bone and other remains of sea lion (*Otaria* sp.), two with human-induced cut marks, deer (*Odocoileus virginianus*), birds (cormorant, *Phalacrocorax bougainvillii*; pelican, *Pelecanus thagus*; gull, *Larus* sp.; blackbird, *Dives dives*), fish (sharks, *Galeorhinus* sp., *Alopias vulpinus*, Carcharhinidae) and spider crab (*Platyxanthus orbignyi*), and 47 shellfish valves (sea snails, *Tegula atra*, *Thais chocolata*; clams, *Protothaca thaca*; limpets, *Fissurella maxima*), and trace amounts of unidentified bone and shell (Table S1). The stone tools were crafted primarily on fine- to coarse-grained quartzite and basalt, source materials widely available as pebble and cobble deposits in river channels and along the seashore and secondarily on toba and a fine green chalcedony from the distant Andean foothills. Stone artifacts include retouched and trimmed cutting, scraping and gouging tools, including unifaces and other retouched-trimmed flakes, as well as smaller flake tools and debitage (Fig. 4, Fig. S2). Although the faunal and artifact sample size from these deposits is limited, our preliminary evidence suggests an economy focused primarily on resources from the seashore, marshes, and coastal plains and secondarily from inland terrestrial zones.

At Huaca Prieta, contemporary with early cultural developments in the Amotape and Siches area on the far north coast of Peru and at Carrizal in the nearby Zaña Valley (Dillehay, 2011), there appears to be a shared technique for producing small to moderate flakes of a consistent size range (Fig. 4, Fig. S2). A flake is struck from a beach pebble or river cobble, typically of basalt, toba or quartzite, and used as a platform for the systematic removal of flakes in the 5–20 mm size range from roughly 40–60% of its perimeter. The consistency in flake size and method of production clearly show these were the intended end product of an expedient edge-trimmed reduction process.

Some of the edge-trimmed flakes were minimally retouched, generally retaining a proportion of cortex. What these flakes were used for is presently unknown, but they effectively extended the amount of the cutting or scraping edge available from a given volume of raw material. However, preliminary micro-usewear analysis of the worked edges of the flakes suggests limited use of the full perimeter of the tool. This seemingly inefficient use of the raw material is likely due to the abundance of raw material strewn along the shoreline and in the nearby riverbed. These types of flakes, traditionally dated between 12,500 and 10,000 cal yr BP on the north coast of Peru (Richardson, 1981; Lavallée, 2000), probably share a technological feature with unifacial assemblages from the early coastal sites in southern Peru and north-central Chile—they are made from moderate- to large-sized pebbles. If the ability to make expedient flake tools consistently is a feature of this early period along the Pacific coast of South America, then edge-trimmed flakes manufactured primarily on beach pebbles are arguably a regional maritime expression. On the other hand, the size and form of those flakes and the unifacial cutting and scraping tools made of quartzite, basalt, and andesite cobbles are similar in size and form to those recovered from the inland site of Monte Verde in south-central Chile, dated around 14,500 cal yr BP (Dillehay, 1997; Collins, 1997). Although our sample size from Huaca Prieta is small, there is no evidence of a bifacial tool technology in either Pleistocene or Holocene times (~14,200–4200 cal yr BP) at the site, though it is present at inland sites in the foothills east and northeast of Huaca Prieta (Chauchat and Pelegrin, 2003; Dillehay, 2011; Lodeho, 2012) and minimally at Quebrada Jaguay (Sandweiss et al., 1998).

More than 400 inland sites have been documented in the nearby Zaña, Jequetepeque and Cupisnique, and Chicama drainages, located 20–70 km north and east of Huaca Prieta and radiocarbon dated between 13,200 to 11,000 cal yr BP (Briceño, 1999; Chauchat and Pelegrin, 2003; Dillehay, 2011; Lodeho, 2012). These sites contain a wide variety of faunal and floral resources primarily from the foothill and riverine environments of the Andes and secondarily from the coastal plains and seashore, the latter including the remains of small amounts of marine fish and shellfish, brackish water fish from marshy estuaries, terrestrial mammals, and a variety of edible plants. Unifacial and bifacial technologies made primarily of local raw material but also jasper and chalcedony from the nearby highlands have also been reported from these sites. These locales may differ significantly from Huaca Prieta and the previously mentioned early sites along the coast of Peru and Chile in that inland foothill groups either exchanged resources with coastal people or moved back and forth between the shoreline and the mountains.

Conclusions

The new evidence from Huaca Prieta establishes that people were present on a prominent landform on a low-gradient alluvial plain between the Andean foothills and the seashore in northern Peru by ~14,200–13,300 cal yr BP. Despite a coastline located at least 20 km away, preliminary data suggest that the primary diet of the site inhabitants consisted of marine foods. The presence of deer remains and stone raw materials also suggest the exploitation of resources in the Andean foothills. We have no evidence to determine whether any of these resources were procured by direct exploitation, by exchange with other groups, or both. Late Pleistocene interzonal movement and exchange on the Pacific rim of the Andes are documented at Monte Verde, Chile, around 14,500 cal yr BP (Dillehay, 1997), where the recovery of resources primarily from riparian habitats and secondarily from coastal and mountain habitats suggests interzonal movement and possibly exchange. Movement between coastal and inland zones is also documented at the late Pleistocene sites of Las Vegas in Ecuador (Stothert, 1985) and several locales in southern Peru (Sandweiss et al., 1998), northern Chile (Santoro, 1985). Although the areal exposure of the deeper deposits reported here is

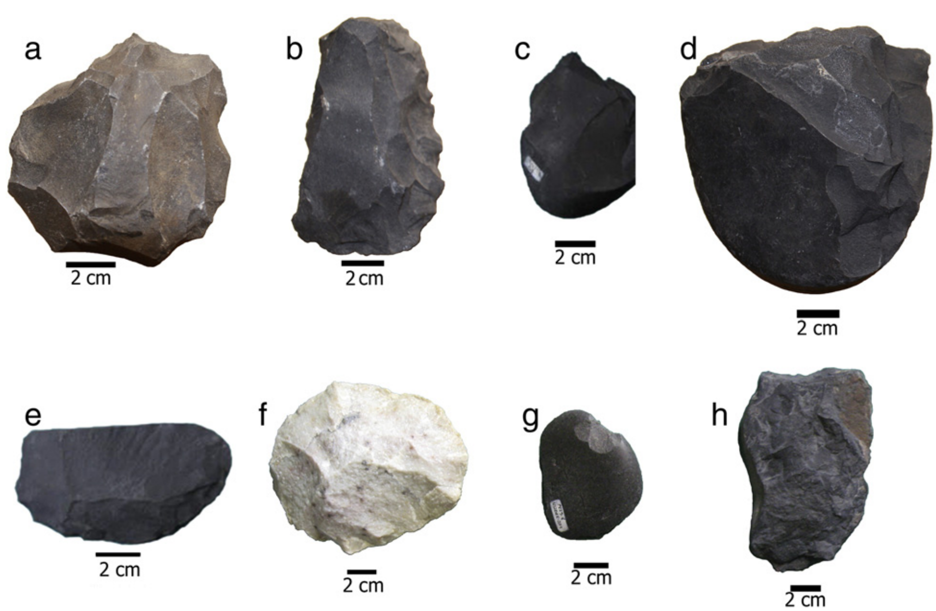

Figure 4. Unifacial edge-trimmed flake tools from basal levels in TP-9 and Unit 22, a–b are associated with the deepest cultural level of TP-9, c–d are derived from cultural stratum 8b and e-g are from cultural stratum 11 in Unit 22.

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limited, the similarity of the recovered stone tool technology and faunal remains at Huaca Prieta with contemporary sites along the coast of Peru and Chile suggests primary marine adapted economies. Our data also suggest that the earliest occupation at Huaca Prieta prepared the way for the later intensification of maritime resources during the early and middle Holocene period (Richardson, 1981) in the region (between ~10,000 and 4200 cal yr BP) when the sea levels continually rose and the shoreline shifted within a few hundred meters of the site (Dillehay et al., 2012).

Huaca Prieta and other documented early coastal sites apparently do not represent the first human migrants into South America because earlier interior sites such as Arroyo Seco in Argentina (Politis et al., 2011), several sites in eastern Brazil (Kipnis, 1998; Dillehay, 2000) and Monte Verde, all dated between ~14,500 and 13,500 cal yr BP, are a few centuries earlier. However, it can be hypothesized that later migrants arriving along the coast from northern latitudes or from the adjacent Andean highlands may have occupied these known coastal sites. Although it is possible that the first migrants arrived along the Pacific coast and their campsites are submerged under water, it can also be hypothesized that these migrants exploited a wide range of coastal and inland zones, thus leaving behind a series of archeologically visible campsites stretching from the ancient seashore to the Andean foothills. Once more early sites are found, we can understand better the diverse adaptive strategies and human migration patterns operating along the western Pacific rim of South America in late Pleistocene and early Holocene times.

Supplementary materials related to this article can be found online at doi:10.1016/j.yqres.2012.02.003.

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