

Chronology, mound-building and environment at Huaca Prieta, coastal Peru, from 13 700 to 4000 years ago

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Renewed in-depth multi-disciplinary investigation of a large coastal mound settlement in Peru has extended the occupation back more than 7000 years to a first human exploitation ~13 720 BP. Research by the authors has chronicled the prehistoric sequence from the activities of the first maritime foragers to the construction of the black mound and the introduction of horticulture and monumentality. The community of Huaca Prieta emerges as innovative, complex and ritualised, as yet with no antecedents.

Keywords: Peru, Holocene, ritual mound, horticulture

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Introduction

The warming trend at the end of the Pleistocene led to new and generally richer terrestrial and coastal environments that were exploited by human foragers in several regions of the world (Straus *et al.* 1996). Post-Pleistocene complex hunters and gatherers who practised intensive maritime adaptations and established extensive often sedentary communities are best represented by the Jomon culture in Japan (Habu 2004), the Ertebølle culture in Scandinavia (Miller *et al.* 2010), the ring-mounds in the south-east of the United States (Thompson & Worth 2010) and the *sambaqui* mounds in Brazil (Fish *et al.* 2000). The settlements of these cultures are invariably characterised by mortuary rituals suggestive of social differentiation, and by extensive shell middens that have yielded a wide array of marine and terrestrial species. At different times between ~8000 and 4000 cal BP, some of these communities also practised various degrees of horticulture as evidenced by the appearance of food crops. Like these regions, the Pacific coast from southern Ecuador to northern Chile witnessed the early rise of complex societies, especially in Peru where sedentism and monumental non-domestic architecture appeared by at least 5200 cal BP (Moseley 1975, 1992; Richardson 1981; Bird *et al.* 1985; Haas & Creamer 2004). Some of these developments are due to the unique ecology of the region, with diverse and abundant maritime resources closely juxtaposed with a long fertile but arid coastal plain, through which rivers descend from the Andean mountains. Others are the result of emerging ideologies adopted by these communities, which built monuments prior to the use of pottery. Associated with these changes was a variety of food and industrial crops (Bird 1948; Pearsall

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Figure 1. Location of Huaca Prieta on the remnant Sangamon terrace and outlying wetlands and Preceramic domestic sites in the Chicama Valley of the north coast of Peru.

2008). Particularly important was cotton for producing fishing nets, textiles and gourds for net floats. One of the early coastal monuments is Huaca Prieta, a large stone and earthen mound measuring $138 \times 62 \times 32\text{m}$, built on the southern point of a remnant Pleistocene terrace overlooking the Pacific Ocean and estuarine wetlands and the delta plain of the Chicama River valley (Bird *et al.* 1985) (Figure 1).

Huaca Prieta was first excavated by Junius Bird in the 1940s and radiocarbon dated to between ~ 5302 and 1933 cal BP in the 1950s (Figure 2; Table 1). Based on the large size of the mound, on an abundance of marine resources, wood charcoal, ash and soot, thus the appearance of a black or *prieta* mound, and on the presence of small stone structures, Bird believed that the site was occupied by sedentary people living in pit-houses. In addition to a marine economy, he documented incipient gardening and social differentiation, as indicated by the remains of several food crops, the uninterrupted accumulation of cultural layers, the presence of room structures, the interment of human burials with grave offerings and a wide variety of material technologies including lithic, gourd, basketry, bone, wood and textile. The most developed technology at the site was cotton weaving and netting (Bird & Mahler 1952). The site's weavers devised sophisticated iconographic styles with various designs. Iconography was also exhibited through incised and engraved gourds, hematite

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Figure 2. View looking north-west toward the mound at Huaca Prieta. Scale indicated by workers standing on the side. The Pacific Ocean is in the background. The wetland farm plot in the foreground is probably similar to those that existed near the site in Preceramic times.

painted pebbles and recently recovered coral sculptures. A crude lithic industry included grinding stones for processing plants and edge-trimmed pebble flake tools, hammerstones, cores and other implements used for various tasks (Bird *et al.* 1985: 77–91).

Until now, the broader importance of Bird's pioneering work at Huaca Prieta has been constrained by few radiocarbon dates and cursory study of the site's environment, stratigraphy and chronology, architecture and off-mound activity. In 2006 we began an interdisciplinary project at the site to re-examine the previous work and to better understand the relationship between coastal environments, economies and mound building within the site's changing social and natural landscapes. To date, we have excavated more than 2000m³ in old and new areas of Huaca Prieta, located and explored other domestic sites on the remnant terrace, conducted a survey of Preceramic settlements along the coast of the Chicama River valley and reconstructed the local palaeoecology (Figure 3).

The new work has greatly extended the time span of occupation at the site and increased its significance for the understanding of the development of early societies in Peru. We have documented the site stratigraphy encountered by Bird and the primary refuse of charcoal, ash, burned rock, the remains of numerous marine organisms such as fish, urchins, shellfish, sea lion and porpoise, birds and other fauna, and cultivated plants. We have also obtained numerous radiocarbon dates from intact features and floors and defined several site phases (Table 1), ranging in chronometric age from 13 720–13 260 cal BP for the first human presence, from ~8979–7500 cal BP for a pre-mound occupational phase and from

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Table 1. Radiocarbon dates from Huaca Prieta, nearby off-mound geological deposits and the Paredones site.

Sample no.	Provenience	$\delta^{13}\text{C}$	Conventional radiocarbon	1 σ -calibrated age range (BP)	2 σ -calibrated age range (BP)	Material
Unit 2						
AA76975	Unit 2 ext west, upper Stratum 3	-24.4	3535 \pm 35	3827-3696	3849-3639	Wood charcoal
Beta233650	Unit 2, lower Stratum 3	-22.2	3700 \pm 40	4073-3893	4088-3844	Charred material
AA76974	Unit 2 ext west, Stratum 5a	-24.2	3588 \pm 36	3873-3724	3956-3694	Wood charcoal
AA76973	Unit 2, Stratum 7a	-24.0	3748 \pm 40	4137-3933	4151-3898	Wood charcoal
AA81925	Unit 2, Stratum 7b	-19.1	3964 \pm 41	4418-4259	4511-4159	Wood charcoal
AA85506	First mound Layer: Unit 2, Stratum 7C-3	-25.4	6641 \pm 49	7555-7434	7571-7424	Wood charcoal
AA76972	Pre-mound occupation (?): Unit 2, Stratum 7C-7 base	-23.5	6797 \pm 48	7656-7572	7680-7508	Wood charcoal
Beta233651	Pre-mound occupation: Unit 2, Stratum 8, base		6920 \pm 30	7740-7660	7786-7618	Wood charcoal
Unit 3						
AA76977	Unit 3 ext south, Floor 2	-22.8	3530 \pm 36	3827-3693	3849-3636	Wood charcoal
AA76978	Unit 3 ext south, Floor 5a	-19.6	3567 \pm 40	3841-3717	3901-3643	Wood charcoal
AA76979	Unit 3 ext south, Floor 5b	-19.6	3758 \pm 40	4142-3978	4216-3901	Wood charcoal

Table 1. Continued

Sample no.	Provenience	$\delta^{13}\text{C}$	Conventional radiocarbon	1 σ -calibrated age range (BP)	2 σ -calibrated age range (BP)	Material
Beta247695	Unit 3, Stratum 8, below Floor 6	-20.8	4000 \pm 40	4510-4296	4520-4245	Organic sediment
Unit 7						
AA76970	Unit 7, Floor 1	-25.1	3649 \pm 36	3964-3841	4072-3727	Wood charcoal
Unit 8						
AA81916	Unit 8, Tomb 4	-17.2	3534 \pm 53	3833-3689	3892-3590	Bone
Unit 9						
AA81922	Unit 9, Stratum 7a, top	-22.0	3547 \pm 40	3829-3705	3876-3640	Wood charcoal
AA84168	Pre-mound occupation: Unit 9, Stratum 8, base	-22.8	7956 \pm 50	8931-8599	8979-8592	Wood charcoal
Unit 10						
AA81923	Unit 10, Base of Structure 2	-25.7	3556 \pm 44	3834-3705	3895-3640	Wood charcoal
AA81919	Unit 10, Floor 4	-26.4	3557 \pm 40	3834-3716	3891-3642	Wood charcoal
Unit 12						
AA81929	Unit 12, Ash Stratum 1	-25.2	3441 \pm 39	3688-3576	3817-3480	Wood charcoal
Unit 13						
AA81920	Unit 13, Floor 3	-19.7	3810 \pm 41	4224-3996	4283-3974	Wood charcoal
Unit 14						
AA81921	Unit 14, Floor 4	-25.1	3508 \pm 40	3825-3641	3838-3588	Wood charcoal

Table 1. Continued

Sample no.	Provenience	$\delta^{13}\text{C}$	Conventional radiocarbon	1 σ -calibrated age range (BP)	2 σ -calibrated age range (BP)	Material
Unit 16						
AA86935	Off-mound domestic Unit 16, Stratum 13-7	-22.6	6310 \pm 33	7251-7162	7266-7021	Wood charcoal
Unit 20 (Paredones)						
AA86936	Unit 20, Stratum 5B	-23.8	4783 \pm 31	5578-5330	5583-5324	Wood charcoal
AA86937	Unit 20, Stratum 6B-18	-25.8	4849 \pm 31	5589-5479	5603-5333	Charred wood
Unit 21 (Unit 15)						
AA86941	Unit 21, Floor 2-3, 16	-10.6	3599 \pm 29	3889-3728	3956-3704	Corn cob
AA86931	Unit 21, Floor 3-2	-25.2	3638 \pm 29	3957-3838	3982-3728	Wood charcoal
AA86946	Unit 21, Floor 9	-11.9	3783 \pm 41	4148-3988	4235-3928	Corn cob
AA75322	Unit 15, Floor 26	-29.4	5018 \pm 86	5860-5599	5911-5488	Wood charcoal
AA85507	First mound layer: Unit 15	-25.6	6522 \pm 54	7429-7323	7474-7268	Wood charcoal
AA75327	Pre-mound occupation: Unit 15, below sunken plaza in mound	-29.5	7226 \pm 44	8019-7947	8156-7871	Wood charcoal
Beta290621	Buried surface of Sangamon Terrace	-25.6	11500 \pm 50	13403-13294**	13420-13260**	Charred wood
Beta299536	Buried surface of Sangamon Terrace	-28.3	11800 \pm 50	13757-13517**	13794-13459**	Wood

Table 1. Continued

Sample no.	Provenience	$\delta^{13}\text{C}$	Conventional radiocarbon	1 σ -calibrated age range (BP)	2 σ -calibrated age range (BP)	Material
Unit 22 (Paredones)						
AA86934	Unit 22, Floor 6	-13.4	4181 \pm 34	4809-4570	4821-4527	Charred cob
Beta263320	Unit 22, Floor 10, Capa 14	-24.5	4590 \pm 40	5308-5062	5435-5044	Wood charcoal
Beta263321	Unit 22, Floor 15	-25.6	4790 \pm 40	5580-5331	5585-5325	Charred material
AA86947	Unit 22, Floor 16, Fill 10	-24.0	4898 \pm 49	5644-5483	5711-5335	Wood charcoal
AA83260	Unit 22, Floor 24	-26.0	5750 \pm 60	6561-6405	6640-6319	Wood charcoal
Unit 23						
AA86930	Unit 23, Stratum 3-1	-10.0	1760 \pm 29	1690-1557	1697-1539	Wood charcoal
AA86949	Unit 23, Floor 3-3	-27.1	3467 \pm 39	3704-3584	3828-3560	Wood charcoal
AA86948	Unit 23, Floor 11	-23.5	5059 \pm 72	5887-5652	5902-5606	Wood charcoal
Bird's HP-2						
Beta233648	Basal mound layer: HP-2 west side of site	-23.8	5110 \pm 40	5891-5745	5919-5667	Organic sediment
Libby-598	Test Pit 2; Bottom	-22.2	4298 \pm 230	5260-4439	5462-4152	Charcoal
Bird's HP-3						
AA81926	HP-3, Stratum 5	-28.0	3394 \pm 40	3634-3485	3688-3464	Wood charcoal
AA86943	HP-3, Stratum 14	-24.6	3806 \pm 28	4213-3999	4233-3985	Wood charcoal
AA86940	HP-3, Stratum 19	-25.6	3875 \pm 30	4287-4107	4406-4090	Wood charcoal
AA81924	HP-3, Stratum 22	-23.5	3687 \pm 40	4063-3876	4084-3838	Wood charcoal
AA81927	HP-3, Stratum 23	-17.3	3728 \pm 40	4084-3927	4147-3875	Wood charcoal

Table 1. Continued

Sample no.	Provenience	$\delta^{13}\text{C}$	Conventional radiocarbon	1 σ -calibrated age range (BP)	2 σ -calibrated age range (BP)	Material
AA86948	HP-3, Stratum 35	-24.1	5020 \pm 35	5830-5598	5848-5585	Wood charcoal
AA82121	HP-3, Stratum 52 (39), upper part	-	5980 \pm 40	6789-6676	6882-6657	Cotton yarn
AA81907	First mound layer: HP-3, Stratum 52-53, lower part	-23.8	6170 \pm 45	7154-6899	7162-6808	Wood charcoal
Beta263318	Pre-mound occupation: Stratum 55	-24.9	7000 \pm 50	7830-7703	7927-7673	Charred material
Beta294021	Pre-mound occupation: Stratum 54	-23.3	7110 \pm 50	7946-7840	7979-7752	Wood charcoal
AA75321	Pre-mound occupation: base HP-3 Stratum 56, P-4	-28.9	7195 \pm 45	8009-7933	8040-7847	Wood charcoal
TP-3 (Ext. of HP-3)						
Beta278233	Test Pit 3, Stratum 2	-25.5	3660 \pm 40	3972-3854	4081-3730	Charred material
TP-6						
Beta247696	Test Pit 6, Base	-18.7	3350 \pm 40	3571-3464	3823-3483	Charred material
TP-9-13						
AA86944	Test Pit 9-13	-28.1	3334 \pm 38	3558-3455	3614-3398	Wood charcoal
TP-22						
AA86947	Test Pit 22, Stratum 10	-24.0	4898 \pm 49	5644-5483	5711-5335	Wood charcoal

Table 1. Continued

Sample no.	Provenience	$\delta^{13}\text{C}$	Conventional radiocarbon	1 σ -calibrated age range (BP)	2 σ -calibrated age range (BP)	Material
Beta210862	Pre-mound Occupation, Stratum 20	-27.4	9530 \pm 50	[11000]-10501	[11000]-10579	Wood charcoal
Beta290620	Test Pit 22, Stratum 25	-28.3	11780 \pm 50	13732-13510**	13720-13440**	Wood
Bird's ^{14}C samples from HP-3*						
321	Test pit 3; Layer D		2966 \pm 340	3555-2621	3905-2160	Gourds, chewed fibre, squash stems, cotton, wood, barkcloth
Beta9286	HP 3, E		3730 \pm 300	4422-3634	4845-3272	Gourd (<i>Lagenaria siceraria</i>)
Beta9288	HP 3, F		3960 \pm 100	4510-4157	4784-3989	Gourd (<i>Lagenaria siceraria</i>)
Beta9287	HP 3, J		3270 \pm 100	3569-3343	3692-3169	Gourd (<i>Lagenaria siceraria</i>)
318b	Test pit 3; Layer J		3550 \pm 600	4569-3005	5446-2344	Twigs and treated huarango wood
362	Test pit 3; Layer K		4044 \pm 300	4845-3996	5298-3648	Carbonised cattail roots
315	Test pit 3; Layer M		3572 \pm 220	4088-3485	4423-3267	Shell
316	Test pit 3; Layer M		4380 \pm 270	5302-4539	5590-4158	Misc. woody plants
313	Test pit 3; Layer Q		4257 \pm 250	5263-4411	5462-3999	Misc. woody plants
Geological dates mentioned in text						
AA83255	Swash-laminated shoreface sands	-21.1	2767 \pm 90	2924-2746	3077-2505	Wood charcoal
Beta244172	Muddy back-dune swale	-19.1	2820 \pm 80	2950-2778	3078-2742	Organic-rich soil
AA83252	Sandy burned cultural horizon	-25.8	3521 \pm 49	3828-3645	3868-3610	Wood charcoal

Table 1. Continued

Sample no.	Provenience	$\delta^{13}\text{C}$	Conventional radiocarbon	1 σ -calibrated age range (BP)	2 σ -calibrated age range (BP)	Material
AA81933	Swash-laminated shoreface sands onlapping Huaca Prieta	-24.7	3598 \pm 40	3893-3725	3964-3696	Wood charcoal
AA83258	Carbonate lagoon sediments	-6.0	5739 \pm 51	6538-6404	6633-6321	Non-marine gastropod
OS-77302	Organic layer inter-bedded within Carbonate lagoon sediments	-25.6	6180 \pm 35	7155-6939	7158-6901	Plant matter
OS82737	Organic layer inter-bedded within Carbonate lagoon sediments	-29.9	6500 \pm 30	7421-7326	7428-7279	Plant matter
OS77304	Organic layer inter-bedded within Carbonate lagoon sediments	-24.1	6500 \pm 45	7422-7324	7432-7269	Plant matter
OS77303	Organic layer inter-bedded within Carbonate lagoon sediments	-27.7	6600 \pm 35	7483-7425	7518-7416	Plant matter

All dates calibrated using shcal04 (McCormac *et al.* 2004).

[] = calibrated range impinges on end of calibration data set.

* Bird's corresponding layers in HP-3 are based on study of his photographs, notes, and profile drawings.

** Calibration done on curve other than shcal04.

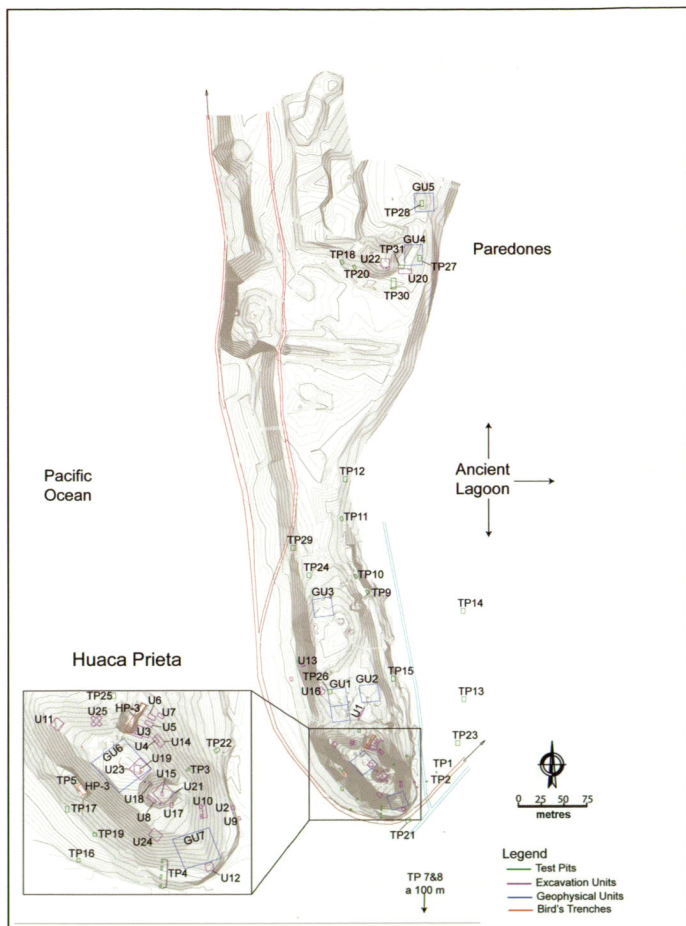


Figure 3. Map of the remnant terrace showing the location of investigations at Paradones and Huaca Prieta. HP: excavations by J.B. Bird; TP: test pit; GU: area of geophysical survey; U: excavations undertaken in the present campaign.

~7555–4510 cal BP for subsequent mound-building phases. Our findings also indicate that the site was first occupied by maritime foragers. After ~7500 cal BP, activity shifted about 50m north and the first mound layers, associated with burning and mortuary rituals, were built on the southern end of the terrace.

Method

During five recent field seasons, we recut, profiled and studied all of Bird's prior pits on the mound (Bird *et al.* 1985: 26), particularly his HP-2 and HP-3 units (Figure 4), taking more than 15 000 measurements of stratigraphic profiles in 60 different archaeological excavations, three with cultural deposits of 22–32m. We selected several new areas for extensive and deeper excavations, working with large teams of professional archaeologists and experienced local workers. Specialists such as botanists, geneticists, malacologists and geologists joined the research team for various periods of time to extract specific data sets.

In total, we excavated 31 block units ranging in size from 2×4 m to 12×14 m, 30 test pits ranging between 1×2 m and 2×3 m, more than 25 geological trenches and hundreds of sediment cores on and off the site. Many of the test pits and small block units were exploratory in nature, seeking to define the mound and off-mound stratigraphy, function and chronology (Figure 3). Given the depth and size of the mound, which covered or destroyed the early occupational deposits to a depth of 8–32m, we obtained only three terminal Pleistocene and six pre-mound Early Holocene radiocarbon dates (Units 2, 9, 15 [21], HP-2, HP-3 and TP-22). Additionally, five large 20×20 m block units were subjected to geophysical mapping for purpose of testing deep subsurface features. Thus, the majority of our work was located in areas not probed by Bird, such as the lower and upper south side of the site and deposits buried underneath later Cupisnique and Moche mounds (~3500–1500 cal years ago) located immediately north of Huaca Prieta.

We also carried out block excavations at Paredones, a smaller 30×70 m mound located 1km north of Huaca Prieta (Figure 3). Paredones dates between ~6700 and 4200 cal BP and presents a 6m-deep cultural sequence associated with domestic occupation. The stratigraphy at both Huaca Prieta and Paredones is intact, with almost impenetrable cement-like floors and floor fills. Minimal disturbance resulted from occasional architectural construction at Huaca Prieta.

In this paper we focus on the dating of the sequence. Summary reports on the floodplain deposits, mound stratigraphy, architectural phases, subsistence economy and off-mound domestic sites (including Paredones) will be found in the supplement online (SOL) at <http://www.antiquity.ac.uk/projgall/dillehay331>.

Holocene environmental history

Our recent palaeoecological studies indicate that the environs of Huaca Prieta are defined by the interface of several geo-climatic settings, which present diverse natural resources (Dillehay *et al.* 2010). Geological evidence reveals an intimate association with fertile deltaic wetland systems that were juxtaposed with diverse semi-arid lowlands and coastal estuarine and marine settings. Located at these ecological junctions, settings like that of Huaca Prieta were

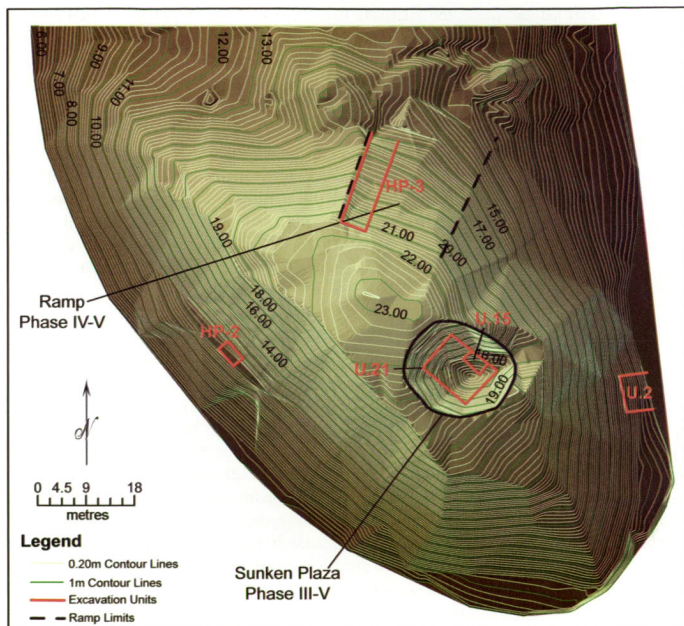


Figure 4. Topographic map of the mound at Huaca Prieta produced by digital contour mapping, GPR probing and pre-excavation drawings and photographs by J.B. Bird. Top of the mound shows a height of 23m above datum at present-day ground surface; however, the mound is 32m high from the top to the first mound layers buried below ground surface. Note the location of the ramp, the circular sunken plaza and excavation units mentioned in the text.

susceptible to environmental changes forced by various phenomena: local (e.g. river avulsion, earthquakes), regional (e.g. El Niño), global (e.g. sea-level change) or anthropogenic (e.g. land use) (Bird, R. 1983; Sandweiss *et al.* 1999, 2009; Wells 1999). The earliest coastal plain formation near the site is recorded by unique algal carbonate (*Charophyta*) and interbedded organic sediments that indicate the development of a widespread wetland-fringed, estuarine lagoon by 7457 cal BP (OS-77303, see Table 1). This setting persisted until 6470 cal BP (AS-83258, see Table 1), after which the onset of El Niño floods began to infill the lagoon with riverine silts. This major environmental transformation from open-water lagoon to a well-drained floodplain occurs over ~2000 years and is largely complete by 4500 cal BP. Floodplain deposition, largely through El Niño flood events, remains a continuous but episodic process up to the present (Sandweiss *et al.* 1999) (SOL 1).

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A prominent feature across the relatively flat and narrow coastal plain of the Chicama River valley are several small drainages that cross-cut the plain as they descend from the Andean foothills to the ocean. These drainages change depending on the level of the water table and El Niño events, becoming larger when heavy rains in the highlands increase their load. When these drainages reach the ocean and mix with its salty tidal water, numerous estuary systems are formed between 2 and 20km north of Huaca Prieta. These estuaries are generally narrow and 2–7km long, running perpendicular to the seashore, although they may connect to lagoons that are elongated and parallel to the coast. Sand dunes created by the sediments dumped by rivers and shaped by the action of waves separate these wetland systems from the ocean. The wetlands provide a wide variety of edible plant and animal life, in addition to various species of reeds used to make mats, baskets and other utilitarian items. Today, people grow crops along the edges of the wetlands where the soils are rich and humid year round (Figure 2).

Phasing and dating at Huaca Prieta

In total, more than 150 radiocarbon dates were obtained from 60 mound and off-mound excavations and from various geological cuts and cores (Table 1). Not all floor and use episodes were radiocarbon dated, which would require more than 1000 chronometric measurements (see SOL). However, the deeper stratigraphic cuts were dated from the top to bottom, as shown in Figures 5–7 for Units 2, 15/21 and HP-3. All radiocarbon dates from Huaca Prieta and Paredones were taken on single chunks of wood charcoal, maize and cotton textiles recovered from features embedded in floors. Unfortunately, not all excavated strata contained single chunks embedded in floors or features. With the exception of fragments of maize and other organic debris, which will be detailed in later publications, all radiocarbon dates are on wood charcoal and cotton. No radiocarbon samples were taken from fills and middens or from marine shells. Given the different organic materials dated by four different laboratories over a period of six decades, nearly all dates agree and overlap chronologically and stratigraphically at the 1σ calibrated age range. There is also agreement and stratigraphic alignment between Bird's ^{14}C dates and his schematic profile of the north to south oriented HP-3 trench and our ^{14}C dates and stratigraphy in this same unit (Bird *et al.* 1985: 51–8) (Figure 5).

Our excavations at the site have defined limited terminal Pleistocene and Early Holocene occupational phases followed by four successive mound-building phases (Figures 8 & 9). The terminal Pleistocene materials are buried in the upper surface deposits of the ancient terrace upon which the mound sits at Huaca Prieta. Because these deposits are deeply buried beneath the mound, we have not yet fully studied the spatial extent and geological setting of this occupation. To date we have recovered simple edge-trimmed pebble flakes, several bone remains of fish and sea lion, and fractured shellfish valves from these deposits, which are dated between 13 720 and 13 260 cal BP (Table 1).

The mound sequence has been resolved in five phases. *Phase I* is dated ~9000–7500 cal BP and is associated with maritime foragers and incipient gardeners intermittently occupying around 80m of the lower east side of the Sangamon terrace near the banks of the brackish water, estuarine lagoon (see Table 1; Figures 3 & 4, Units 2, 9 & 15/21, HP-3 & TP 22).

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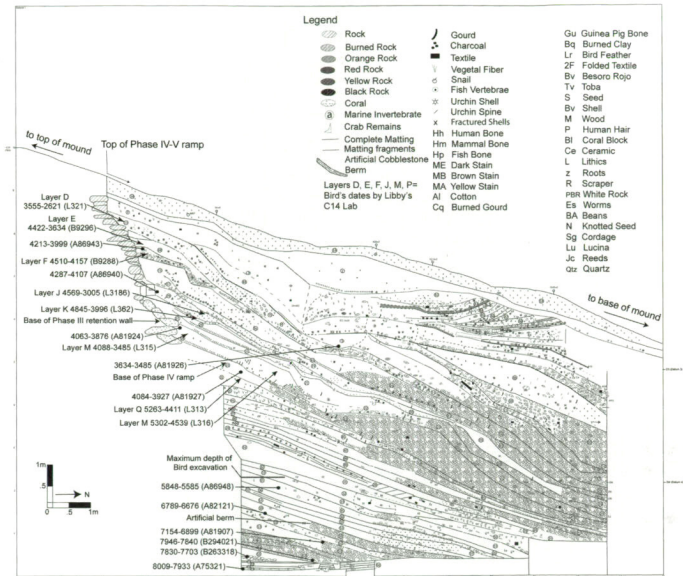


Figure 5. Profile view of a section of the west wall in the north-south trench (Bird's HP-3) showing the lower stratigraphic levels at the north end of Huaca Prieta, the stratigraphic location of the Phase IV-V ramp addition, and the combined radiocarbon date locations of Bird's and our excavations in the basal pre-mound and later mound layers in this sector of the site. The numeration of strata in this unit does not follow a progressive sequence. Those strata in the west wall that correspond with previously numbered strata in the east wall of the trench were given the same number, thus resulting in some strata with higher numbers, assigned by our work, overlying or underlying lower or higher numbers, respectively. Dates with prefix of 'Layer...' are radiocarbon dated strata from Bird's work at the site (Bird et al. 1985: figs 20 & 33). All dates are given at 1 σ calibration years before present. Radiocarbon laboratory numbers beginning with A are from the University of Arizona, with B from Beta Analytic and with L are from Willard Libby's radiocarbon laboratory in the 1950s. The hystack construction technique is best represented by strata 54, 53, 39, 48, 22 and 23.

No architecture was detected for this phase. Phase II is dated between ~7572 and 6538 cal BP and represents the first mound construction stage. We estimate that the mound during this phase minimally measured ~5m high, ~25m wide and ~25–35m long and consisted of several cobblestone and soil layers. In Units 15/21 and HP-3, the first layers are dated between 7429 and 6899 cal BP, with younger and older dates stratigraphically bracketing these layers, respectively. In Unit 2, the first layer is represented by stratum 7C-2, which we have not dated due to the absence of datable charcoal (Figure 6). However, this layer overlies stratum 7C-3, which is AMS dated to between 7555 and 7434 cal years ago, suggesting the former probably dates to at least ~7000 cal years ago. The current evidence suggests that the earliest mound layers were placed on the south-east flank and crest of the ancient

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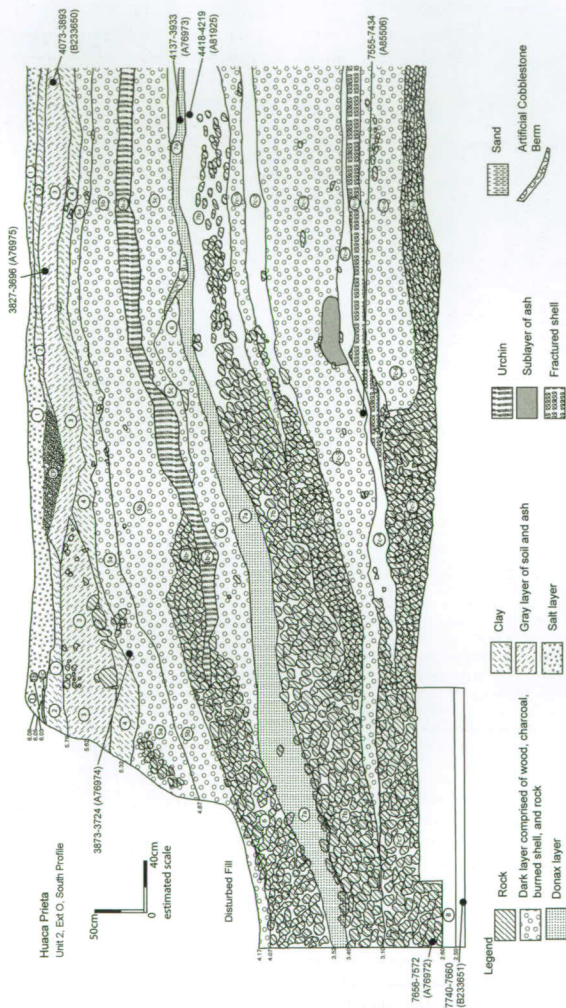


Figure 6. Profile view of Unit 2 showing the pre-mound occupational layers and the initial mound and later strata. All dates are given at 1 σ calibration years before present. Radiocarbon laboratory numbers beginning with A are from the University of Arizona and with B from Beta Analytic. The hystacking construction technique is represented by layers 7b, 7b2, 6 and 5b-1.

terrace near the shoreline of the lagoon (Table 1, Units 2, 15/21 & HP-3; and see Figure 3 and SOL 2). From there, the mound appears to have gradually spread to the north and west along this flank, with later construction layers reaching to the western edge of the terrace in the vicinity of Bird's HP-2 pit. The use of space along the eastern flank and the crest of the terrace eventually became more restricted by the increasing steeper sloping sides of the mound. No stone room foundations were recovered for this phase, though a few postholes and cane poles were excavated suggesting the construction of perishable structures.

The mound building phases, beginning with Phase II, did not develop from a gradual accumulation of occupation midden but from deliberate and gradual, planned mounding over a period of ~3000 years. The beginning points of the individual mounding phases are represented in the form of *haystacking* strata whereby a basal ring or layer of shingled cobblestone berms are laid out and angled to define the outer limits of the structure and to provide an architectural footing for the space inside to be infilled by floors and floor fills (Figure 7).

During *Phase III* the focus of mound construction shifted more to the crest and the western edge of the terrace (Figure 3; Table 1, Units 2, 15/21, HP-2, HP-3). Phase III dates between ~6538 and 5308 cal BP and is characterised by the addition of more artificial layers, several small stone-faced, terraced rooms placed along the eastern and western slopes of the mound and, at the end of this phase, the lower floors of a circular sunken pit (Figures 7, 8 & 9: IIIa) on the south side, and the lower part of a stone retention wall on the north-east side (see Figure 4 and SOL 3). These structural features are spatially and architecturally conjoined, suggesting simultaneous planned construction and use across the entire upper surface of the mound at this time. These features began to give the mound a stepped platform-like form. During this phase, the mound expanded to ~8–10m in height in some places and ~80m in length.

Phase IV dates from ~5308–4107 cal years ago, when the mound spread over a more extended area of old and new ground and increased in height (Figures 8 & 9; Table 1, all units). Phases III and IV are separated by a yellowish clay cap ~25cm thick placed over most of the mound. Further additions during this phase were the first layers of a ramp built on the east side, the upper portion of the retention wall and the stepped structures in the sunken plaza (Figures 4, 8 & 9: IIIb) (see SOL 3). The ramp addition is ~40m long and ~35m wide and characterised by a series of thick cobble stone berm layers and by intervening floors built over and sealing the retention wall and the first construction phases of the mound. Later the foundations of the ramp rested directly upon the eastern edge of mound layers built during Phase III. The mound during Phase IV was roughly the size it is today, although a few new layers were added in Phase V.

During *Phase V* the steep sloping flanks of the mound to both the east and west were used less, with most activity now limited to the flat crest of the structure. It dates between ~4107 and 3455 cal BP when, during the early part of this phase, cobblestone burial chambers were built along the upper rim of the sunken pit and on the top of the mound. More layers were also added to the ramp, which eventually covered and sealed the retention wall. By ~4000–3800 cal BP the Preceramic use of the site terminated. People of later ceramic cultures, dating from the Cupisnique to Inca periods (~3500–600 cal years ago) carried out rituals and buried their dead on the top of the mound.

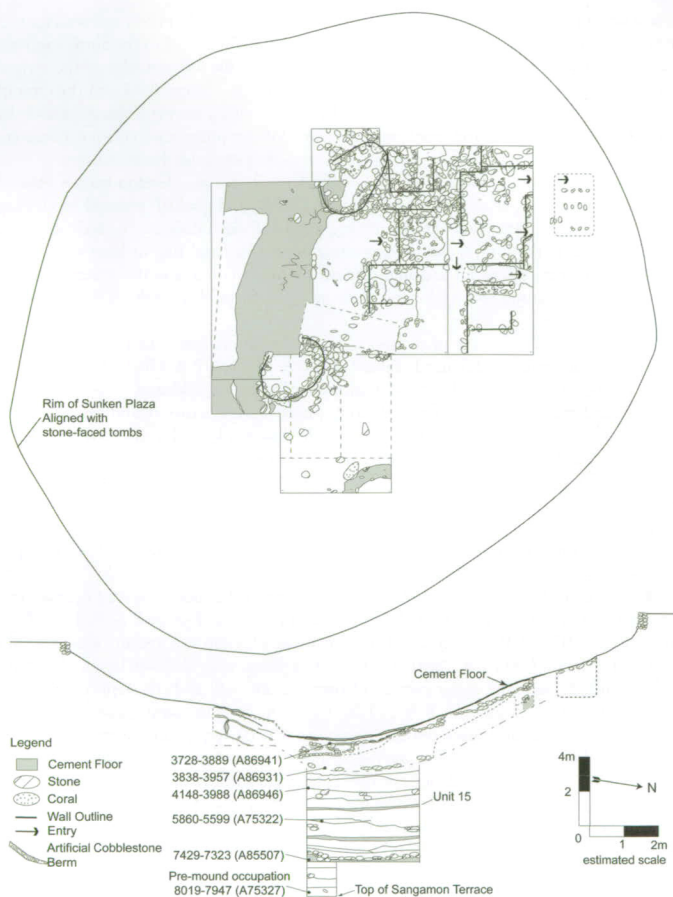


Figure 7. Plan and profile views of the circular sunken plaza showing stepped-rooms and platforms and radiocarbon dated stratigraphy in Units 15 and 21. All dates are given at 1 σ calibration years before present. Radiocarbon laboratory numbers beginning with A are from the University of Arizona and with B from Beta Analytic.

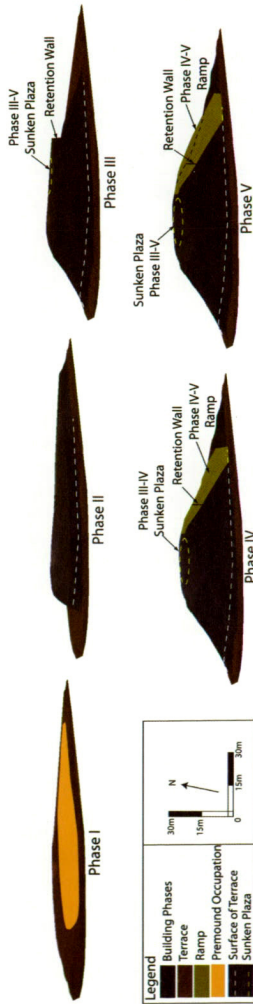


Figure 8. Mosaic of the pre-mound and mound building Phases I-V at Huaca Prieta. Phase I shows the pre-mound occupation area on the lower east side of the Sangamon terrace. Phases II-V reveal the sequential development of the mound from a small, low hummocked structure to a flat-top pyramid with a sunken plaza and ramp.

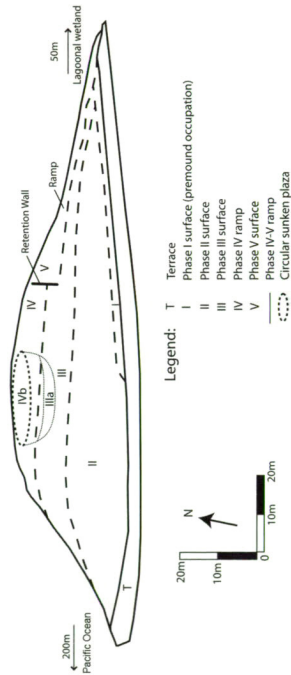


Figure 9. Schematic profile of the pre-mound occupational and mound building phases at Huaca Prieta.

Discussion

Huaca Prieta was a place where several important architectural, technological and artistic innovations took place. The rich coastal environment of the site continuously supported a mixed maritime, wetland and agriculture economy that gave rise to one of the earliest developments of cultural complexity in the Americas (see also SOL 4). Complexity is evidenced not only in the textile and gourd technology, iconography, burial chambers, mound architecture and mixed economy of Huaca Prieta, but in the growth and density of the Preceramic population in the diverse littoral environment north of Huaca Prieta of the Chicama Valley.

Huaca Prieta is an enigma in Andean archaeology because it currently has no known antecedents, either on the ancient terrace (see SOL 5) or further afield. Its complexity lies in its form, function and location. The haystacking construction technique, the circular sunken plaza and retention walls, and the multiple agglutinated rooms of the mound impart a sense of site planning as evidenced at other public monuments during the late Preceramic period (c. 5000–4500 cal BP), such as Alto Salaverry, Cerro Ventarrón, Sechín Bajo, Aspero, Bandurria and others along the north and central coast of Peru. However, the architecture, stratigraphy and mortuary remains evidenced for Phases II and III are different from the staircases, ramps and maze-like room construction of the late Preceramic platform monuments at sites such as Sechin Bajo, Caral, Caballote and Cerro Lampay located farther inland in coastal valleys farther south (Moseley 1975; Shady *et al.* 2001; Haas & Creamer 2004; Fuchs & Briceno 2006; Alva 2010), suggesting different activities. The inland sites do not exhibit large numbers of human burials, extensive soot layers and burning, isolated retention walls or the stone- and earth-layered mound, as seen at Huaca Prieta and Paredones. On the other hand, Phases II and III at Huaca Prieta are not associated with large platform structures, suggestive of more formalised, non-mortuary architecture and activity. Feasting associated with burned offerings and probably mortuary rituals appears to have been a primary activity at Huaca Prieta. It was not until Phases IV and V, when the agglutinated rooms and burial chambers on top of the mound and the ramp were added, that Huaca Prieta appeared more typical of other coastal monuments. None of these early coastal sites provide concrete evidence of permanent elites or authoritative figures.

The archaeological record and particularly the age and construction of the mound at Huaca Prieta contribute to a growing body of evidence indicating that the Early to Middle Holocene period in the Central Andes was a complex mosaic of different economies and social forms. For instance, in south-west coastal Ecuador (Piperno & Stothert 2003) and the western montane slopes of northern Peru (Piperno & Dillehay 2008; Dillehay *et al.* 2008; Dillehay 2011), mixed farming and foraging societies existed by at least 10 000–9000 cal BP. In the Andean highlands from Peru and Bolivia to northern Chile and Argentina, economies focused on camelid husbandry and high-altitude crops were developed by at least 6000 cal BP (Aldenderfer 1988; Bonavia 2008). Additional research will continue to reveal that the origins of Andean civilisation have several interrelated regional roots, each characterised by different social and economic conditions. In our perspective, a critical threshold was crossed when these societies moved beyond the domestic context to include planned sedentary communities and a formalised and structured public life. Not

only did these societies establish social complexity and public monuments, but they also initiated important environmental changes such as extensive landscape modification and the domestication and spread of plants and animals that eventually led to the development of early states in the Andes.

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References

- ALDENDERFER, M. 1988. Middle Archaic phase domestic architecture from southern Peru. *Science* 241: 1828–30.
- ALVA MENESES, I. 2010. Los complejos de Cerro Ventarr  n y Collud-Zarpan: del Precer  mico al Formativo en el valle de Lambayeque. *Bolet  n de Arqueolog  a PUCP* 12: 97–118.
- BIRD, J.B. 1948. America's oldest farmers. *Natural History* 17: 296–303.
- BIRD, J.B. & J. MAHLER. 1952. America's oldest fabrics. *American Fabric* 20: 73–8.
- BIRD, J.B., J. HYSLOP & M.D. SKINNER. 1985. *The Preceramic excavations at the Huaca Prieta, Chicama Valley, Peru* (Anthropological papers of the American Museum of Natural History 62: 1). New York: American Museum of Natural History.
- BIRD, R. 1983. A tsunami, a head, maize and dates in the Peruvian early horizon. *American Antiquity* 45: 325–32.
- BONAVIA, D. 2008. *The South American camelids* (Cotsen Institute of Archaeology monographs 64). Los Angeles (CA): Cotsen Institute of Archaeology at UCLA.
- DILLEHAY, T.D. (ed.) 2011. *From foraging to farming in the Andes: new perspectives on food production and social organization*. Cambridge: Cambridge University Press.
- DILLEHAY, T.D., J. ROSSEN, T.C. ANDRES & D.E. WILLIAMS. 2008. Preceramic adoption of peanut, squash and cotton in northern Peru. *Science* 316: 1890–93.
- DILLEHAY, T.D., D. BONAVIA, S. GOODBRED & M. PINO. 2010. Un enfoque metodol  gico hacia un entendimiento de la interacci  n humana y medioambiente en el valle Bajo de Chicama. *Arqueobios* 4: 154–67.
- FISH S., P. DE BLASIS, M.D. GASP  R & P. FISH. 2000. Eventos incrementais na constru  o de sambaquis, litoral sul do Estado de Santa Catarina. *Revista Museu Arqueol  gico* 10: 69–87.
- FUCHS, P.R. & J. BRICENO. 2006. Investigaciones arqueol  gicas en el sitio de Sech  n Bajo, Casma. *Bolet  n Arqueol  gico PUCP* 10: 111–36.
- HAAS, J. & W. CREAMER. 2004. Cultural transformations in the Central Andean Late Archaic, in H. Silverman (ed.) *Andean archaeology*: 35–50. London: Blackwell.
- HABU, J. 2004. *Ancient Jomon of Japan*. London: Cambridge University Press.
- MCCORMAC, F.G., A.G. HOGG, P.G. BLACKWELL, C.E. BUCK, T.F.G. HIGHAM & P.J. REIMER. 2004. SHCal04 Southern Hemisphere Calibration 0–11.0 cal kyr BP. *Radiocarbon* 46: 1087–1092.
- MILLER, E.P. A.F. VANDOME & J. MCBREWSTER. 2010. *Erteb  lle culture*. Leiden: Alphascript.
- MOSELEY, M.E. 1975. *The maritime foundations of Andean civilization*. Menlo Park (CA): Cummings.
- 1992. Maritime foundations and multilinear evolution: retrospect and prospect. *Andean Past* 3: 5–42.
- PEARSALL, D.M. 2008. Plant domestication and the shift to agriculture in the Andes, in H. Silverman & W.H. Isbell (ed.) *Handbook of South American archaeology*: 105–120. New York: Springer.
- PIPERNO, D. & T.D. DILLEHAY. 2008. Starch grains on human teeth reveal early broad crop diet in northern Peru. *Proceedings of the National Academy of Sciences USA* 105: 376–85.
- PIPERNO, D. & K. STOTHERT. 2003. Phytolith evidence for Early Holocene *Cucurbita* domestication in south-west Ecuador. *Science* 299: 1054–57.

- RICHARDSON III, J.B. 1981. Modeling the development of sedentary maritime economies on the coast of Peru: a preliminary statement. *Annals of the Carnegie Museum* 50: 139–50.
- SANDWEISS, D.H., K.A. MAASCH & D.G. ANDERSON. 1999. Transitions in the Mid-Holocene. *Science* 283: 499–500.
- SANDWEISS, D.H., R. SHADY SOLÍS, M.E. MOSELEY, D.K. KEEFER & D.R. ORTLOFF. 2009. Environmental change and economic development in coastal Peru between 5800 and 3600 years ago. *Proceedings of the National Academy of Sciences USA* 106: 1359–63.
- SHADY, R.S., J. HAAS & W. CREAMER. 2001. Dating Caral, a Preceramic site in the Supe Valley on the central coast of Peru. *Science* 292: 723–26.
- STRAUS, L.G., B.V. ERIKSEN, J.M. ERLANDSON & D.R. YESNER (ed.). 1996. *Humans at the end of the Ice Age: the archaeology of the Pleistocene–Holocene transition*. New York: Plenum Press.
- THOMPSON, V. & J.E. WORTH. 2010. Dwellers by the sea: Native American adaptations along the southern coasts of eastern North America. *Journal of Archaeological Research* 25: 23–45.
- WELLS, L.E. 1999. The Santa beach ridge complex: sea-level and progradational history of an open gravel coast in central Peru. *Journal of Coastal Research* 12: 1–17.

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