A Late Pleistocene Occupation on the Southern Coast of Oregon

Loren G. Davis
Michele L. Punke
Roberta L. Hall
Matthew Fillmore
Samuel C. Willis
Oregon State University
Corvallis, Oregon

Geoarchaeological research on the southern coast of Oregon brought to light archaeological evidence of early human occupation in the late Pleistocene. Indian Sands (35CU67) lies on a highly eroded deflated headland on the Oregon coast where previous surveys had found and dated surficial cultural materials as early as 8250 b.p. (uncalibrated radiocarbon years). Prior to excavation of Indian Sands, sediment and stratigraphic analysis, along with radiocarbon and thermoluminescence dates, established the existence of late Pleistocene deposits. The excavations confirmed the presence of buried cultural deposits containing lithic artifacts, charcoal, and fire-cracked rock. Dispersed charcoal from the floor of an artifact-bearing level was dated to 10,430 b.p., more than 2000 ^{14}C years older than any other Oregon coastal site.

Introduction

Over the past century, the archaeological literature on the peopling of the Americas has grown dramatically. Today, this research topic is pursued as a multidisciplinary effort involving combined studies of prehistoric human ecology and Quaternary geology. Because paleoenvironmental evidence for the late Pleistocene and early Holocene is widespread and readily accessible we know much more about the physical environment of early humans than we do about the people themselves. As a result of the incomplete archaeological record and the burgeoning paleoenvironmental database, there are multiple models of potential human entry into the New World.

The hypothesis of migration through an ice-free corridor between the Cordilleran and Laurentide ice sheets has enjoyed great longevity among archaeologists, but the hypothesis of an eastern Pacific coastal route of entry has been gaining ground during the past two decades (Fladmark 1979, 1983; Gruhn 1994, 1998; Easton 1992). Questions raised about the viability of an inland entry from eastern Beringia helped to shift attention to the coast, and the discovery that marine and terrestrial refugia existed along the NW Pacific coast in the millennia following the last glacial maximum generated new enthusiasm for a possible coastal migration route (e.g., Blaise, Clague, and Mathewes 1990; Bobrowsky et al. 1990; Heaton 1993; Heaton, Talbot, and Shield 1996; Mandryk et al. 2001).

The general acceptance that the Monte Verde site in Chile contains pre-11,200 b.p. (uncalibrated radiocarbon years) evidence of humans in South America (Dillehay 1997) provides additional support that a coastal migration could have preceded continental entry via an ice-free corridor. Despite growing interest in the coastal migration model, only a handful of sites dating before 10,000 b.p. are known along the western coast of North America, all consistently younger than 11,000 b.p. Although coastal sites between 9000 and 10,500 b.p. are known from Alaska, British Columbia, and southern California, no late Pleistocene-early Holocene sites have hitherto been identified along the coasts of Oregon or Washington. A number of sites in British Columbia may belong to this period, and sites in the 8500 to 9000 b.p. range are found in near-coastal and off-shore localities along the central and southern California coast (Erlandson and Moss 1996). This existence of early coastal sites to the north and south suggests that Oregon may have similar sites. This paper reports the discovery of lithic artifacts in a late Pleistocene paleosol at the Indian Sands site on the southern Oregon coast.

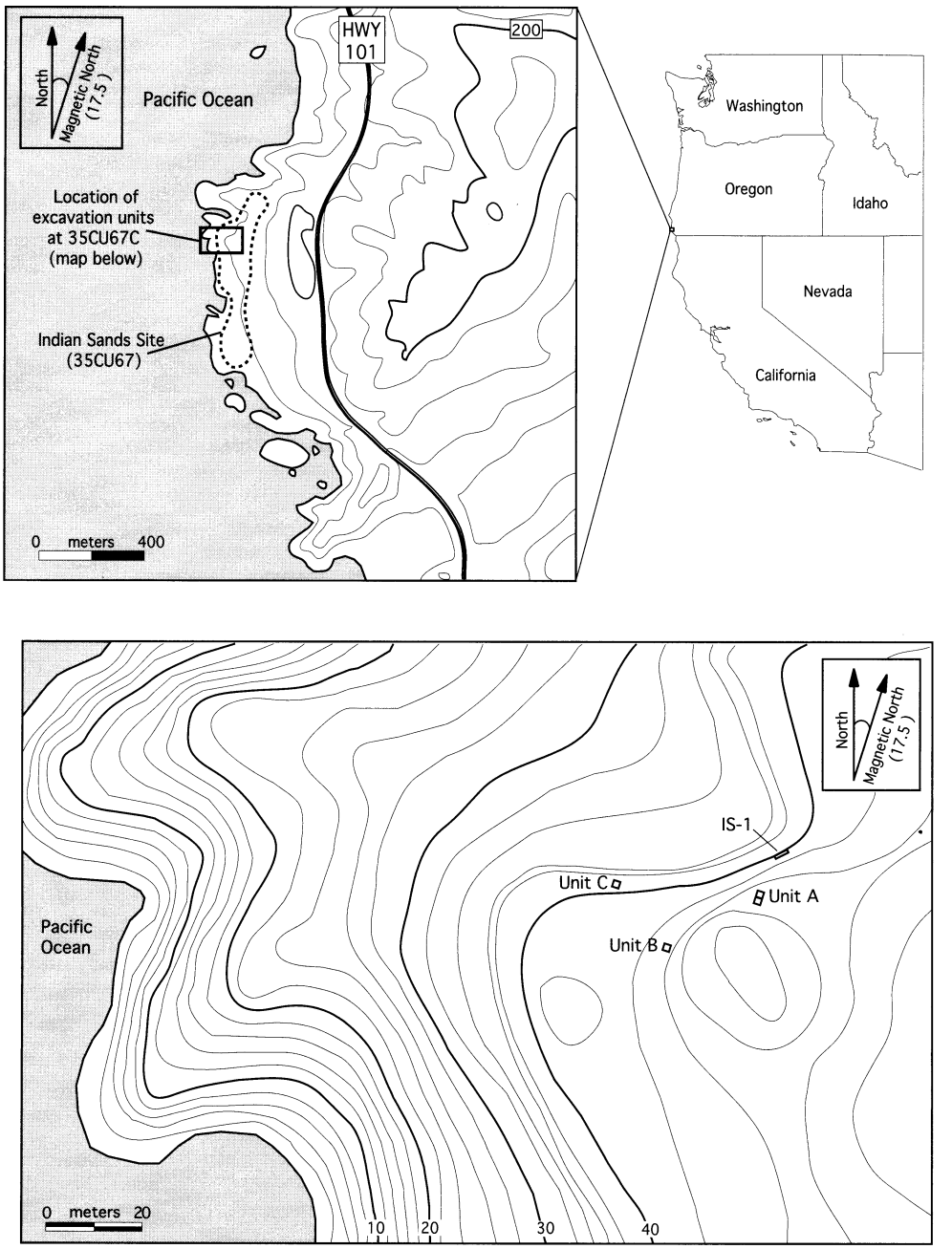

Figure 1. Location of study area along the southern Oregon coast. Top, location of the Indian Sands site (35CU67); contour interval is 40 m. Bottom, excavation units at 35CU67C in relation to interpolated topography; contour interval is 2 m.

Archaeological Research at Indian Sands

Indian Sands (35CU67) is located in the Samuel H. Boardman State Park about 8.5 km north of Brookings, Oregon (FIG. 1). As its name suggests, extensive scatters of lithic material and shell fragments are found on a deflated dune surface about 30 m above sea level and 100 m east of the Pacific Ocean. The locality is underlain by Jurassic Otter Point Formation bedrock, which includes chert-bearing breccias and conglomerates (Beaulieu and Hughes 1976). Pacific winds actively erode large portions of Indian Sands creating extensive blowouts and lagged lithic pavements (FIG. 2).

Moss and Erlandson (1995) collected burned and unburned mussel shells from a deflated scatter in the central

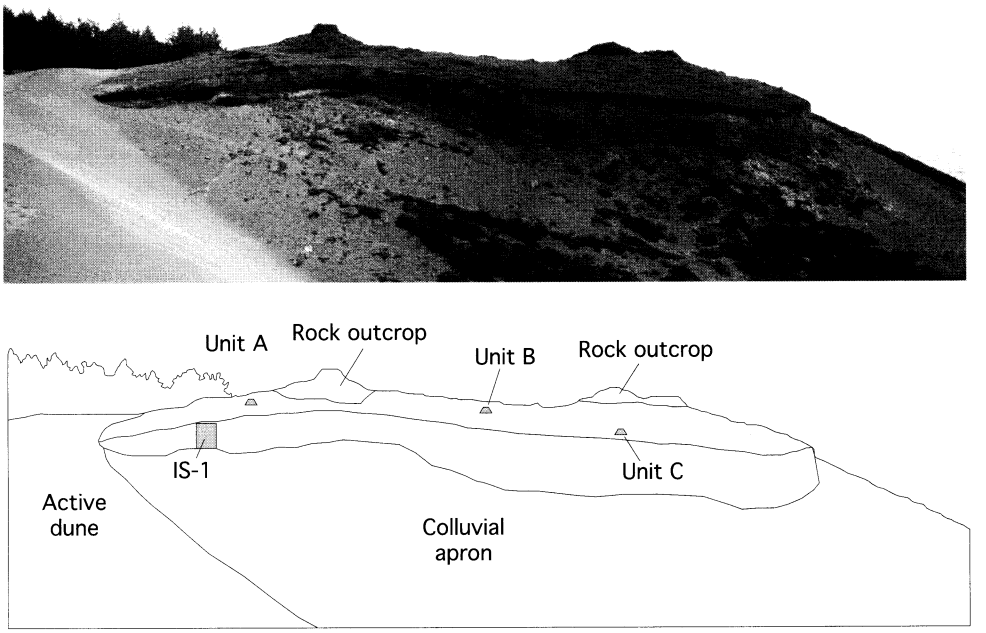

Figure 2. Photograph and sketch of 35CU67C at Indian Sands showing locations of the IS-1 profile and excavation units. Strong winds erode deposits that have weak consistency causing collapse of cutbanks onto the colluvial apron and the aeolian mobilization of sediments into active dunes.

part of Indian Sands, which they designate as 35CU67C. These shells have radiocarbon dates ranging from 7790 ± 70 to 8250 ± 80 b.p. Lyman (1997) questions the claim that the burned shells from the surface are actually cultural, but Moss and Erlandson (1998: 21) provide plausible arguments to establish the association between dated shell and human activity at the site.

Discovery of a late Pleistocene site at Indian Sands was the result of an effort to identify paleolandscape components along the southern Oregon coast, and in 2000 our team concentrated on establishing and clarifying stratigraphic records of coastal headlands and building a model of landscape evolution and potential site preservation. Our investigations along the active beach zone revealed only late Holocene deposits, but on the uplifted marine terraces we identified late Pleistocene soils and sediments at multiple localities. Stratigraphic work at Indian Sands in the summers of 2000 and 2001, coupled with the knowledge of early Holocene dates from previous investigations (Erlandson and Moss 1996: 293–294; Moss and Erlandson 1995, 1998) and abundant artifacts on the surface, helped to narrow our search for key areas to excavate. Three test units (FIGS. 1, 2) were excavated: Unit A (1 × 2 m) was located at the eastern edge of the site, where deflation appeared less extensive; Unit B (1 × 1 m) was situated in the central portion of the site, in an area where a dense charcoal concentration was eroding at the surface; and Unit C (1 × 1 m) was placed at the eastern edge of an early Holocene shell and artifact scatter (Moss and Erlandson 1995; Erlandson and Moss 1996: 293–294) to evaluate whether intact late Pleistocene and early Holocene cultural deposits were present. Stratigraphic profiles were described using USDA guidelines (Soil Survey Division Staff 1993).

Stratigraphy and Site Formation

Nine stratigraphic units were identified in a cutbank (designated IS-1) and in Units A–C (TABLE 1) and were dated with six radiocarbon assays, of which three are shown in Table 2, and four thermoluminescence assays (TABLE 3). The oldest units (6Cb3–6Cb1) predate the 28,830 b.p. charcoal date on the surface of the 5Ab paleosol exposed at the bottom of IS-1 (FIG. 3). A second zone of soil development (4Cb2–4Bsb) dated to between 35,600 and 15,600 cal B.P. is seen above the eroded 5Ab paleosol. The younger radiocarbon and thermoluminescence dates are similar. The greater age and larger error for the 35,600 B.P. date may reflect incomplete bleaching of sample lattice traps prior to redeposition (Berger 1988); the preservation of foreset bedding in the 4Cb2 horizon suggests rapid burial, which possibly contributed to incomplete zeroing. Since thermoluminescence dates are calendrical ages, however, a calibration of the oldest two radiocarbon dates could close this temporal gap. A litholog-

Table 1. Composite stratigraphic description of 35CU67C at Indian Sands.

Stratum	*Depth in cm*	*Description*
2C	0–50	Olive brown (2.5Y4/4) loamy sand; single grain; loose, loose; nonsticky, nonplastic; abrupt wavy boundary.
3Ab	50–70	Very dark grayish brown (10YR3/2) loam; moderate fine subangular blocky structure; friable, slightly hard; slightly sticky, slightly plastic; 12 percent fine distinct spherical moderately cemented yellowish brown (10YR5/6) and yellowish brown (10YR5/8) iron-manganese nodules with clear boundaries in matrix and 12% medium distinct spherical moderately cemented yellowish brown (10YR5/6) and yellowish brown (10YR5/8) iron-manganese nodules with clear boundaries in matrix; clear smooth boundary.
4Bsb	70–134	Brown (7.5YR4/4) fine sandy loam; weak subangular blocky and weak fine subangular blocky structure; very friable, slightly hard; nonsticky, nonplastic; 12 percent fine distinct spherical moderately cemented yellowish brown (10YR5/6) and yellowish brown (10YR5/8) iron-manganese nodules with clear boundaries in matrix and 12% medium distinct spherical moderately cemented yellowish brown (10YR5/6) and yellowish brown (10YR5/8) iron manganese nodules with clear boundaries in matrix; abrupt smooth boundary.
4Cb1	134–172	Olive brown (2.5Y4/4) loamy fine sand; single grain; loose, loose; nonsticky, nonplastic; abrupt smooth boundary.
4Cb2	172–228	Olive brown (2.5Y4/3) loamy sand; single grain; parallel 5–7 cm thick foreset beds show apparent dip of ca. 25–30° to the east; loose, loose; nonsticky, nonplastic, abrupt smooth boundary.
5Ab	228–278	Very dark grayish brown (10YR3/2) fine sandy loam; weak fine subangular blocky structure; very friable, slightly hard; nonsticky, nonplastic; 12 percent fine distinct spherical moderately cemented yellowish brown (10YR5/6) and yellowish brown (10YR5/8) iron manganese nodules with clear boundaries in matrix and 12% medium distinct spherical moderately cemented yellowish brown (10YR5/6) and yellowish brown (10YR5/8) iron-manganese nodules with clear boundaries in matrix; 22% flat weakly cemented 2 to 10 mm charcoal fragments; clear smooth boundary.
6Cb1	278–328	Olive brown (2.5Y4/3) loamy fine sand; single grain; loose, loose; nonsticky, nonplastic; gradual smooth boundary.
6Cb2	328–378	Olive brown (2.5Y4/3) loamy sand; single grain; retains weak, fine (< 1 cm thick) horizontally bedded laminae at intervals of 3–5 cm; loose, loose; nonsticky, nonplastic; gradual smooth boundary.
6Cb3	378–428	Olive brown (2.5Y4/4) fine sand; single grain; loose, loose; nonsticky, nonplastic.

Table 2. Radiocarbon dates from Indian Sands (35CU67C). Beta # is a sample tracking number provided by Beta Analytic. Wood charcoal dated in all cases.

Provenience	*Soil horizon*	*Method*	*Beta #*	*^{14}C b.p.**	*Cal B.P.†*	*Context*
35CU67C, Unit A	3Ab	AMS	170406	10,430 ± 150	12,930–11,690	Dispersed in 3Ab matrix at 70 cm below datum
IS-1 profile	5Ab	Conventional	166026	26,240 ± 270	–	On surface of 5Ab at 180 cm below surface
Indian Sands, north of 35CU67C	5Ab	AMS	148867	28,830 ± 330	–	Downslope extension of 5Ab

*Uncalibrated ^{14}C years before present.
†Calibrated ^{14}C date calculated with INTCAL98 (Stuiver et al. 1998) and expressed in calendar years before present (cal B.P.), i.e., before 2003.

Table 3. Thermoluminescence ages of IS-1 profile samples, located on the northern edge of Indian Sands (35CU67C), calculated from dose-rate assessments. Error limits include both random and systematic uncertainties and refer to the 68% confidence level. Analysis and ages produced by Quaternary TL Surveys.

Sample	*Alpha NRD (μm^{-2})*	*Beta NRD(Gy)*	*Alpha track rate (μm^{-2}/ka)*	*Beta external dose-rate (Gy/ka)*	*Decay corrected TL age in years B.P.*
ISP1	10.47 ± 0.48	15.60 ±1.20	0.229 ± 0.030	0.811 ± 0.063	15,600 ± 1800
ISP2	13.84 ± 1.35	20.22 ± 2.11	0.198 ± 0.027	0.791 ± 0.063	21,900 ± 3300
ISP3	14.77 ± 1.59	22.38 ± 3.24	0.235 ± 0.028	0.800 ± 0.063	22,800 ± 3700
ISP4	15.80 ± 1.74	26.46 ± 2.76	0.143 ± 0.018	0.751 ± 0.061	35,600 ± 5600

ical and pedological discontinuity at the boundary between the 4Bsb and 3Ab horizons marks the upper limits of the eroded 4Bsb paleosol.

The 3Ab soil overlies unconformably the eroded 4Bsb surface. The clear boundary between the units suggests gradual burial and bioturbation after 15,600 B.P. A return to surficial stability is seen in the development of the 3Ab soil, which retains a moderately-developed fine subangular blocky structure. Dispersed charcoal from 3Ab, collected from Unit A at a depth of 70 cm below datum outside the boundaries of rodent burrows (FIGS. 4, 5), has an uncalibrated ^{14}C age of 10,430 ± 150 b.p. The 3Ab horizon is unconformably overlain by loamy 2C sands. Dated mussel shell gathered by Moss and Erlandson (1995) from the surface of 2C, in the general vicinity of Unit C, dates from 7790 ± 70 to 8250 ± 80 b.p.

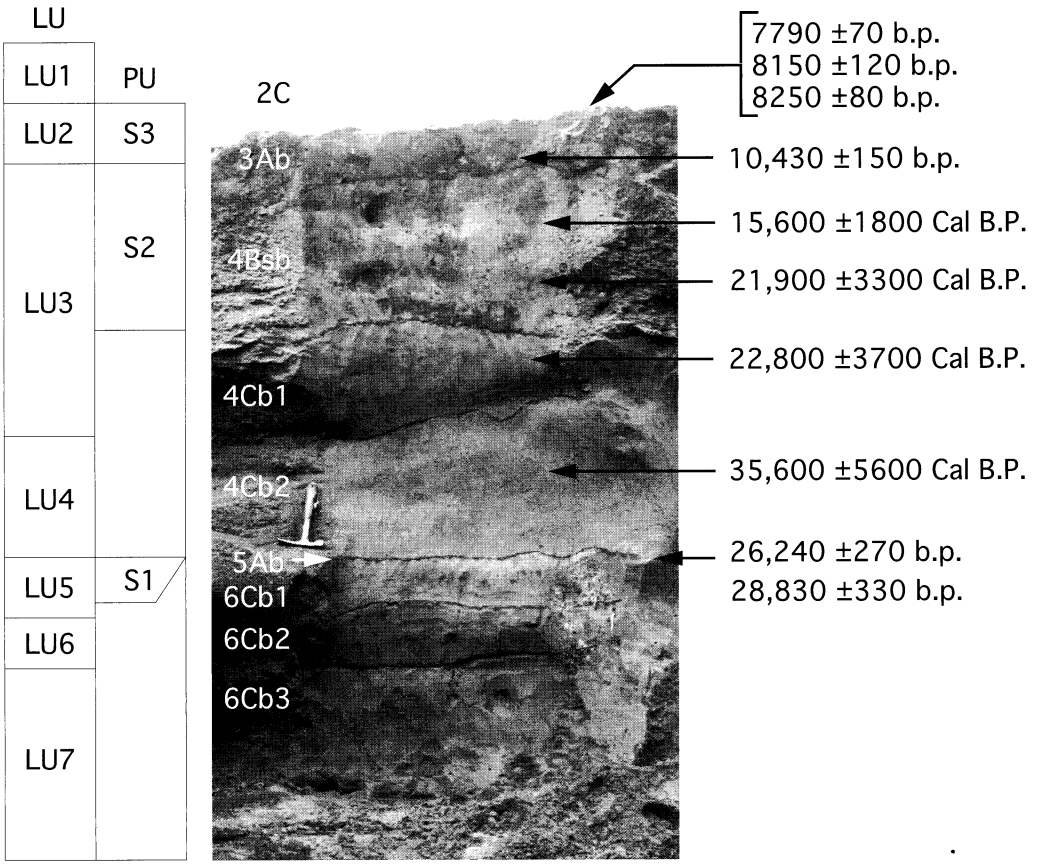

Figure 3. Stratigraphic profile at the IS-1 section; horizon designations follow stratigraphic descriptions in Table 1. Uncalibrated radiocarbon dates reported in ^{14}C years before present (b.p.). Thermoluminescence dates shown as calendrical ages (TABLE 3) in years before present. The 7790–8250 b.p. dates are from Moss and Erlandson (1995).

The sections reveal significant erosion in the late Pleistocene and Holocene (FIG. 4). Profiles on the western side of the site lack the 3Ab horizon but have an irregular, erosional contact between 2C sands and the 4Bsb paleosol horizon. To the east, Unit A preserves a complete stratigraphic sequence of 2C, 3Ab, and 4Bsb horizons (FIG 5A). IS-1 is situated at the eroded NE edge of 35CU67C and lacks the uppermost 2C sands.

The history of the site began when Pacific winds transported sand from the exposed continental shelf to form a large dune sheet at Indian Sands during the late Pleistocene. The surface of Indian Sands was stable by ca. 29,000 b.p. when the 5Ab paleosol at IS-1 was formed. Around 26,000 b.p. vegetation cover on the 5Ab paleosol was burned, exposing the surface of Indian Sands to erosion by Pacific winds. Dune sedimentation resumed after 26,000 b.p. as evidenced by continuing aeolian deposition of sand (4Cb2–4Cb1) which continued until 15,600 B.P. Pedogenic alteration of dune sands produced the 4Bsb paleosol between 15,600 B.P. and 10,430 b.p. Prior to 10,430 b.p., erosion of the 4Bsb paleosol removed its A horizon, resulting in an unconformable stratigraphic boundary between 4Bsb and 3Ab. Aeolian deposition began immediately prior to 10,430 b.p. and stopped before 8250 b.p. A period of surface stability followed and promoted development of the 3Ab paleosol seen at IS-1 and Unit A. The spread of the 2C dunes across the surface of Indian Sands is dated by radiocarbon samples that bracket the 2C deposition between 10,430 and 8250 b.p. Widespread deflation of Indian Sands occurred after 8250 b.p.

Cultural Materials

The small volume of excavated deposits limits our view of the early human occupation. The recovery of a lithic assemblage associated with the terminal Pleistocene paleosol provides an invaluable perspective on an otherwise unknown period of Northwest Coastal prehistory. Because artifacts associated with the sandy 2C deposit that covers much of the site are derived from assemblages of subsequent prehistoric occupations, discussion is limited to

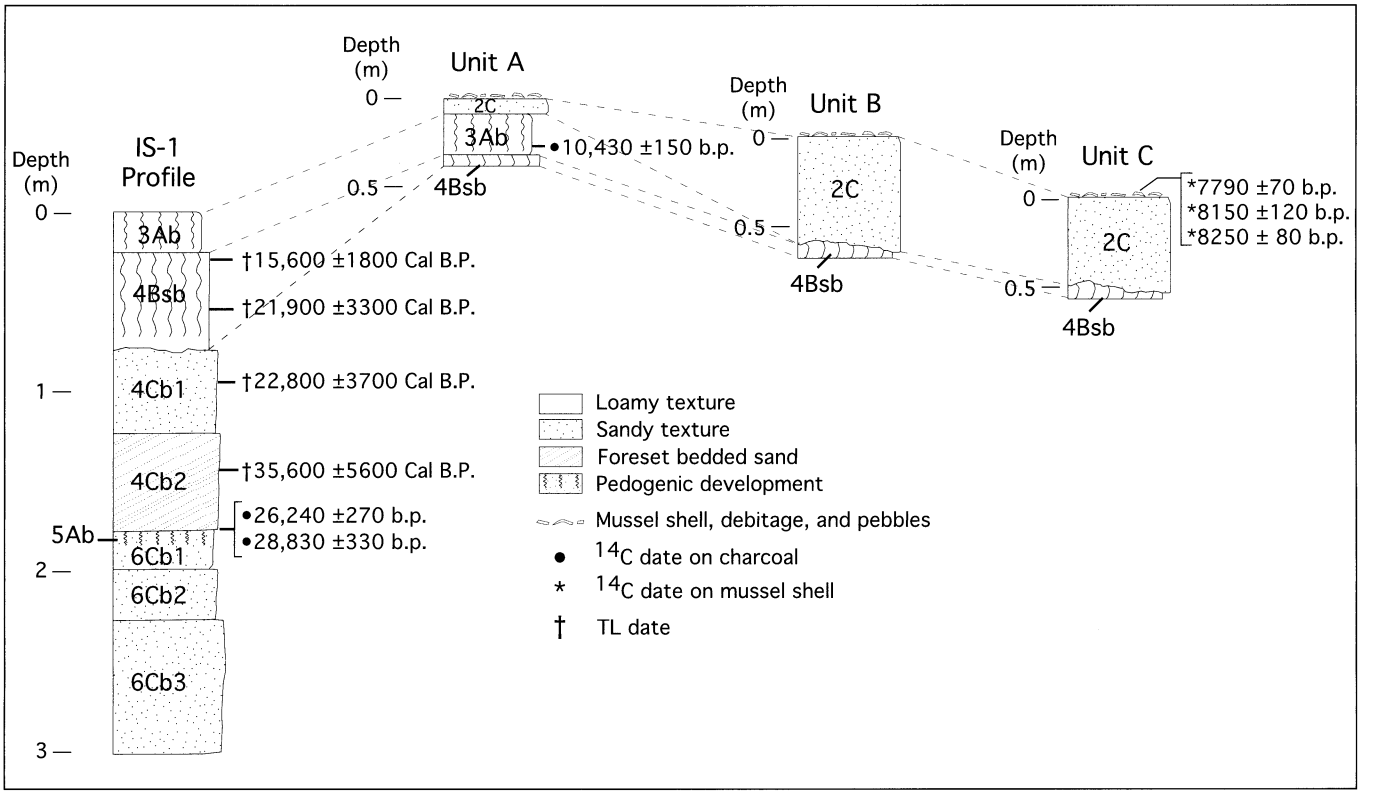

Figure 4. Correlation of the IS-1 section with profiles exposed in excavation Units A, B, and C; horizon designations follow stratigraphic descriptions in Table 1. Dates on shell near Unit C range from 7790 to 8250 b.p. (Moss and Erlandson 1995). West is to the right.

lithics associated with the 3Ab sediments in Unit A, an undisturbed cultural component (FIG. 5).

Of the 136 lithics from the 3Ab deposit in Unit A, the majority (85%) are smaller than 2 cm. A size-aggregate analysis (Stahle and Dunn 1982) indicates that the Unit A debitage results from late stage reduction, an observation reinforced by a weight-aggregate analysis that predicts that 78% of all debitage should fall within the range of 0.1 to 0.2 g. Chert was the dominant material type (91.9%), followed by obsidian (5.9%) and metamorphic rock (2.2%). Trace element characterization by x-ray fluorescence of the obsidian reveals that it was imported from southern Oregon (NE of Klamath Falls) and from the Medicine Lake basin in northern California.

Retouched lithic artifacts from the 3Ab paleosol are limited to a pair of chert artifacts: a single core reduction flake from a multidirectional core and a utilized flake with well-developed edge polish. Seven pieces of metamorphic rock have surficial oxidation, small adhering charcoal fragments, and a fracture pattern that defines them as fire-cracked rock. A cultural origin for the charcoal and fire-cracked rock is based on the facts that fire-cracked rocks in Unit A are limited to seven small pieces, a number too small to result from natural burning of vegetation on the 3Ab paleosol, and that the large anticipated quantities of charcoal from intrusive roots burned by a forest fire are absent in the Unit A profile and the exposures of the 3Ab horizon. Materials recovered from Unit A are evidence that prehistoric people stopped long enough to make stone tools and build a fire, contributing charcoal and fire-cracked rock to the 3Ab deposit.

Discussion and Conclusion

The discovery of a late Pleistocene presence at Indian Sands is a clue to the coastal localities attractive to early peoples where early sites may be preserved in the modern landscape. At 10,000 b.p., the Pacific shoreline was ca. 1.5–2.0 km west of Indian Sands (FIG. 6). By 8000 b.p., the shoreline was within 0.5–0.25 km of the site and had developed a littoral ecosystem with marine resources. These changes in sea level and coastal geomorphology may explain the absence of shellfish in the late Pleistocene 3Ab deposit and subsequent appearance of shell remains after 8250 b.p.

Although the environment of Oregon's late Pleistocene coastal plain is largely a matter of conjecture, this pale-

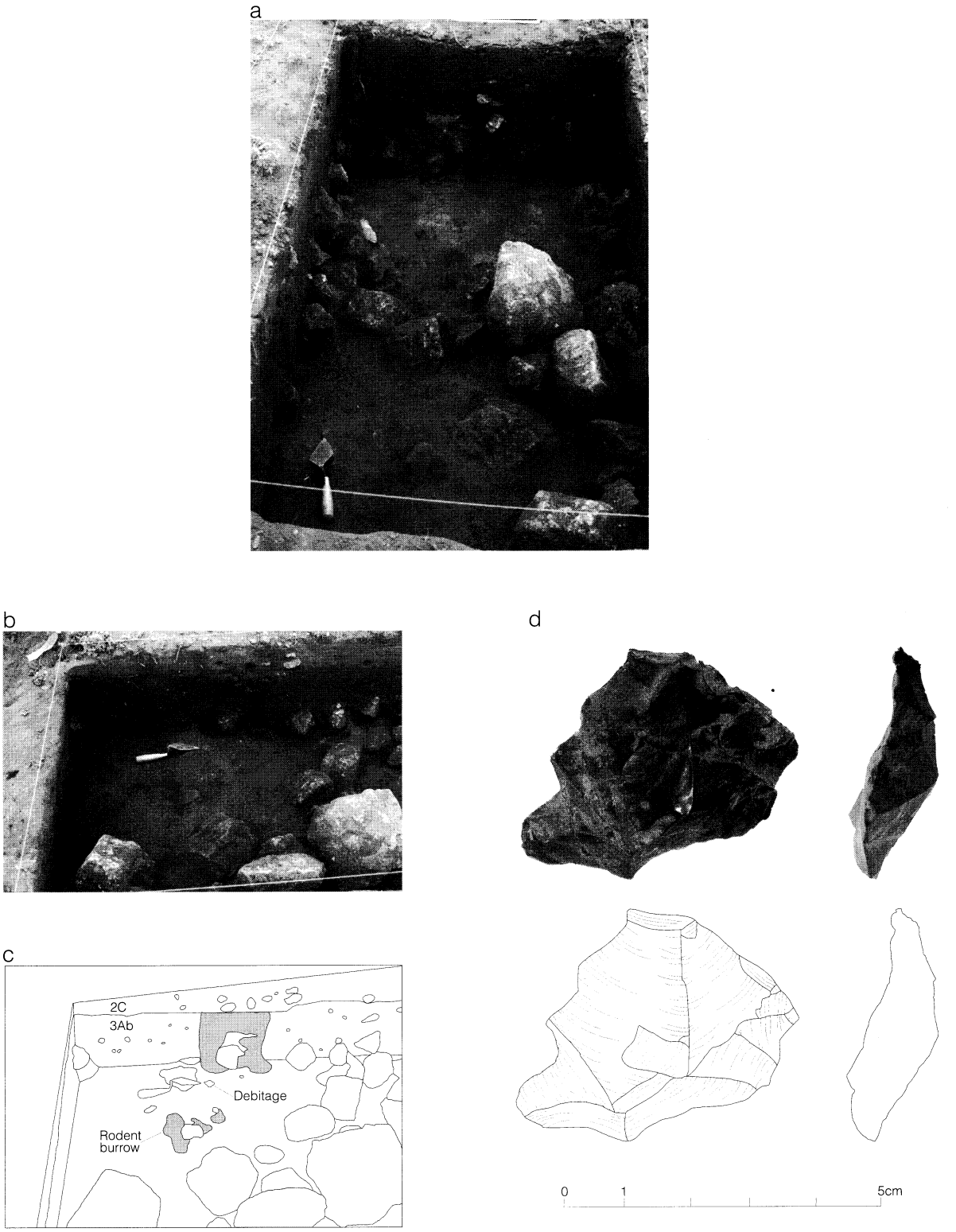

Figure 5. Photographs of Unit A, level 7 (60–70 cm below datum). A) View to south: sediment mottling in floor of south end shows unconformable contact between 3Ab and 4Bcb horizons; trowel points to chert artifact; B) NE corner of Unit A; trowel points to chert artifact; C) drawing showing relative positions of soil horizons, rocks, rodent burrows, and chert artifact; D) image and illustration of chert artifact shown in C. The charcoal sample dated to 10,430 b.p. was collected from small dispersed fragments at 70 cm below datum in sediments around the chert artifact but outside of demarcated rodent burrows.

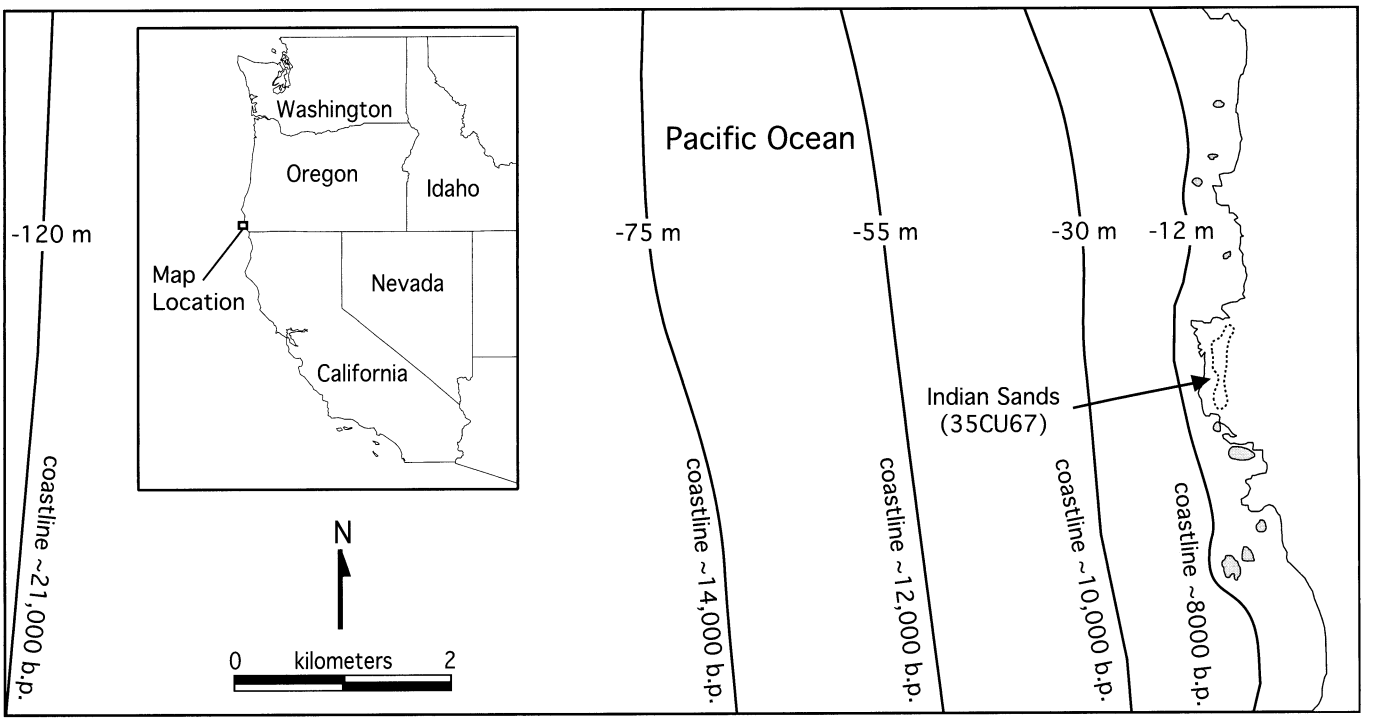

Figure 6. Former shorelines. Global sea level estimates from Fleming et al. (1998); bathymetric data from GEODAS 1998.

olandscape probably supported mammoth, mastodon, ground sloth, giant beaver, elk, and deer in a riparian and wetland ecosystem associated with coastal streams that also promoted high densities of coastal fauna. Paleoenvironmental records from the Pacific Northwest indicate warming by 13,000 b.p. (e.g., Barnosky, Anderson, and Bartlein 1987; Grigg and Whitlock 1998; Heusser, Heusser, and Peteet 1985), but these records do not specifically reflect conditions on the exposed coastal shelf. Pollen records from marine cores located 120 km east of Indian Sands show an increase in oak, redwood, and alder beginning at 14,000 b.p., suggesting a response to atmospheric warming (Sancetta et al. 1992: 368).

The stratigraphic record of the IS-1 profile provides a general perspective on late Pleistocene coastal plain environments (FIG. 3). The expansion of sand dunes indicates both windiness and availability of sediments, and late Pleistocene dunes at Indian Sands may reflect indirectly the conditions on the nearby coastal plain. Three periods of late Pleistocene erosion and pedogenesis are seen in the IS-1 profile, corresponding to the 5Ab, 4Bsb, and 3Ab horizons. The absence of dune formation between the erosion of the 4Bsb paleosol and 3Ab soil formation suggests a sand source was unavailable on the coastal plain between 15,600 B.P. and 10,430 b.p., probably due to surface stabilization by extensive vegetation. Early visitors to Indian Sands probably saw a wooded coastal plain intersected with small streams instead of the broad sparsely-vegetated dune field that exists today.

The availability of chert in local bedrock undoubtedly attracted people to Indian Sands and the headland gave hunters a good view of animal movement on the coastal plain during periods of lower sea level. The extensive Pleistocene dunes at Indian Sands point to a large sand ramp that connected the headland with the exposed continental shelf. This ramp would have provided a route for hunter-gatherers from the uplands down to the coastal plain. The headlands here rose abruptly and steeply from the eastern edge of the coastal plain before 8000 b.p., and access to them would be difficult in areas lacking sand dunes; further travel inland along coastal stream valleys would have been required. Indian Sands was an attractive spot in the late Pleistocene and early Holocene because it contained an important lithic source, was positioned on an ecotone, offered an excellent view of the coast, and provided an easy route for people to travel between the coastal plain and the uplands.

Geoarchaeological investigations and archaeological excavations at Indian Sands produced a stratigraphic and geochronologic record with multiple periods of soil formation spanning the late Pleistocene and early Holocene. One paleosol (3Ab) has evidence of an early human pres-

ence (10,430 b.p.), placing it among the earliest documented sites for the Northwest coast. The presence of obsidian at Indian Sands shows that trade or, at least, contact with other regions was established by the terminal Pleistocene. Ultimately, collecting more information from Indian Sands will elucidate patterns of lithic reduction and tool manufacture, and will build understanding of the technological systems, economic approaches, and logistical strategies used by early coastal peoples. Most importantly, this research illustrates the utility of using geoarchaeological data to locate early coastal sites. Geoarchaeological investigations in advance of archaeological excavation will aid the discovery of additional early coastal sites necessary to evaluate the timing of human entry into the New World (Mandryk et al. 2001: 301, 310).

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Loren G. Davis (Ph.D. University of Alberta 2001) is a lecturer in the Department of Anthropology at Oregon State University. His research interests include the archaeology, geoarchaeology, and Quaternary geology of western North America and Baja California, and the Pleistocene peopling of the New World. Mailing address: Department of Anthropology, Oregon State University, Waldo 238, Corvallis, OR 97331. E-mail: loren.davis@oregonstate.edu

Michele L. Punke (M.A.I.S. Oregon State University 2001) is a research assistant and Ph.D. student in the Department of Geosciences at Oregon State University. Her research involves physical landscape processes, digital modeling, archaeology, and geographic information system applications in anthropology.

Roberta L. Hall (Ph.D. University of Oregon 1970) is a Professor of Anthropology at Oregon State University. Her major interests are human evolution, ecology, and variation worldwide and the cultural traditions, archaeology, and palaeoecology of Oregon's southern coast.

Matthew H. Fillmore (B.Sc. Oregon State University 1976) is a Soil Scientist and Soil Survey Project Leader for the USDA Natural Resources Conservation Service. His research interests include soil survey and mapping, soil genesis and morphology, soil-landscape relationships, and forest soils.

Samuel C. Willis (B.A. Middle Tennessee State University) is a research assistant and M.A. student in the Department of Anthropology at Oregon State University. His research interests include lithic analysis and Paleoindian lithic technology of western North America.

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