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24. Elemental analysis for the cadmium intercalate found: C, 18.34; H, 1.91; N, 2.66; S, 33.17; P, 10.30; and Cd, 31.96. Required for $Cd_{0.86}PS_3(DAMS)_{0.28}$: C, 18.50; H, 1.84; N, 2.70; S, 33.07; P, 10.65; and Cd, 33.24. Elemental analysis for the manganese intercalate found: C, 21.67; H, 2.22; N, 3.17; S, 38.98; P, 12.84; and Mn, 19.20. Required for $Mn_{0.86}PS_3(DAMS)_{0.28}$: C, 22.29; H, 2.22; N, 3.25; S, 39.84; P, 12.83; and Mn, 19.57. The intercalation of cationic species is accompanied by the creation of interlayer metal vacancies to maintain the electrical neutrality. The unit cell of the intercalates is closely related to the cell of the pure host lattice. The "in plane" **a** and **b** parameters are quasi-identical, and the **c** parameter is enlarged because of the bulk of the guest species. The parameters for $Cd_{0.86}PS_3(DAMS)_{0.28}$ are a = 6.242 Å, b = 10.768 Å, c = 12.550 Å, and β = 94.0°; versus a = 6.218 Å, b = 10.763 Å, c = 6.867 Å, and β = 107.6° for pure $CdPS_3$.
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Paleoindians in Beringia: Evidence from Arctic Alaska

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Excavations at the Mesa site in arctic Alaska provide evidence for a Paleoindian occupation of Beringia, the region adjacent to the Bering Strait. Eleven carbon-14 dates on hearths associated with Paleoindian projectile points place humans at the site between 9,730 and 11,660 radiocarbon years before present (years B.P.). The presence of Paleoindians in Beringia at these times challenges the notion that Paleoindian cultures arose exclusively in mid-continental North America. The age span of Paleoindians at the Mesa site overlaps with dates from two other cultural complexes in interior Alaska. A hiatus in the record of human occupation occurs between 10,300 and 11,000 years B.P. Late Glacial climatic fluctuations may have made northern Alaska temporarily unfavorable for humans and spurred their southward dispersal.

Since the 16th century, the Bering Strait region has been viewed as the likely route for peopling of the New World from Asia (*1*). More than 60 years have elapsed since the 1926 discovery of Paleoindian fluted projectile points in undoubted association with extinct Pleistocene bison near Folsom, New Mexico (*2*), yet convincing evidence for a Paleoindian presence in Beringia has remained elusive (*3–5*). Although Paleoindian-like projectile points have been found in Alaska since the 1930s (*6*), most have come from undatable contexts (*4*). We report here on well-dated examples of lanceolate Paleoindian projectile points from Beringia. These were recovered from the Mesa site, a late Pleistocene–early Holocene hunting lookout located on the northern flanks of Alaska's Brooks Range (*7*) (Fig. 1).

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The Mesa site has a commanding view from atop a weathered gabbro dike that rises 60 m above the Iteriak Creek valley. The view from the site, together with the predominance of point bases, the presence of impact-fractured points, the pattern of resharpening, and the large amount of flakes from point manufacture, all suggest that the site was used as a weapon-repair and game-spotting station. Artifacts come from the surface or from within a thin (<30 cm) layer of colluvium on top of the mesa. The most common tools are basally concave lanceolate projectile points, most of which are broken or resharpened (Fig. 2). These points display basal thinning although not true fluting. They have relatively thick lenticular to diamond-shaped cross sections and heavily ground proximal edges and bases. The Mesa points were finished by robust pressure flaking. Among the classic Paleoindian projectile point types from mid-continental North America, the Mesa points are most similar in technology to Agate Basin and Hell Gap points (*8*), but typically have basal concavities like Goshen and Plainview points (*9*).

Other tools in the assemblage include bifaces, spurred gravers, scrapers, and hammerstones (Fig. 2). These tools are all typical of Paleoindian assemblages. The core and blade technology reported from other early Alaskan sites (*10, 11*) is absent from this assemblage. Unlike many other sites in the region, the Mesa site was evidently not used by people of the ensuing Holocene cultural periods, despite the presence of their cultural remains in nearby sites along Iteriak Creek.

We discovered nine shallowly buried, unlined hearths on the mesa in association with artifact concentrations. Contemporaneity between the hearths and the Mesa points is demonstrated by occasional flakes and projectile point fragments that are associated with charcoal and possess pot-lid fractures, a pattern known to result from heating. Of the 11 accelerator mass spectrometry (AMS) ^{14}C dates on charcoal from the site, nine indicate occupation near 10,000 radiocarbon years before present (years B.P.), and two from a single hearth indicate occupation between 11,000 and 12,000 years B.P. (Table 1) (*12*). Apart from the Mesa site, only the Putu site 290 km to the east provides potential dating for a northern Paleoindian tradition (Fig. 1). At the Putu site, a single date of 11,470 ± 500 years B.P. may relate to a Paleoindian occupation containing both fluted and nonfluted lanceolate projectile points (*13*).

Our findings at the Mesa site have several implications. The Mesa Complex clearly demonstrates that Paleoindians once occupied Beringia, an occupation previously considered speculative by most prehistorians. The oldest date from the Mesa site, 11,660 ± 80 years B.P., seems to preclude the derivation of

the Mesa Complex from Clovis, the earliest of the mid-continental Paleoindian complexes, because revisions in the ^{14}C ages of Clovis in the desert Southwest now place it between about 10,900 and 11,200 years B.P. (*14*). The early Mesa site date strengthens the hypothesis that Paleoindian cultures originated in the north (*3, 4, 15*).

The northern Paleoindian tradition evidenced at the Mesa site complicates previous models of Alaskan prehistory. Hoffecker, Powers, and Goebel suggested a model in which the Nenana Complex (which includes core and blade as well as bifacial technology and is thought to be similar to Clovis except that it lacks lanceolate fluted projectile points) was present in eastern Beringia before 11,000 years B.P. (*10*). This was followed after 11,000 years B.P. by the Denali Complex, which contains wedge-shaped cores and microblades that are clearly of Siberian derivation. The Mesa Complex adds a third distinct cultural unit to the period 10,000 to 12,000 years B.P. (*16*). This early cultural diversity is unexpected for the Arctic and may reflect the complexity of environmental change occurring during this interval of the Late Glacial.

The most radical of climatic shifts during the Late Glacial interval was the Younger Dryas episode, a 1300-year-long cold period between 11,640 ± 250 and 12,940 ± 260 calendar years ago (*17*). Although best known from the North Atlantic region, evidence for the Younger Dryas stadial has recently been found in pollen cores (*18, 19*) and geologic sections (*20*) from Alaska and in marine cores from the North Pacific (*21*), which suggests that the stadial was circumboreal in extent. In southern Alaska, pollen evidence suggests

Table 1. AMS radiocarbon dates from the Mesa site. All samples are wood charcoal. Dates (±1σ) are based on the 5568-year ^{14}C half-life and are corrected with ^{13}C for fractionation. An earlier published conventional date of 7620 ± 95 years B.P. (*7*) has been rejected in favor of date 7, which was split from the original sample. Date 1 is from soil charcoal, dates 2 through 9 are each from different hearths, and dates 10 and 11 are replicate dates from a single hearth.

Laboratory number	Date (years B.P.)
1. Beta-36805 (ETH-6570)	9,730 ± 80
2. Beta-57429 (CAMS-4146)	9,900 ± 70
3. Beta-55284 (CAMS-3570)	9,930 ± 80
4. Beta-50430 (ETH-9087)	9,945 ± 75
5. Beta-55282 (CAMS-3568)	9,990 ± 80
6. Beta-55285 (CAMS-3571)	10,000 ± 80
7. Beta-52606 (CAMS-2688)	10,060 ± 70
8. Beta-50428 (ETH-9086)	10,090 ± 85
9. Beta-55283 (CAMS-3569)	10,240 ± 80
10. Beta-57430 (CAMS-4147)	11,190 ± 70
11. Beta-55286 (CAMS-3572)	11,660 ± 80

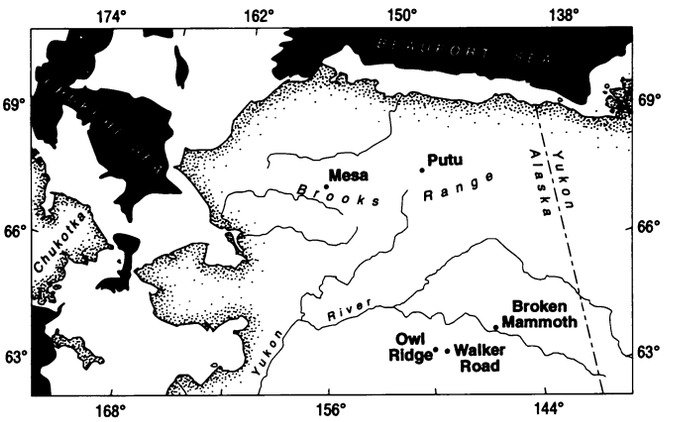

Fig. 1. Locations of the Mesa and Putu sites in northern Alaska and of the Nenana Complex sites (Walker Road, Owl Ridge, and Broken Mammoth). Black areas lie below the 50-m isobath and approximate the extent of land bridge submergence about 11,000 years B.P. during the postglacial rise in the sea level (*17, 25*).

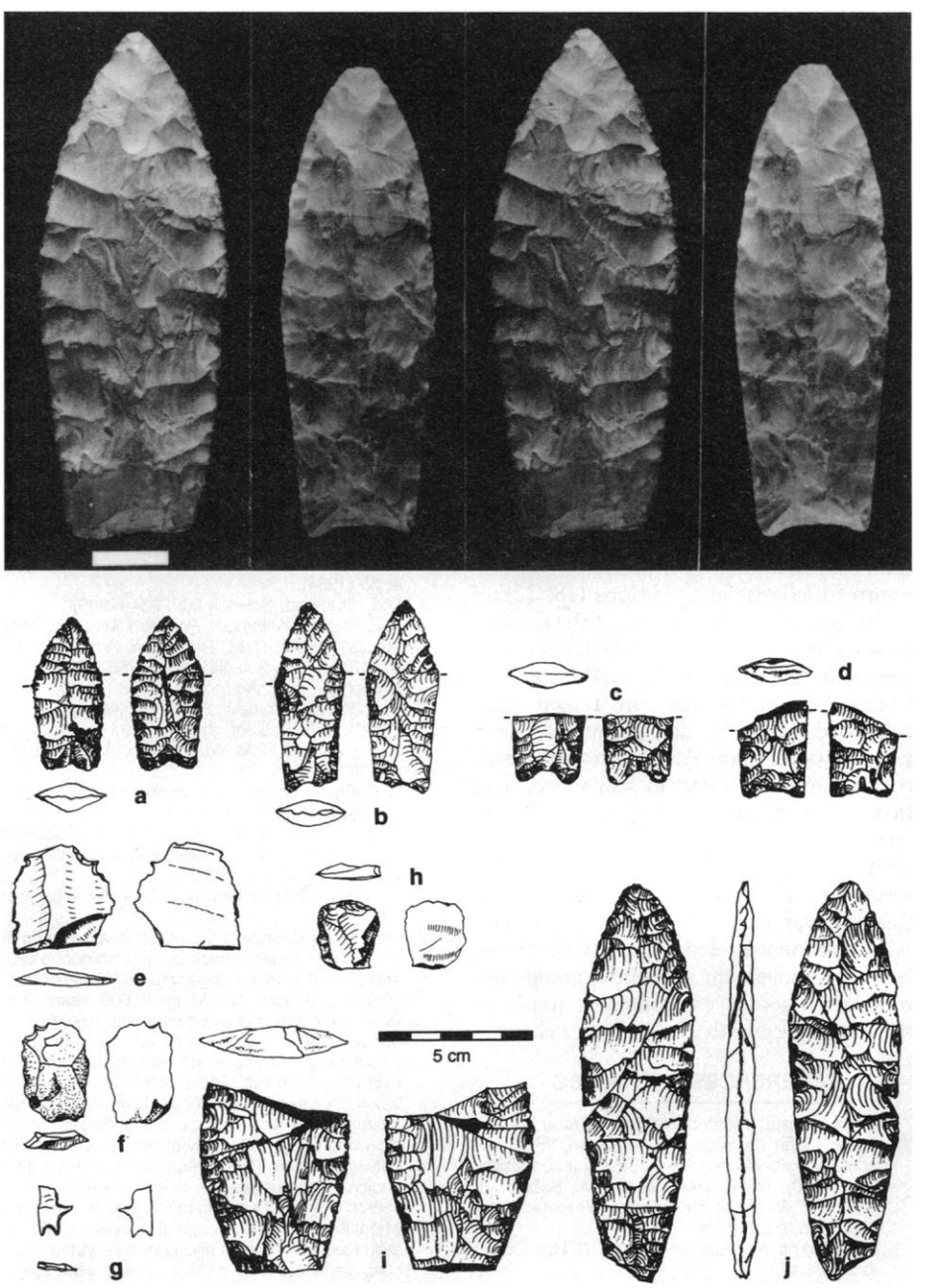

Fig. 2. Artifacts from the Mesa site. Upper panel: Stereopair of two complete Mesa points; scale bar, 1 cm. Lower panel: Mesa points (a to d), spurred gravers (e to g), scraper (h), and bifaces (i and j).

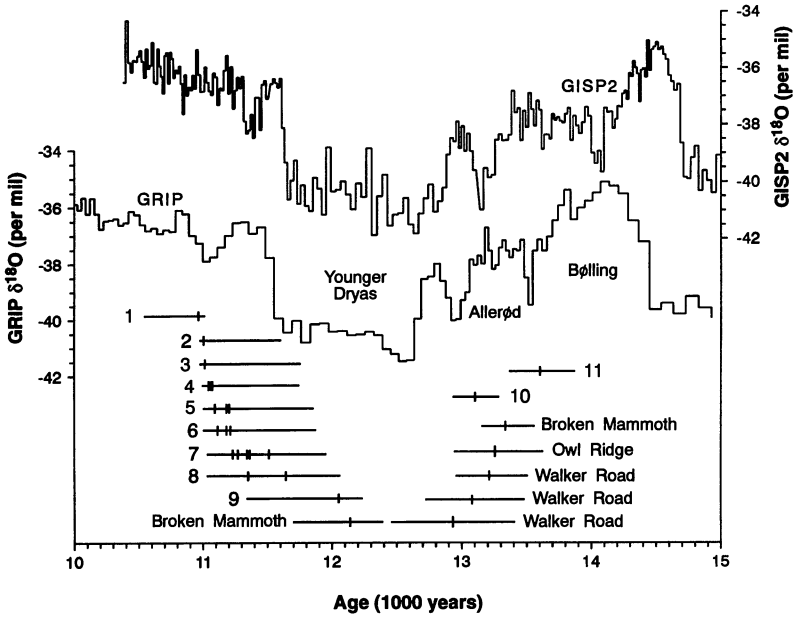

Fig. 3. Comparison of late-glacial climatic fluctuations with AMS ^{14}C dates from the Mesa site and other early Alaskan occupations. The $\delta^{18}O$ curves [the per mil deviations of the $^{18}O/^{16}O$ ratio from that in SMOW (standard mean ocean water)] are from the Greenland Ice-Core Project (GRIP) (*23*) and the Greenland Ice Sheet Project II (GISP2) (*24*) ice cores. Lower $\delta^{18}O$ values generally indicate lower temperatures of formation of the original precipitation. Core depths have been converted to ages with a cubic spline interpolation of preliminary depth-age control points as described (*23, 24*). Calibrated dates include all available AMS ^{14}C dates on hearth charcoal from early Alaskan sites. Numbers refer to ^{14}C dates in Table 1. Nenana Complex AMS dates on hearth charcoal are from the Walker Road (*11*), Owl Ridge (*26*), and Broken Mammoth (*27*) sites. All ^{14}C dates are calibrated with the program CALIB (version 3.0) of Stuiver and Reimer, with the use of the intercept method and the combined bi-decadal tree ring and coral reef data set INTCAL93 (*28*). Vertical lines indicate possible calendar ages; horizontal lines denote $\pm 2\sigma$ ranges. Preliminary calibration evidence in (*17*) suggests that the calendar ages of date 9 and of the younger date from Broken Mammoth may be as much as 300 years younger than indicated here, placing each date nearer to the end of the Younger Dryas event.

that the Younger Dryas period brought a return to full-glacial conditions (*18, 22*).

Ice cores from the summit of the Greenland ice sheet record Late Glacial climatic events in great detail (*23, 24*) (Fig. 3). Comparison of the ice core record with calibrated AMS ^{14}C dates from the Mesa site and other early Alaskan sites suggests that a hiatus occurring in human occupation of the Alaskan sites between 12,200 and 12,900 calendar years ago correlates with the height of the Younger Dryas. We speculate that climatic deterioration during this interval rendered much of northern Alaska uninhabitable and may have stimulated the movement of human groups toward less rigorous environments south of the retreating North American ice sheets.

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