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Geoarchaeology and Geochronology of the Miami (Clovis) Site, Southern High Plains of Texas

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The Miami site, excavated in 1937, is in a small "playa" basin on the High Plains surface. The site is one of the earliest documented co-occurrences of Clovis points and mammoth. Reinvestigation of the site and related collections was undertaken to better understand the stratigraphy, geochronology, and archaeology. The basin, 23 m diameter × 1.6 m deep, filled with (1) dark gray silty clay, and (2) near the top of the section, a lens of well-sorted silt or loess. The basin started to fill ca. 13,700 yr B.P., the loess dates to ca. 11,400 yr B.P., and the bone bed probably dates to ca. 11,400–10,500 yr B.P. The loess may be the local manifestation of a "Clovis drought." The partial remains of five mammoths (three adults and two juveniles) were recovered in 1937; no other animal remains are known. The bone is heavily weathered and there are no clear indications of human modification. Artifacts found at the site include three Clovis points and a scraper found among the bones and two flakes and a scraper found on the surface near the playa. The origins of the bone and stone assemblage are uncertain but four scenarios are offered: a successful mammoth kill, an unsuccessful kill with wounded animals dying at the watering hole, opportunistic scavenging following natural deaths, or a palimpsest of multiple deaths following both natural and human causes.

INTRODUCTION

In the decade following the Folsom discovery in 1927, a series of sites were discovered in midcontinental North America containing fluted points with late Pleistocene fossils. These sites played a central role in forming archaeological opinions about Paleoindian adaptations (Wormington, 1957). In retrospect, some take on particular significance given our greater understanding of Paleoindian archaeology and late Quaternary environments. One of those is the Miami site (41RB1) in the Texas Panhandle (Fig. 1).

The site was excavated over half a century ago (Sellards, 1938), and is one of the earliest documented co-occurrences of Clovis fluted points and mammoths. The Miami site is in one of the ubiquitous small "playa" basins that dot the Llano Estacado, and the geological analysis of the basin fill remains one of the very few studies of small playa fills in the geosciences literature. Importantly, Sellards reported a "loess" layer within the fill, which appears to support the hypothesis of a Clovis-age drought proposed by Haynes (1991).

Given the importance of Miami, the questions remaining about the site such as its precise age, and the decades of Quaternary research elsewhere in the region following its excavation, a reinvestigation of the locality was undertaken by the authors in 1990. The goals of the research were to (1) relocate the site; (2) collect exposed bone or stone artifacts; (3) examine the site stratigraphy in the light of current understanding of regional late Quaternary history; and (4) date the site radiometrically. This paper presents the results of our reinvestigation.

BACKGROUND

The Miami site is near the town of Miami in Roberts County, Texas, on the Southern High Plains (Fig. 1). The region is a relatively featureless plateau with a semiarid continental climate. The principal surficial deposit of the region, the Blackwater Draw Formation (Reeves, 1976), consists of extensive layers of Pleistocene eolian deposits and intercalated soils (Holliday, 1989, 1990). The site is on the level, open surface of the Llano Estacado on a narrow divide between two drainages cut into the High Plains surface and within 60 m of the heavily dissected terrain which marks the northeastern margin of the plateau (Fig. 1).

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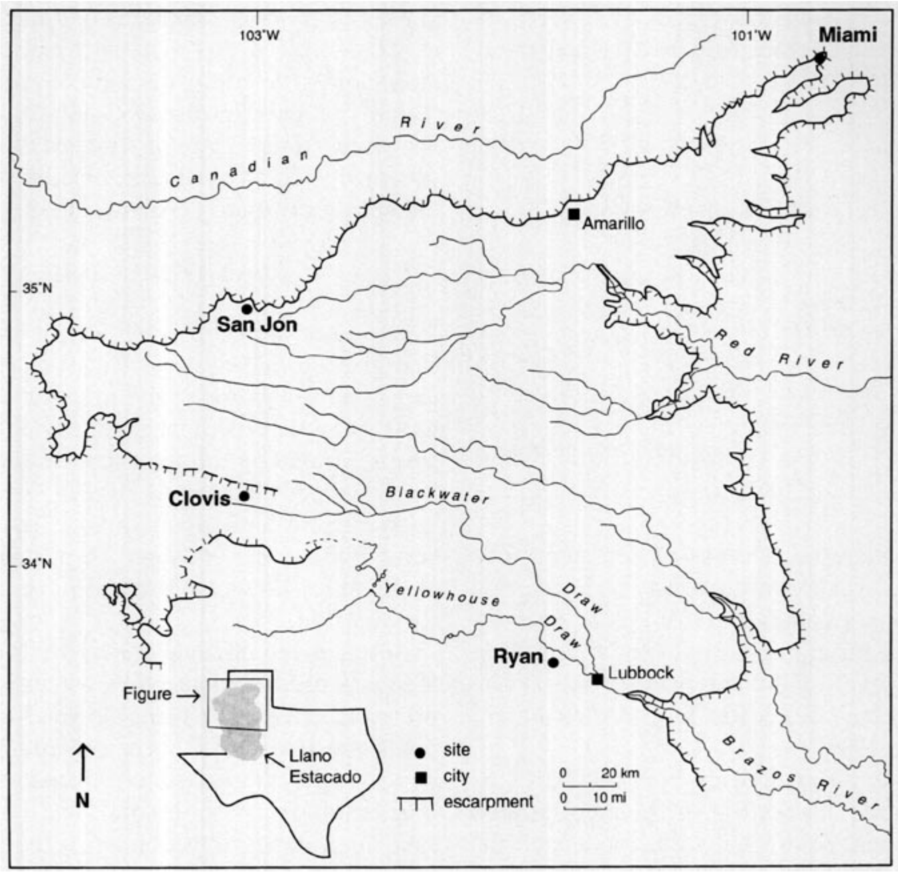

FIG. 1. Northern Llano Estacado showing the location of sites mentioned in the text, selected towns and physiographic features, the Clovis type site, and Paleoindian sites within playas: San Jon (Roberts, 1942; Judson, 1953) and Ryan (Johnson *et al.*, 1987). Inset map shows the Llano Estacado relative to Texas and the area of the Llano Estacado portrayed in the figure.

The flat High Plains surface is modified by thousands of small (<4 km^2) basins containing seasonal lakes or "playas" (Reeves and Parry, 1969). The Miami site is in one of the playas. These basins contain the only available, naturally impounded surface water on the Llano Estacado, although the water is seasonal and sometimes brackish or saline. The basins are cut into the Blackwater Draw Formation or older units. Once the playa basins

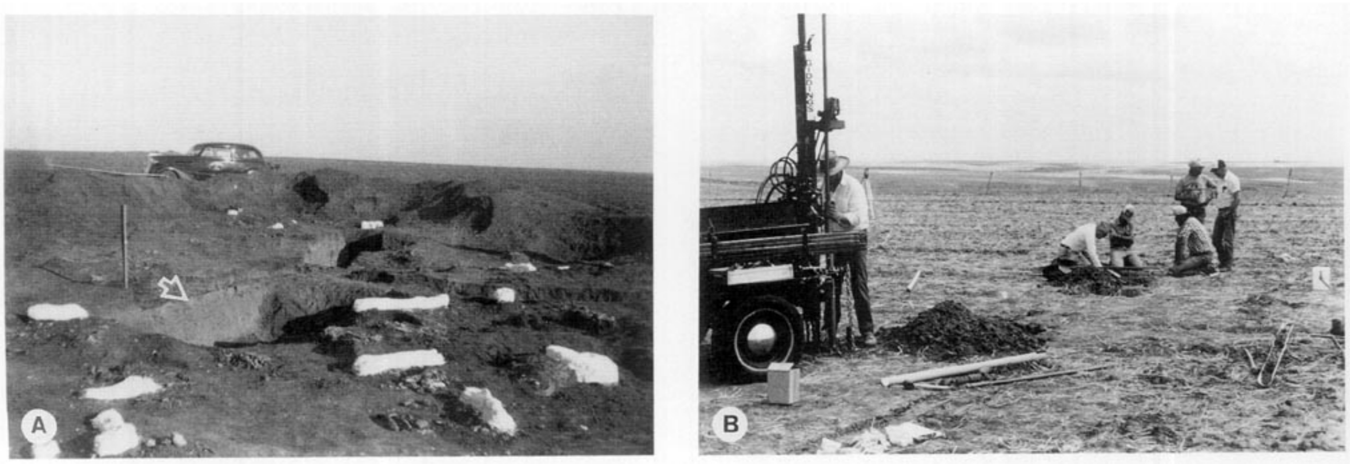

FIG. 2. Field work at the Miami site. (A) The site near the end of the 1937 excavations with some bones in plaster jackets and others removed. Below the bone bed are deep test pits which yielded poorly preserved, unidentifiable bone fragments, some from a large animal (G. L. Evans, personal communication, 1992). The light zone on the far side of the nearest pit (arrow) is probably the loess. (Photo courtesy of the Texas Archeological Research Laboratory, The University of Texas at Austin.) (B) Coring in progress in 1990 (looking south–southeast). The Giddings rig is at core 90-16 and the group is looking at a small test pit dug at 90-6 (Fig. 3). Note the rolling, eroded landscape in the distance.

TABLE 1
Correlation of Stratigraphic Terminology for the Miami Site

Sellards	This Paper
"Silt similar to that below" (Sellars 1938, p. 1002)	[removed in 1937 excavation]
"Loess stratum about 6 inches thick" (Sellards, 1938, p. 1002)	Light gray silt
"Fine silt colored by organic matter . . . [with] . . . the appearance of a dark sandy clay" (Sellards, 1938, p. 1002) "Fine silt" (Sellards, 1952, p. 18).	Very dark gray silt loam
"Red sandy clay bedrock" (Sellards, 1938, Figs. 3, 5)	Blackwater Draw Formation

formed they filled with several types of sediment. The most common deposit is clayey, dark gray to black, and usually noncalcareous (Holliday, 1985, 1993; Reeves, 1990). Lithologic and stratigraphic data for these clays are very limited, however, and come primarily from playas on the central Llano Estacado (e.g., Allen *et al.*, 1972; Holliday, 1983, 1993).

The Miami site was discovered in 1933 on the C. R. Cowan Ranch by Charles Puckett. J. A. Mead of Miami, an amateur archaeologist and fossil collector, tested the site in 1934 and then arranged for full-scale excavations under the auspices of E. H. Sellards of the University of Texas at Austin. The work, in 1937, was directed by Sellards' chief assistant, G. L. Evans. The bone bed was completely excavated (Fig. 2A) and the site then was backfilled.

The playa fill was reported as up to 9 feet (2.8 m) thick and stratified (Table 1). The bone bed was 12 to 18 in. (30 to 46 cm) below the surface. All of the fossils recovered were "elephant," "referable to *Parelephas* [*Mammuthus*] *columbi*," and represented by bones, tusks, and teeth. The skeletons were incomplete, but by the "duplication of parts and by relative size and age," Sellards determined the assemblage came from at least three mature or nearly mature individuals, and two younger individuals (Sellards, 1938, p. 1005–1007). Aside from the remains of the five mammoths, no bones were found. Among the mammoth bones were a scraper and three "Folsom or Folsom-like" fluted projectile points, now known as "Clovis." Sellards felt that the "most probable explanation" of this unusual association of a group of mammoth (and only mammoth) with human artifacts "seems to be that disease, starvation, or drought may have caused the death of some of the elephants and that others, enfeebled by disease or otherwise, may have been killed by early man" (Sellards, 1938, p. 1008; 1952, p. 23).

1990–1992 INVESTIGATIONS

Upon our arrival in 1990 we found the same situation that greeted Sellards and Evans: a flat field with no topographic indication of the site, but with numerous mammoth bone and teeth fragments at the surface. The fragments, providing an approximate location of the playa, were mapped (Tables 2A, 2B; Fig. 3) and collected for ^{14}C analyses and taphonomic study. Two lithic flakes and a scraper also were collected. A permanent datum was set in the fence line (also present in the 1930s) southeast of the site (Fig. 3).

A trailer-mounted Giddings hydraulic soil-coring device was used to locate the excavated and backfilled depression, referred to as the Cowan Ranch playa. Eighteen cores (90-1 to 90-18) were drilled, generally to 240 cm depth, in a T-shaped pattern through the area of the bone concentration (Figs. 2B, 3). The cores were described following standard pedologic terminology (Soil Survey Staff, 1951, 1990; Table 3). Samples from two cores, one away from the playa (90-2) and one in it (90-10) (Fig. 3), were analyzed for sedimentological and pedological characterization (Table 4). Procedures for particle-size analysis (sand–silt–clay content) and for determining $CaCO_3$ and organic-carbon content followed Singer and Janitzky (1986).

Bulk samples of playa fill were collected for radiocarbon analysis by accelerator mass spectrometry (AMS) to date the Clovis level above the loess lens, the loess itself, and the base of the playa fill. Most of the fill above the loess was disturbed during the 1937 work, but along the basin margin, at core 90-6 (Figs. 3, 4), the loess layer and the Clovis level were undisturbed. Two samples were collected: the entire 10 cm of the loess and 17 cm of overlying silt. The basal 12 cm of playa fill from core 90-16 (Fig. 4) was also sampled. Carbonate was removed by acid hydrolysis. Humic acids were extracted and prepared for dating. All visible particulate contaminants

TABLE 2A
Inventory and Characteristics of Miami 1990 Bone Sample

Material	Total pieces	Pieces < 2 cm	Pieces > 2 cm	Total wt (gm)	Average wt (gm)	Largest piece[a] *L* (mm)	Largest piece[a] *W* (mm)	Largest piece[a] Wt (gm)
Bone	286	96	190	1744.2	6.1	169	73	483.5
Enamel	51	35	16	50.2	1.0	25	17	3.8

[a] Length, width, and weight of largest pieces. The largest long-bone fragment was used in evaluation of bone chemistry.

TABLE 2B
Miami 1990 Bone Surface Modifications

	$CaCO_3$ In/Ex	Root etch	Plow mark	Rodent gnaw	Spiral break	Burning	Exfoliation
Count	37/60	94	95	7	53	0	63
%	20/32	49.5	50	3.7	27.9	0	33.2

Note. The 190 pieces > 2 cm in size (66.4% of the total bone sample) were recorded for these attributes. Percentages refer to the 190 pieces, not to the total sample. Calcium carbonate ($CaCO_3$) was recorded as being on the interior (In) or exterior (Ex) of long bone shaft fragments. Root etching probably includes some other chemical alterations of the bone surfaces.

were physically removed from the insoluble residue fraction by hand picking, panning, and flotation. Some small degree of contamination may persist and ^{14}C ages of both the residue and humate fractions should be considered minimum ages if not true ones. The site is sufficiently shallow to preclude the possibility of ground water affecting the humates.

CORING RESULTS AND DISCUSSION

Our coring essentially confirms the stratigraphy reported by Sellards and sheds additional light on the history of the site. The basin is inset into the Blackwater Draw Formation (Fig. 4) which locally consists of two well-developed buried soils (Table 3). The basin is bowl-shaped and 23 m in diameter.

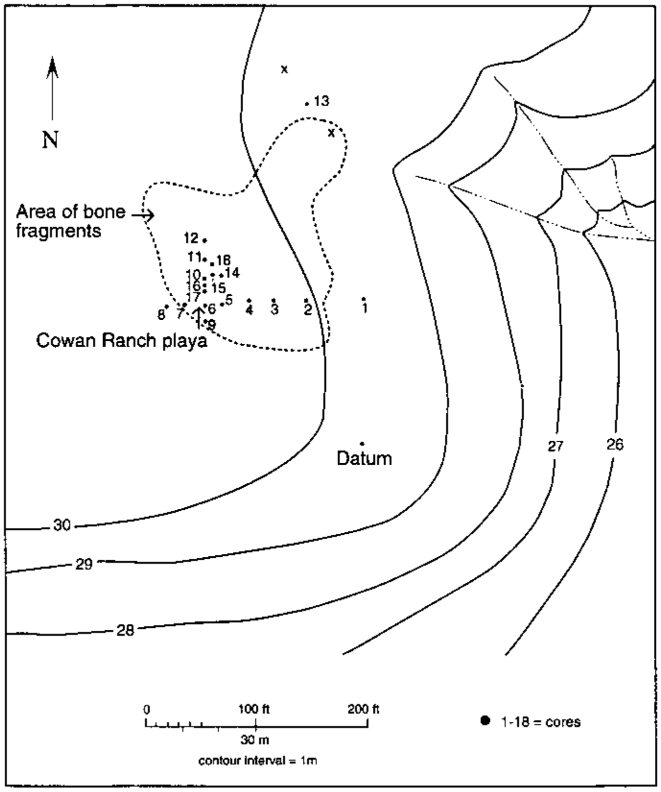

FIG. 3. Map of site showing the topographic breaks to the south and southeast, area of exposed bone, area of the Cowan Ranch playa basin, core locations, position of the two flakes (×) found on the surface, and the new permanent datum. The end scraper found in 1990 was 180 m north–northeast of the permanent datum.

Close inspection of the field and laboratory data requires some revision of Sellards' interpretations. The sediment from the core nearest the center of the basin (90-10, Table 3) is very dark colored to about 3 m, although the colors gradually become redder beginning at 162 cm. Examination of individual peds, especially their structure, and the particle-size data indicate that the zone from 0 to 162 cm is the basin fill. Above 162 cm, the peds are fine angular–blocky and dark gray to very dark gray, similar to those described for other basin fills (Allen *et al.*, 1972; Holliday, 1983, 1993), whereas below they are coarser and subangular–blocky, characteristic of the Blackwater Draw Formation. The dark staining below 162 cm (Table 3) is just that—coatings of organic matter on ped faces of the eroded Blackwater Draw Formation. The colors relative to the unaltered Blackwater Draw Formation (light brownish gray vs strong brown or reddish yellow) also suggest some iron reduction or iron removal. Oxidized iron is mobile under saturated conditions in the presence of organic matter (Pollock, 1978; Schwertmann and Taylor, 1989), conditions that likely existed as the playa filled. The color change between 162 and 290 cm (dark grayish brown to light brownish gray) reflects decreasing alteration of the reddish-brown colors of the Blackwater Draw Formation. Films and patches of manganese, common in sediments and soils buried below the fill in other playa basins in the region (Allen *et al.*, 1972; Holliday, 1983), also are common below 162 cm. There also is a slight change in sand and silt content below 162 cm.

The fill in the basin is mostly silty loam that varies in color from gray or grayish brown to black. This sediment, which originally filled the basin to the level of the High Plains surface, is generally similar to that found in many other playa basins of the region (e.g., Wyrick, 1981). The fill probably resulted from slow accumulation of dust in a well-vegetated and moist basin. Sellards also believed the sediment to be eolian.

An exception to the general description of the basin fill is a gray silt "loess" layer (Table 1). The silt averages 10 cm thick and occurs between 30 and 50 cm below the surface in the center of the basin. Sellards believed the layer to be eolian in origin and we concur. There seems no other way to produce such a well-sorted (94% silt, 93% of which is coarse silt; Table 4) and lithologically distinct layer.

TABLE 3
Field Descriptions for Selected Cores from the Miami Site

Horizon	Depth (cm)	Munsell color Dry		Moist	Texture	Structure	Dry consistence	Boundary	Remarks
						CORE: 90-2			
Ap	0–13	7.5 YR	5/4	4/4	SiL	1msb	vh	cs	
Bk	13–38	7.5 YR	8/2	6/4	SiL	1mpr 1msb	vh	cs	Common carbonate concentrations
Btk1	38–58	7.5 YR	8/4	6/6	SiL	2mpr 2msb	vh	cs	Common thin clay films; continuous carbonate films and threads
Btk2	58–85	7.5 YR	6/4	5/6	SiL	2mpr 2msb	vh	cs	Continuous thin clay films; common carbonate films and threads
Btb1	85–148	7.5 YR	6/4	4/6	SiL	2mpr 2msb	vh	cs	Continuous thick clay films
Btkb1	148–180	7.5 YR	7/4	6/6	SiL	1mpr 2msb	vh	cs	Very common carbonate concretions
Btb2	180–240+	7.5 YR	6/6	4/6	SiL	2mpr 2mab	vh		Continuous thick clay films
						CORE: 90-10			
	0–31								1937 back fill
AC	31–38	10 YR	6/1	4/1	SiL	2fab	vh	as	
C	38–48	10 YR	6/2	4/2	Si	1msb	so	as	"Loess"
AC1b1	48–92	10 YR	5/1	3/1	SiL	2mab	vh	cs	Common carbonate films and threads; common, fine oxidation mottles
AC2b1	92–122	10 YR	4/1	3/1	SiL	2mab	vh	cs	Common, fine oxidation mottles
Btb1	122–162	10 YR	4/1	2/1	SiL	2fab	vh	cs	Continuous thin clay films; subdivided for sampling
Bt1b2	162–202	10 YR	4/2	3/2	SiL	2mpr 2msb	vh	cs	Continuous thin clay films; subdivided for sampling
Bt2b2	202–232	10 YR	5/3	3/2	SiL	2mpr 2msb	vh	ci	Continuous thin clay films
Bt3b2	232–290	10 YR	6/2	4/2	SiL	2mpr 2msb	vh	cs	Continuous thick clay films; common Mn patches
Bt4b2	290–360+	7.5 YR	6/6	4/6	SiL	2mpr 2msb	vh		Continuous thick clay films; few Mn patches

Note. Texture: Si = silt; SiL = silty loam. Structure: Grade—1 = weak; 2 = moderate. Class—f = fine; m = medium. Type—sb = subangular blocky; ab = angular blocky; pr = prismatic. More than one designation for structure indicates compound structure. Consistence: so = soft; vh = very hard. Boundary: Distinctness—a = abrupt; c = clear; Topography—s = smooth; i = irregular.

The bone bed occurred in playa fill 0–10 cm above the loess. Today, the uppermost 30–40 cm of fill in the depression is backdirt from the 1937 excavation, a jumbled mixture of chunks of reddish-brown and black silt loam. The contact between the backdirt and the black silt loam marks the level of the bone bed.

RADIOCARBON DATING AND DISCUSSION

The loess layer yielded a ^{14}C age of 11,415 ± 125 yr B.P. (AA-7086) for the organic residue fraction. The humic acid fraction was inadvertently contaminated in the pretreatment laboratory by filter paper and therefore not analyzed. The overlying fill provided ages on both fractions: 9385 ± 70 yr B.P. (AA-7084) for the residue and 10,345 ± 330 yr B.P. (AA-7085) for the humates. The basal 12 cm of the playa fill produced ages of 13,700 ± 140 yr B.P. (AA-7083) for the residue and 13,215 ± 125 yr B.P. (AA-7082) for the humates. The Clovis level and loess layer immediately below it are clearly in the zone of active pedogenesis and could therefore contain a younger component of humic acids. Evidence of gleying in the playa fill indicate that when the Cowan Ranch playa was active, a recharge bulge may have brought the local water table into contact with the basal playa sediments, but

TABLE 4
Lab Data for Selected Cores from the Miami Site

Horizon	Depth	% of < 2 mm fraction										
		VCOS	COS	MS	FS	VFS	Sand	Silt	Clay	USDA texture	$CaCO_3$ (%)	Org. carbon (%)
CORE: 90-10												
	0–8	0	0	1	2	10	14	72	14	SiL	1	1.1
	8–31	0	0	1	3	0	4	76	20	SiL	3	0.9
	31–38	0	0	1	2	5	8	74	18	SiL	5	0.8
	38–48	0	0	0	0	0	0	94	6	Si	2	0.5
	45–48	0	0	1	3	9	13	77	10	SiL	4	0.5
	48–92	0	0	2	4	1	7	77	14	SiL	2	0.7
	92–122	0	1	3	4	6	14	69	17	SiL	1	1.0
	122–142	0	0	2	3	1	6	77	17	SiL	0	0.8
	142–162	0	0	1	3	6	10	73	17	SiL	0	0.9
	162–182	0	0	1	2	1	4	77	19	SiL	0	0.6
	182–202	0	0	0	3	6	9	70	21	SiL	0	0.8
	202–232	0	0	1	2	0	3	74	23	SiL	1	0.6
	232–290	0	0	0	4	12	16	63	21	SiL	0	0.1
	290–360	0	0	0	1	1	2	83	15	SiL	1	0.2
CORE: 90-2												
	0–13	0	0	0	3	8	11	69	20	SiL	7	0.7
	13–38	0	0	0	2	1	3	74	23	SiL	47	0.4
	38–58	0	0	0	3	12	15	69	16	SiL	26	0.3
	58–85	0	0	0	3	1	4	70	26	SiL	29	0.2
	85–148	0	0	0	4	13	17	57	26	SiL	20	0.2
	148–180	0	0	0	2	1	3	75	22	SiL	33	0.2
	180–240	0	0	0	2	10	12	75	13	SiL	4	0.0

Note. Abbreviations for lab data: < 2 mm fraction—VCOS = very coarse sand; COS = coarse sand; MS = medium sand; FS = fine sand; VFS = very fine sand. USDA texture—SiL = silt loam; Si = silt.

humic contaminants so derived should have ^{14}C ages not greatly different from indigenous humates.

In the upper playa fill, only the basal part of the layer contained the Clovis bone bed. Apparent ages of both the humate and residue fractions are within 2 σ of each other. However, because both are considered minimum values, the Clovis event probably occurred sometime between 11,400 and 10,500 yr B.P., and probably closer to the former. Other well-dated Clovis sites are between 11,200 and 10,900 yr B.P. (Haynes, 1992, p. 364; Haynes *et al.*, 1984). Dates from the Miami site, bracketing the age range of other Clovis sites, indicate remarkably little contamination by either younger humates or microscopic organic matter.

There is a possibility that the loess age of 11,415 yr B.P. reflects contamination by organic matter from the underlying playa mud. The edge of the loess lens at core 90-6 is not the well-sorted silt of more central areas but appears to be a mixture likely due to a combination of bioturbation and reworking of older deposits by slope wash erosion of the basin rim and redeposition inward.

The ^{14}C results for the basal playa mud show agreement within 2 σ between the organic residue and humate fractions. The older residue age, from a sample nearly 2 m deeper than the upper playa sample and therefore less subject to contamination by root remains, may be considered a minimum age for the beginning of playa filling.

Bone fragments collected from the surface of the site proved unsuitable for radiocarbon dating. Stafford *et al.* (1991, p. 65) determined that for successful, accurate dating of fossil bone, the ". . . bone should have >0.1–2% N and a collagenous amino acid content. . . ." The Miami sample yielded only 0.04% N (T. W. Stafford, Jr., personal communication, 1991).

THE MIAMI MAMMOTHS

Only a partial inventory of the bone sample was recovered during the original Miami excavations; moreover, only "important" and complete bones are included on Sellards' published map while "poorly preserved and less important bones and bone fragments" were omitted (Sellards, 1938, p. 1005). Sellards' interpretation of five mammoths was based on the presence of three right femora of mature or nearly mature mammoths, a lower jaw from a younger mammoth, and another set of lower jaws and a skull (Sellards, 1938, p. 1005–1006; 1952, p. 22–23). Saunders (1980) located teeth from only three individuals at the Texas Memorial Museum (other bones are on display in Miami), and found that the few postcranial elements in the TMM collection could be assigned to those three individuals as well. He still concluded, however, that five individuals were represented (Saunders, 1980, p. 94).

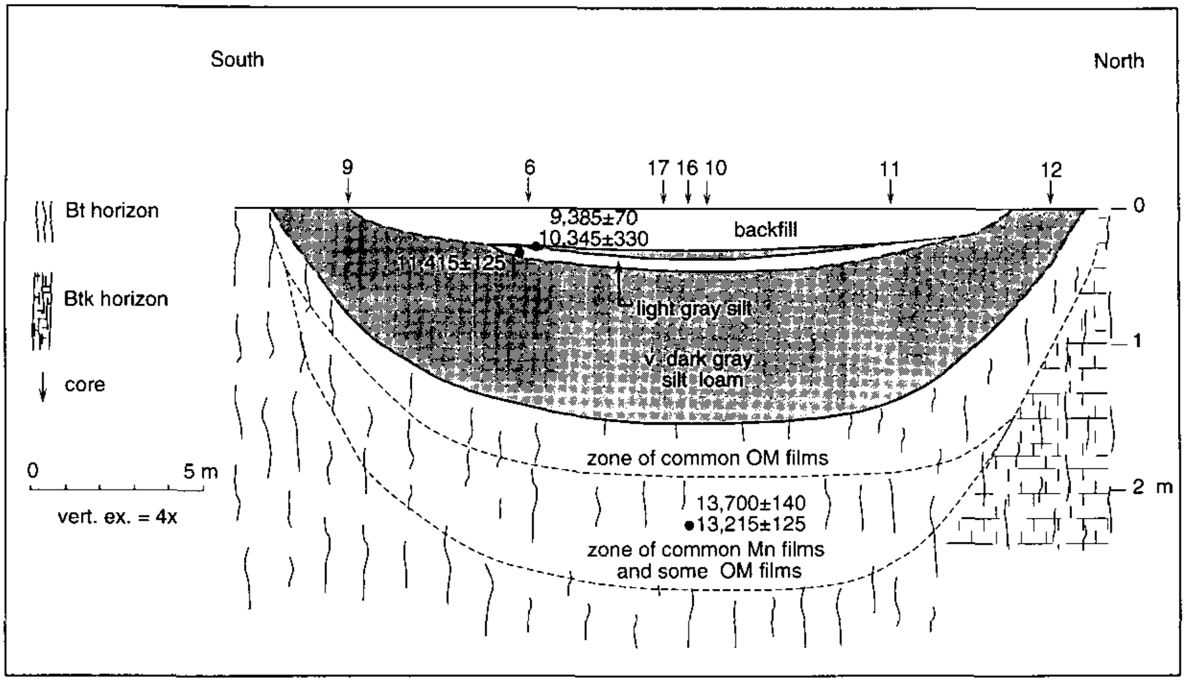

FIG. 4. North–south cross section looking west along coring line 90-9–90-12 (Fig. 3) through Cowan Ranch playa showing the lithostratigraphy, pedostratigraphy, and position of radiocarbon samples.

Of the three mammoths represented by teeth, one was an adult (32 African Equivalent Years—AEY), and the other two were juveniles (0.5 and 3–4 AEY in age; Saunders, 1980, Table 2). Given this age profile, Saunders suggests that a matriarchal family unit may be represented. We cannot say whether the two additional mature mammoths were part of this group, nor can we determine whether all five mammoths entered the deposit at the same time.

The remains underwent a variety of taphonomic processes once the animal died (Table 2B). The bone was modified by carnivore action and weathering which precluded SEM confirmation of possible cut and hack marks (Johnson, 1989, 1991). The long bones were not intentionally broken or fractured (Johnson, 1989, p. 452; 1991, p. 227) and the 1990 sample was devoid of bone flakes, impact points, or marks attributable to prehistoric butchery. The bone probably was in a very moist or waterlogged deposit during part of its history. This is suggested by smear marks, perhaps made by metal implements (e.g., a plow) when the bone surfaces were soft; exfoliation from repeated wetting and drying; and "green bone" spiral fractures on previously weathered pieces. Green bone fractures on proboscideans often occur without human involvement (G. Haynes, 1990, Table 3) and resaturated weathered bones may become reconstituted to a "fresh or green" state and fracture like new bone (Oliver, 1989, p. 85). Coatings of pedogenic $CaCO_3$ occur on the underside of many of the bones and artifacts (Sellards, 1938 p. 1007; Johnson, 1989) (Table 2B). Root etching occurs most commonly and most densely on the upper bone surfaces. This provides additional evidence that the bones were fairly stable (carbonate side down) and remained relatively close to the surface throughout their history. Carbonate coatings on the interior of bones may indicate repeated saturation with carbonate-rich water. Such coating has been noted on other Pleistocene faunal remains from pond deposits (e.g., Wyckoff *et al.*, 1991).

THE MIAMI ARTIFACT INVENTORY

The Miami site excavations yielded relatively few stone artifacts: three Clovis points and a single side scraper (Sellards, 1938, p. 1007, Plate 1, 3; 1952, Figs. 8, 9) (Table 5). The excavated sediments were not screened, however, nor did the excavations extend beyond the bone bed itself. The Miami artifact inventory is therefore similar to several other Clovis localities which have a very limited artifact record.

Only in recent years have the effects of spatially limited excavations become apparent. Both archaeological (e.g., Ferring, 1990; Haynes, 1979, 1982) and ethnoarchaeological work (Fisher, 1992; O'Connell *et al.*, 1992) show that camp sites that may be associated with kill or scavenging events are sometimes distant from the bone bed; 20 to 135 m separates the Murray Springs camp and kill sites (Hemmings, 1970), while distances on the order of 30–200 m are recorded ethnoarchaeologically (Fisher, 1992 p. 73; O'Connell *et al.*, 1992).

Further, kill or scavenging areas often have a different

TABLE 5
Attributes of Miami Lithic Artifacts*

Artifact	Catalog number	Material	Length (mm)	Width (mm)	Base width (mm)	Thickness (mm)
Clovis pt	TMM 976-1	gray qzt	114.8	29.9	21.9	8.6
Clovis pt	TMM 976-2	Alibates	74	24.1	20.8	7.9
Clovis pt	TMM 976-3[a]	Alibates?	110.7	29.9	23.4	7.8
Scraper	TMM 976-4	Alibates	70	29	—	
Scraper	—[b]	Edwards	36	39	—	7.2
Flake	41RB1/1	Alibates	8.9	8	—	1.6
Flake	41RB1/2	Alibates	11.2	12	—	3.8

Note. Metric data based on Sellards (1938, 1952) and measurements by Meltzer for the Texas Memorial Museum (TMM) specimens. Raw material information for the TMM pieces is based on accession records and Sellards (1938, p. 1007). Specimens TMM 976-1 and 976-2 were stolen in 1972 and are available for study only as casts.

[a] This specimen is reconstructed from blade and base fragments.

[b] This scraper is in a private collection.

artifact pattern (and possibly a lighter artifact rain) than camp areas. Therefore, the range and kind of prehistoric activities associated with the Miami mammoths may not be easily discerned from the limited artifact record in the bone bed itself (O'Connell *et al.*, 1992, p. 340).

These caveats aside, the artifacts from the original excavations and several new specimens recorded in 1990 provide some clues to the activities at Miami. Of the three fluted points recovered, only one original (TMM 976–3) can still be examined; the other two were stolen and are available only as casts. These points show varying degrees of attrition. Specimen TMM 976–1 was found complete and undamaged. The exact provenience is unknown, but in his maps, Sellards places it near the ribs of a mammoth and near the base of another fluted point.

The second fluted point (TMM 976–3) was recovered in two pieces: the lower portion of the point base (which would have been hafted) was found with rib bones and located about 1 m from the rest of the point, which was within 6.5 cm of the atlas vertebra of a mature mammoth (Sellards, 1938, p. 1005). A point in association with vertebrae was observed at other Clovis sites (Cotter, 1938, Plate 6, No. 3; Haury, 1953, p. 7). This specimen is missing its tip and this fact, plus the snap fracture, is suggestive of end shock caused by an impact against bone or from subsequent use or damage (e.g., Frison, 1974, pp. 90-91; Meltzer, 1986, p. 49).

The third fluted point (TMM 976–2) was found in the center of the bone bed near pieces of mammoth ribs, and shows the greatest degree of attrition. The blade was heavily damaged and possibly reworked, apparently while hafted.

In 1990, a side scraper and two bifacial retouch flakes were collected from the surface of the cultivated field at Miami (Table 5). All three were found outside the area of the original excavation, but the two retouched flakes were within the present area of bone fragments (Fig. 3). Both could be the byproducts of flakes removed from the fluted pints (the stone is the same), either from retouching or resharpening, though one has a larger platform and was struck off a more irregular edge, suggestive of removal from an artifact other than a finely finished point. These flakes were likely dispersed either from a primary context in the bone bed, or perhaps from plowing the backfill.

The side scraper was found on the surface of the site 108 m beyond the area currently yielding bone fragments (Fig. 3). This is a rectangular flake, unifacially retouched on two edges and one corner. The tool lacks a platform or cortex. Whether this specimen was originally a part of the Clovis assemblage is uncertain; it is made of Edwards chert, the closest sources of which are about 300 km southeast of the site. This chert is not commonly present in Clovis assemblages in the Texas Panhandle, but it was used for Clovis artifacts at sites east of the Southern High Plains. If this artifact is a part of the Miami Clovis occupation, it may mark the presence of an associated camp. Its distance from the bone bed is well within the range of the distance between the Murray Springs bone bed and camp. There was no systematic search for surface indications of such a camp, however. Johnson (1989, p. 443) suggested that a portion of the Miami site outside the playa may have eroded away, but the presence of this scraper, the flat terrain in the immediate playa area, and the limited artifact displacement which occurs even after decades of plowing (e.g., Roper, 1976) keeps open the possibility of an associated camp at Miami.

Aside from the Edwards chert scraper, the stone represented in the Miami artifact assemblage includes Alibates agate, which occurs in primary outcrop sources along the Canadian River 60 km west of Miami, and in secondary gravel sources 25 km north of the site, and the unnamed quartzite which may come from local Tecovas Formation sources or sources north or south of the site within a range of 100–200 km (Banks, 1990; Holliday and Welty, 1981). These two materials were commonly used to manufacture local Clovis artifacts (Hofman and Wyckoff, 1991, p. 31; Meltzer, 1989, p. 31). If the scraper fashioned of Edwards chert is a part of the assemblage, the evidence indicates a highly mobile settlement pattern.

PREHISTORIC ACTIVITIES AT THE MIAMI SITE

The data from the Miami site enable us to examine several hypotheses regarding prehistoric activity at the locality. These data may be biased, for example by lack of screening, but we evaluate the record as it stands. The alternate hypotheses are:

1. The Miami site represents a successful mammoth kill. Saunders (1980) used Miami as an example of his "herd confrontation" model based primarily on the age profile of the mammoths, the "absence of faunal associates," and the presumption that human hunters would elect to crop mammoth family units. Saunders (1980, p. 94) concedes, however, that the age profile may equally reflect a natural death assemblage (see also G. Haynes, 1985; 1987; 1990, p. 27). Frison (1989, p. 782; Frison and Todd, 1986, p. 107–108) further argues that family cropping would have been dangerous and risky. We would also expect a heavier artifact rain in a mass kill, and more definitive evidence for mammoth butchering and processing than exists.

2. Miami represents an unsuccessful kill. One or more of the mammoths were wounded by human hunters, but escaped to die at the Miami pond. Were only the matriarch wounded, the juveniles may have followed her to the pond, then lingered there after her death until their own. Support for this hypothesis is the presence of fluted points in the carcass of at least one adult mammoth. This hypothesis is weakened by the presence of a scraper and (apparently) two resharpening flakes with the bones. Assuming these are part of the original assemblage, they suggest some post-mortem carcass use.

3. One or more of the Miami mammoths were opportunistically scavenged by human groups. This was the view of Sellards (1938, p. 1008; 1952, p. 23). G. Haynes (1985, p. 343) observes that proboscideans under stress (e.g., during drought) frequent water holes, and human hunters need only monitor the condition of the animals. Their deaths would have been predictable, and they could have been utilized at low risk. This scenario is supported by the relatively modest remains of projectile points (perhaps thrust into the older animal as a coup de grace or used as knives) and the relatively light evidence of butchering and processing tools.

4. Finally, Miami represents a palimpsest of multiple death events, from both natural and human causes. While the human remains and the Miami mammoths were geologically contemporaneous, they may not have been on the landscape and died at the same time. Elephants (and presumably mammoths, as well) die at water holes with or without the presence of humans, and juveniles tend to die at water holes more often than mature animals (G. Haynes, 1985, 1991). We might surmise that a single animal (the mature mammoth) was hunted and butchered—or opportunistically scavenged—at the water hole, while the other animals died there of natural causes (e.g., drought, disease, loss of a parent). The data do not negate this hypothesis, but it remains untested, lacking any opportunity to reexamine the original stratigraphy for microdepositional units that might reveal serial accumulation events. DNA research using the Miami bone might eventually determine whether a family group was represented.

CONCLUSIONS

Sellards' 1938 report on Miami was one of the earliest Paleoindian and geoarchaeological studies in North America. Our research addressed some lingering questions about the site's contents, origin, and age. The 1990 coring confirmed and refined the stratigraphy reported by Sellards (1938). The basin fill is similar to that reported from other playas on the Southern High Plains except for the loess lens encountered immediately below the bone bed. Our ^{14}C ages indicate that the basin started to fill with sediment by 13,700 yr B.P. The loess layer dates to about 11,400 yr B.P. and the bone bed probably dates between 11,400 and 10,500 yr B.P. These ^{14}C ages fit well with the known Clovis chronology. The basin was probably completely filled relatively soon after Clovis time. The site yielded five mammoths: three older individuals (possibly including a matriarch) and two juveniles. An impact-fractured fluted point was directly associated with the cervical vertebrae and ribs of the older individual; another fluted point was apparently in the ribs of the same animal. The scraper was associated with a humerus. The association of the artifacts found in 1990 with the bone bed or with a Clovis camp is circumstantial, and based largely on the apparent lack of later occupations in this locality.

Sellards' (1938) report on the Miami site provided important early support for the co-occurrence of Clovis fluted points and mammoth. Although the site subsequently was used as evidence that Clovis groups were specialized big-game hunters, Sellards' conclusion that Miami represents opportunistic scavenging of enfeebled mammoths is reasonable (see also G. Haynes, 1991, p. 290).

Miami is one of the very few documented Paleoindian sites within the ubiquitous small playa basins of the Great Plains. Only two others are reported on the Llano Estacado with archaeological materials buried in the basin fill (Roberts, 1942; Judson, 1953; Johnson *et al.*, 1987) (Fig. 1). However, Paleoindian sites and artifacts commonly are found on playa margins and on dunes and ridges adjacent to playas (Wendorf and Hester, 1962). This is not surprising given that playas hold water seasonally, and, during times of increased effective precipitation, probably held water perennially. Human occupation is expected at these localities.

The Miami playa also is distinctive for its loess layer. There are no reports of similar deposits in other playa fills, although few such investigations are known. Correlative loess layers may be present but not recognized due to bioturbation. The Miami loess may be indicative of a relatively brief period of reduced vegetation cover and deflation on the High Plains surface, and the Miami loess may be a manifestation of the "Clovis drought" proposed for the Southwest (Haynes, 1991). Stratigraphic evidence of drought on the Llano Estacado for the period of 12,000–10,000 yr B.P. also is reported from the Clovis site (Haynes, 1975, 1991) (Fig. 1), but is not known elsewhere in the region.

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